THE RELATIONSHIP BETWEEN MARKET PRICE AND BOOK VALUE FOR REGULATED UTILITIES

By

THOMAS ARTHUR BANKSTON

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TABLE OF CONTENTS

TABLE OF CONTENTS - continued

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES - continued

Abstract of Dissertation Presented to the
Graduate Council of the University of Florida in Partial
Fulfillment of the Requirements for the Degree of
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By

Thomas Arthur Bankston
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Today the great majority of regulated public utilities find their market prices below their book values. Many utilities are faced with the need for heavy capital expenditures. However, if these firms sell new common stock to meet their financing requirements, this very action reduces allowable earnings per share and this is detrimental to the existing stockholders. In this dissertation, the theoretical and practical aspects of this dilemma are discussed, and the implications of these considerations for rate-of-return regulation are given special emphasis.

First, a mathematical model is developed to describe the relationships among the financial variables. The market value/book value ratio is treated as the dependent variable, and the model examines the effects

of changes in the allowed rate of return, growth in assets, and other factors on this variable.

Empirical tests are then undertaken to test the extent to which the theoretical relationships among the variables actually exist. The findings are generally consistent with the model, but this statistical confirmation is not strong. Clearly, factors not incorporated into the model are also at work, or the data (which consists to some extent of proxies for investors' expectations) contain inaccuracies, or both.

It has been suggested in the literature that the market/book ratio can be used as an indicator of the regulatory agency's fairness to equity investors. Under ideal economic conditions of perfect competition, instantaneous regulation, no flotation costs, and no inflation, a market/book ratio of 1.0 would result when the firm earns a fair return. In a more realistic economic setting, this research suggests that a market/book ratio somewhat greater than unity is required both in fairness to investors and to enable the company to attract capital over the long pull. The model developed in the thesis can be used to help regulators specify the rate of return on the rate base necessary to maintain the market/book ratio at any predetermined level.

CHAPTER 1

INTRODUCTION TO THE ECONOMICS OF REGULATION

> Of 106 utilities listed on the NYSE, only eight were selling at above book value on September 6, 1974. One was at book value and the rest were selling below.
>
> This means that each time those utilities selling below book value are forced to sell common stock, they dilute the book value of existing stockholders. Because of the exigencies of rate regulations, this reduces the earnings base of the existing stockholder. The result is a downward spiral.
>
> In order to break this cycle, it is necessary that the price of the stock equal or exceed book value. This cannot happen until the rate of return on equity equals or exceeds approximately 16%.[1]

This statement by a telephone company executive illustrates the nature and seriousness of one problem faced by regulated public utilities in the United States today. The statement not only recognizes the dependence of market price on the rate of return on equity, but also indicates a specific rate of return necessary for utility companies to achieve a market price equal to book value per share, that is, a market/book ratio equal to unity. Because of the increasing recognition of the market/book relationship by industry spokesmen and in regulatory proceedings, this thesis probes the theoretical determinants of the market/book ratio in an attempt to define the functional form of the market/book model when new stock is sold by the firm. The practical problems involved in using theoretical relationships as an input to the process of rate determination are then explored by empirical testing.

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[1] Theodore F. Brophy, "A Plan for Action by Independents", Telephony, November 11, 1974, p. 35.

The need for regulation arises when government views the competitive pricing mechanism as being unable to function properly. The responsibility for nonmarket regulation specifically falls upon some state or federal agency. The agency's problem is to allow equity owners a sufficient return to maintain a going enterprise but not to allow extraction of monopolistic profits from the consuming public.

Two situations often used to justify regulation are those of "natural monopolies" and "infrastructure." A natural monopoly exists when declining long-run average costs allow one firm to supply an entire market more efficiently than could several competing firms. The other case sometimes used to justify regulation involves an industry or firm which is part of the foundation or infrastructure of economic society.[2] Power and communication utilities often fall into both categories and are subject to regulation.

The most prominent forms of regulation in these instances are restricting entry, regulating prices, requiring certain quality standards, and obligating the firm to serve all applicants. This thesis focuses upon price and regulation designed to restrict the rate of return on invested capital. In order to isolate several problems involved in rate-of-return regulation, it considers only established firms, so the question of entry is moot. It also assumes that all applicants are served with an adequate quality of service.

The determination of total dollar return on invested capital involves establishing the rate of return and specifying the aggregate investment

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[2]Alfred E. Kahn, The Economics of Regulation: Principles and Institutions, I (New York: John Wiley & Sons, Inc., 1970), p. 11.

or "rate base" to which the rate will be applied.[3] In 1898 the Supreme Court of the United States in Smyth v. Ames established that the "fair value" of the property should be considered by regulatory commissions in rate determination. Among the matters deemed appropriate for consideration in the fair value were "the original cost of construction, ...the amount and market value of its bonds and stock, the present as compared with the original cost of construction, the probable earning capacity of the property...and...operating expenses...."[4] The Court, therefore, set a precedent for considering both the book value and the market value of the firm as well as inflation (through replacement costs) and probable earnings. These are still central elements of controversy 75 years later.

The legitimate expenses were expanded to include the cost of capital in the Bluefield case in 1923.[5] Financial integrity, capital attraction, and compensation for risk were specified as valid tests for rate fairness in the Hope case in 1944.[6] The search still continues for generally applicable guidelines which will assist regulatory commissions in their job of intervening where the competitive market system cannot or does not function.

The ratio of market value to book value of equity has been discussed in several recent rate cases as one possible criterion of fairness that has been largely overlooked in much past regulation. David Kosh's comment, relative to his proposal to allow a rate of return slightly in excess of

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[3]Kahn, pp. 35-36.

[4]Smyth v. Ames, 169 U.S. 466, 546-547 (1898), cited by Alfred E. Kahn, The Economics of Regulation: Principles and Institutions, I (New York: John Wiley & Sons, Inc., 1970).

[5]Bluefield Water Works & Improve. Co. v. Public Service Commission of West Virginia, 262 U.S. 679, 693 (1923).

[6]Federal Power Commission v. Hope Natural Gas Co., 320 U.S. 591 (1944).

his estimate of the cost of capital for South Central Bell in a 1972 rate case in an example: "This rate would, in my opinion, keep the market price of South Central's stock if traded more than sufficiently above book value so as to allow for equity financing without dilution. As such it will maintain the credit of the company."[7]

Rhoads Foster, in a similar vein, stated in a Southern Bell rate hearing that "It may be agreed that financial integrity means, at a minimum, the maintenance of stock market values somewhere above book value. The crucial issue is: How much higher than book value?"[8] Foster's testimony included an exhibit comparing market/book ratios of AT&T to those of samples of electric utilities, industrials, food processors, and another exhibit showing the capital of Southern Bell in current dollars as compared with the book value.[9] An analytical approach to using comparative market/book ratios as a means of determining a fair rate of return was presented by Peter Gutmann in two rate cases involving Consolidated Edison Company and Brooklyn Union Gas.[10] In still another instance, rebuttal testimony of Alexander Robichek recalled that Kosh has stated that a market/book ratio in the range of 1.1 to 1.5 was desirable for Pacific Northwest Bell. Robichek disagreed with Kosh as to what allowed rate of return would be necessary for the firm to achieve a market/book ratio within

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[7]David A. Kosh, Testimony of, re Fair Rate of Return, before the Public Service Commission of the State of Tennessee in re South Central Bell Telephone Company, Docket U-5571, March 1972, p. 54.

[8]J. Rhoads Foster, Testimony before the Florida Public Service Commission, Fair Rate of Return to Southern Bell Telephone & Telegraph Company, February 1973, p. 52.

[9]Foster, pp. 27 and 58 of exhibits.

[10]Peter M. Gutmann, "The Fair Rate of Return: A New Approach," Public Utilities Fortnightly, Vol. 87, No. 5 (March 4, 1971), p. 41.

this range.[11]

The subject of market/book ratios, therefore, has been receiving some discussion but without general agreement as to the approach to be taken, the level to be sought, or even the usefulness thereof. As Robichek expressed it, "In my opinion, the desirable market-to-book ratio should reflect more than one's own feelings about the subject. In particular, I believe that the desirable range for this ratio should be justifiable on economic grounds."[12] The purpose of this thesis is to explore the questions involved, to clarify the issues and, hopefully, to develop useful input for the regulatory decision process.

The urgency attached to this task may be emphasized by considering historic trends in public utilities' market/book ratios, which have been falling rapidly during recent years. The severe declines shown for several Florida companies in Figure 1 pervade the electricity utility industry. The market/book ratio for each firm at the end of 1973 was very near or below 1.0. The implications of a firm's common stock selling below book value (i.e., market/book ratio less than 1.0) are discussed at length in the chapters to follow. Let it suffice here to mention that where capital expansion requires the sale of new common stock at a time when the market/book ratio is below 1.0, the previously existing stockholders suffer a financial loss.

Consider the plight of Consolidated Edison of New York, whose market/book ratio has been below 1.0 since 1969, as shown in Figure 2. The

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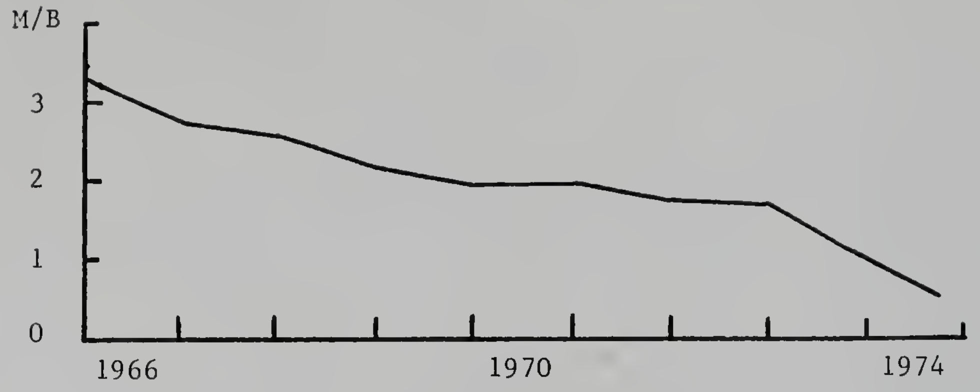
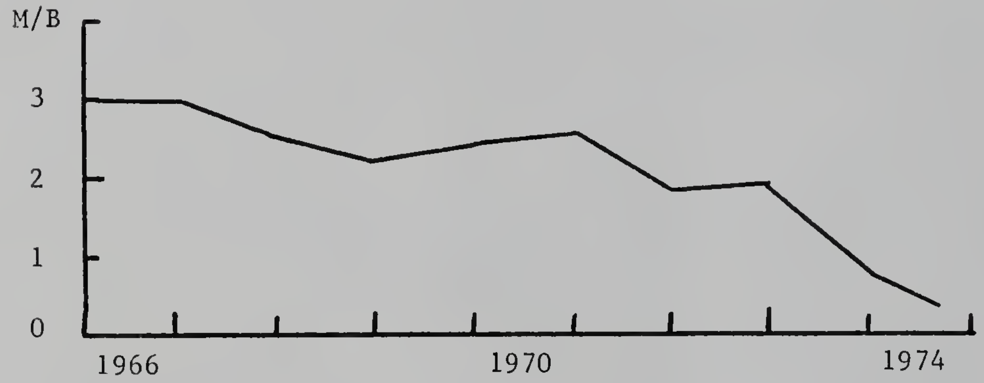
[11] Alexander A. Robichek, Testimony of, <u>Washington Utilities and Transportation Commission v. Pacific Northwest Bell Telephone Company</u>, Cause No. U-71-5-TR, September 27, 1971, pp. 1493-1680.

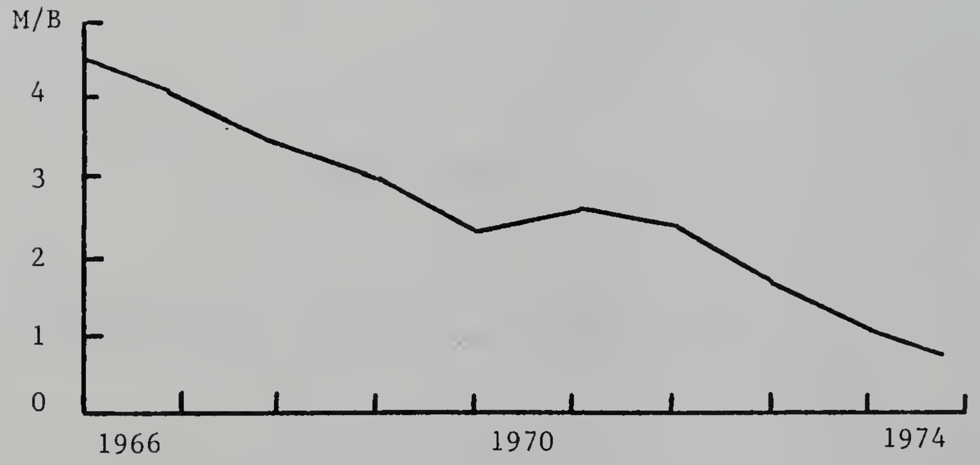
[12] Robichek, pp. 1567-68.



Florida Power & Light Company



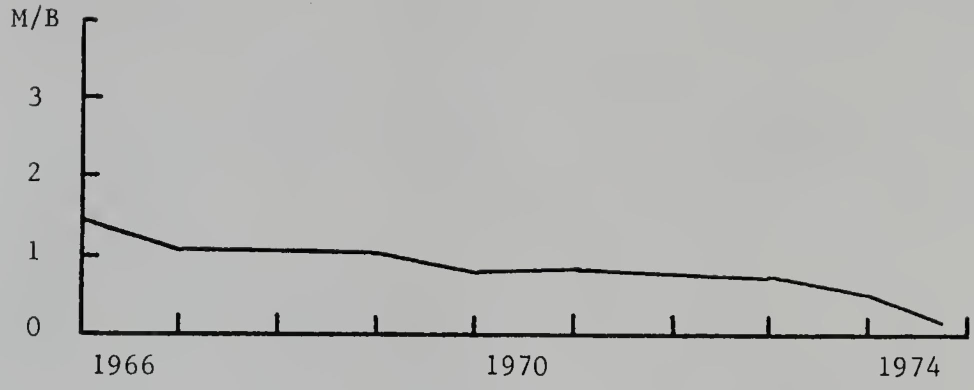
Florida Power Corporation



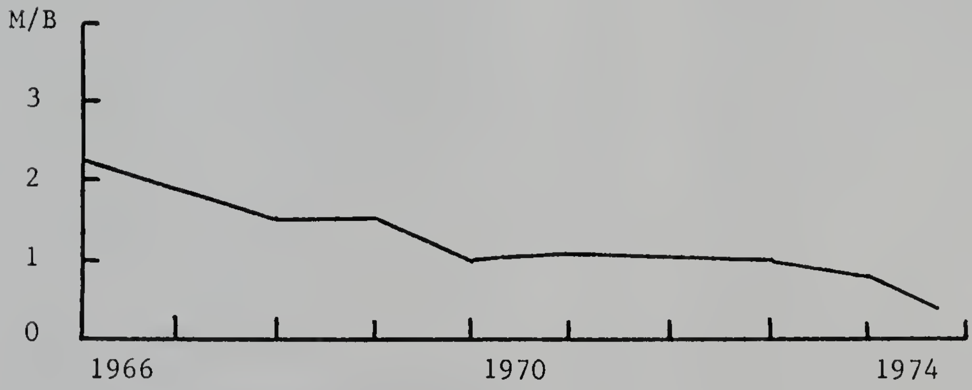
Tampa Electric Company

Figure 1: Market/Book Ratios of Selected Florida Utilities.

Source: Calculated from Compustat Annual Utility Tape and Standard & Poor's Stock Guide, October 1974.



Consolidated Edison of New York



Detroit Edison Company

Figure 2: Market/Book Ratios of Selected Utilities.

Source: Calculated from Compustat Annual Utility Tape and Standard & Poor's Stock Guide, October 1974.

company has been suffering a severe cash shortage, both as a result of rising operating costs and a need to expand plant facilities. The seriousness of Consolidated Edison's situation was recently highlighted when the Board of Directors passed a regular quarterly dividend payment. Because this firm has paid some dividends in each year since 1885 and has long been considered a stronghold within the electric power industry, the gravity of this decision was felt throughout the financial community. The Dow Jones Utility Average, in fact, responded by tumbling 4.16 points (4.93 percent) on April 23, 1974, the day of Consolidated Edison's dividend announcement.[13]

Another firm with current financing woes is Detroit Edison Company, whose bonds were downgraded in April 1974, from AA to A by Standard and Poor's. Their action raised interest rates paid by the firm, since the lower rating indicated a higher risk. The utility is now having so much trouble attracting capital at a reasonable cost to finance construction that in May it announced an 18 percent cut in its five-year capital-spending plan. The company realized that this curtailment of expansion might affect service within a few years.[14] Detroit Edison's market/book ratio was only slightly above 1.0 from 1969 through 1972; then in 1973 it dropped below, as indicated in Figure 2.

The problems illustrated by these firms are not isolated instances; rather, they are widespread. Irving Trust Company predicted that $75 billion will have to be raised by electric utilities in the period

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[13] The Value Line Investment Survey, Edition 5 (May 10, 1974), pp. 700-842.

[14] "Detroit Edison Cuts Its Spending Plans 18% Due To Financing Woes," The Wall Street Journal, May 24, 1974.

1974 - 1978.[15] With this magnitude of capital needed, other companies will almost certainly be facing financing problems similar to those of Consolidated Edison and Detroit Edison. An approach to these problems through an understanding of the relationships among the market/book ratio, the firm's financial decisions, the regulatory agency's actions, and the effects on both owners and consumers is sought in the pages that follow.

The discounted cash flow valuation model presented by Robichek,[16] among others, relates the market/book ratio to the rate of return allowed by the regulatory commission, the rate of return required by investors in the securities markets, and the retention rate of the firm's earnings. This basic model is developed in detail in Chapter 2 to reveal the assumptions and implications within testimony such as that cited above. The assumptions in the model are then relaxed to accommodate sale of new equity with allowance for flotation costs and to restructure the assumptions concerning total asset growth. Implications of the expanded model for regulatory purposes are considered in light of current practices.

The market/book model uses expectations to explain investor behavior in relation to other economic forces. Historical data are a record of financial events as they actually occurred, not a record of investors' expectations. Empirical evidence can be used as a guide to judging expectations as explained in Chapter 3. Market/book ratios were calculated and compared to actual values to test the predictive power of the model. Least-squares regression was also performed as an alternative method for predicting market/book ratios.

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[15] Value Line, p. 703.

[16] Robichek, Exhibit 106, pp. 1-6.

Chapter 4 deals with the elusive problem of fairness in rate regulation. An economic basis for a competitive, and presumably fair, rate of return is developed and related to the market/book model. Certain assumptions regarding the value of assets make application of the economic theory difficult. An approach to reconciling economic theory and accounting conventions is suggested in hopes of providing a practical and economically sound input for the rate determination process.

CHAPTER 2

A MODEL OF MARKET/BOOK RATIOS

This chapter develops a mathematical model relating the firm's market/book ratio to other financial variables, including the rate of return allowed on equity. The first section distinguishes among several rate of return concepts discussed in the financial literature. The second section examines in detail the expected rate of return as determined by the discounted cash flow (DCF) technique, which has been widely cited in utility rate regulation proceedings. The assumptions going into the DCF approach, the implications arising out of its usage, and its limitations are discussed for a better understanding of past and current rate regulation. One limiting assumption in many DCF models is that retention of earnings supplied all equity financing; this assumption is relaxed in the third section, where the model is expanded to allow for equity financing through the sale of new stock. The expanded model includes flotation costs, and it is this new model that should be used in utility rate regulation.

A discussion of several other market/book models concludes the chapter, and few relevant, but lengthy, points are developed in the appendices to this chapter.

Rates of Return

The term rate of return refers to rate of return on equity capital throughout this thesis. The rate of return required by investors on the ith company's stock, k^*_i, consists of a risk-free rate of return, R_F, plus a risk premium, ρ_i, suitable to the riskiness of the stock. In equation form, this required rate of return is defined as follows:

$$k^*_i = R_F + \rho_i. \tag{1}$$

The average investor requires a return of k^*_i to induce him to buy or hold the asset.

Any particular asset, say the common stock of a regulated utility, has associated with it an expected rate of return, k. For common equity the <u>expected rate of return</u> often used in rate regulation cases is

$$k = \frac{D_1}{P_0} + g, \tag{2}$$

where D_1 is the cash dividend expected during the year, P_0 is the current price of the stock, and g is the expected constant growth rate in earnings, dividends, and stock price.[1] This equation is the discounted cash flow (DCF) cost of equity capital formula. When investors expect asset i to earn the rate that they require for its level of risk, the capital market is in equilibrium; that is, equilibrium exists when $k = k^*_i$. Henceforward, we shall assume that the capital market is in equilibrium, so that the required and expected rates of return are the same at any point in time. Subsequent model developments use k in the context of Equation (2) while sometimes referring to it as the required rate of return because of market equilibrium.

One aspect of utility regulation is the control of profits by setting

[1] Myron Gordon, <u>The Investment, Financing, and Valuation of the Corporation</u> (Homewood, Illinois: Irwin, 1962).

a maximum overall rate of return on the rate base. This allowed rate of return is given the symbol r in the following equations. (Further, for convenience, we assume that the rate base is equal to total capital.) The regulatory agency is required by legal precedent to allow a rate of return that is "fair" to the equity owners. Thus r is also the fair rate of return. The allowed and fair rates of return are ex ante concepts. If, indeed, the utility achieves a level of earnings sufficient for the allowed rate to be realized, then the actual rate of return, in the ex post sense, is equivalent to the allowed rate. Because of regulatory lag or other problems, the actual rate of return may be quite different from the commission-determined fair and, therefore, allowed return. For the following equation derivations, we shall assume that the fair, the allowed, and the actual rates of return are equal. Later on, where regulatory lag is discussed, this equality assumption is relaxed.

Basic Market/Book Relationships

The DCF approach to the cost of equity capital is based on expected and required market returns; it relates the price investors pay for a stock to the return these investors require and expect to receive on that investment. Regulation, on the other hand, generally focuses on book value, and regulators prescribe rates of return on the book value of equity. If regulation is to be fair and effective, the interrelationships between market value, book value, and rate of return must be recognized and taken into account in the regulatory process. Here we show the basic relationships in algebraic form.

The Gordon model[2] for constant growth, Equation 2, which is used

[2]Gordon (1962).

frequently in financial and regulatory analysis, can be rewritten as

$$P_o = \frac{D_1}{k - g} . \tag{3}$$

Recognizing capital market equilibrium, k, the expected rate of return, must equal k^*_i, the required rate of return. Dividends are dependent on earnings per share, E_t, and the percentage of earnings paid out. If a constant percentage of earnings, b, is retained, then the dividend payout ratio is (1 - b), and dividends per share for a period t are

$$D_t = (1 - b)E_t . \tag{4}$$

Earnings per share is equal to the allowed rate of return, r, times the book value per share at the beginning of the period, B_{t-1}:

$$E_t = rB_{t-1} . \tag{5}$$

Substituting Equation 5 into Equation 4 we see that the dividend expected during period t is

$$D_t = (1 - b)rB_{t-1} . \tag{6}$$

The growth rate in earnings, dividends, and share prices is

$$g = br, \tag{7}$$

in the very limited situation that assumes (1) k, b, and r are constant and (2) that all growth is from internally generated funds. Letting t = 1 and substituting Equations 6 and 7 into Equation 3 gives

$$P_o = \frac{(1 - b)rB_o}{k - br} . \tag{8}$$

One can now solve for the market value/book value ratio, M/B:

$$M/B = \frac{P_0}{B_0} = \frac{(1 - b)r}{k - br} \ . \tag{9}$$

This M/B relationship is basic to much of the discussion throughout this thesis. It is expanded later in this chapter in order to take into account the effects of selling new stock. We shall return to it in Chapter 4 in order to study the effects of inflation on the utility. Thus it is important that we understand the nature of the equation and the underlying assumptions. Consequently we shall now look carefully at the characteristics of the function.

Characteristics of the Function

Further examination of Equation 9 reveals that the signs of the first and second derivatives[3] with respect to r are positive for relevant ranges of the constants, namely, $k > 0$, $1 > b \geq 0$, and $k > br$. If $b = 1$, then both derivatives are zero. Setting the first derivative equal to zero and solving for r, one finds that $r = k/b$. These mathematics indicate that the market/book ratio is an increasing function as r approaches k/b for positive values of M/B.

If one recognizes b, the retention rate, as a variable, also, he can determine the second order partial derivative of M/B with respect to r and b. The sign of this derivative depends not only on r and b but also on k. For values of $k > 0$, $1 > b \geq 0$, $k > br$, and $r > 0$ the sign will be positive, which indicates that the M/B ratio increases with both r and b.

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[3]Details of these derivatives are presented in Appendix B.

Some illustrative M/B ratios are calculated with Equation 9 and plotted in Figure 3. The significant features of this exhibit may be summarized as follows:

1. For any given b and k, the higher the value of r, as r approaches k/b, the higher the M/B ratio. For r greater than k/b, M/B is undefined.

2. If b is zero--i.e., if the firm pays all its earnings out as dividends--then the M/B ratio rises linearly with r without limit. Otherwise the relationship between M/B and r is not linear.

3. For any specified r and b, the M/B ratio is higher for lower values of k.

4. Over most of the ranges of the curves, the higher the value of b, the steeper the slope of the curve relating M/B to r; i.e., M/B is most sensitive to changes in r for high values of b.

5. When $r = k$, $M/B = 1.0$ regardless of the level of b. If $r > k$, then $M/B > 1.0$, and conversely if $r < k$. The relative levels of r and k are important to the question of fairness as discussed in Chapter 4.

6. If $r > k$, then the higher the level of b, the larger the value of M/B, and conversely if $r < k$.

<u>The Special Case When r = k</u>

With this basic relationship one can predict what will happen if a regulatory agency sets the allowed rate of return, r, equal to the DCF required (and expected) rate of return, k. Substituting $r = k$ into Equation 9 gives

$$\frac{P_o}{B_o} = \frac{(1 - b)k}{k - bk}$$

$$= \frac{(1 - b)k}{(1 - b)k}$$

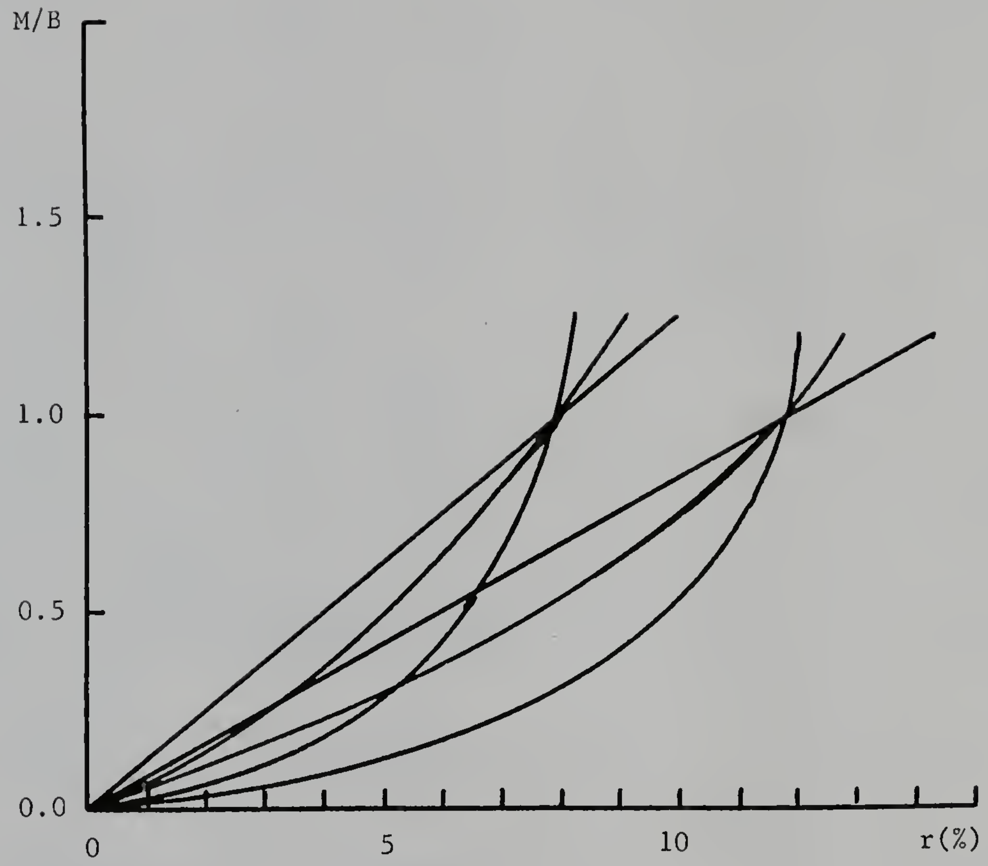

Figure 3: General Relationship Between Market/Book Ratios and Allowed Rates of Return.

Equation: $M/B = (1 - b)r/(k - br)$.

$$= 1,$$

which can be rewritten

$$P_o = B_o.$$

This equality shows that by using the DCF cost of equity capital as the allowed rate of return, a utility commission will be forcing the market price of the stock to equal its book value.

Although a slight digression, it is interesting to note that when the market/book ratio equals 1.0, the required rate of return, k, equals the earnings/price ratio.[4] In this case the earnings/price ratio is an appropriate measure of the cost of equity capital. The derivation of this result is presented in Appendix C.

The Asset Growth Rate

In the calculations used to construct Figure 3, the growth rate in total assets, g, was assumed to increase with r, i.e., g = br, with b constant. Thus, increase in the allowed rate of return implies a faster rate of growth in total assets. Is this assumption that g increases with r reasonable? Probably not--ordinarily, for most utilities, g is probably independent of r. The demand for many utility services, including electricity, appeared to be relatively inelastic in the short run over observed narrow ranges of prices, at least prior to the recent escalation in prices. More recently, there has been a reduction in power usage, apparently demonstrating some price elasticity, but perhaps reflecting a desire to

[4] J. C. Van Horne, Financial Management and Policy, 2nd ed. (Englewood Cliffs: Prentice-Hall, Inc.), pp. 115-117.

conserve waning energy supplies as well as price elasticity. If elasticity is low, the price changes necessitated by changes in r probably will not greatly affect the amount demanded in the short run. Since growth in demand is the primary determinant of the asset growth rate, g would seem to be relatively independent of r. Accordingly, it would seem preferable to evaluate Equation 9 under the assumption that g is a constant rather than to assume that g changes proportionately to r.

If we assume that g is a constant, then increases in r must be offset by decreases in b to keep the product br = g constant. In other words, if g is to be held constant, the higher earnings resulting from an increase in r must be paid out as dividends, which results in a reduction of b. Under these conditions, the M/B ratio is a linear function of r, as illustrated by the examples plotted in Figure 4. As was true with an increasing g, the M/B ratio still equals 1.0 where r equals k. However, we now have an X-axis intercept at the point where r = g. If r is less than g, negative M/B ratios, which are nonsense, arise, while positive M/Bs occur whenever r is greater than g. The higher the growth rate, the more sensitive is M/B to changes in r (i.e., the greater the slope) for any given value of k.

These points hold if all new equity financing is expected to come from retained earnings. They also hold if new equity is sold at book value. Since these conditions do not hold for all utilities, it is necessary to broaden the analysis to permit the sale of stock, and at prices different from book values.

Market/Book Ratios With External Equity Financing

In the no-external-equity model, earnings growth occurs only through reinvestment of retained earnings. If, however, equity is raised externally,

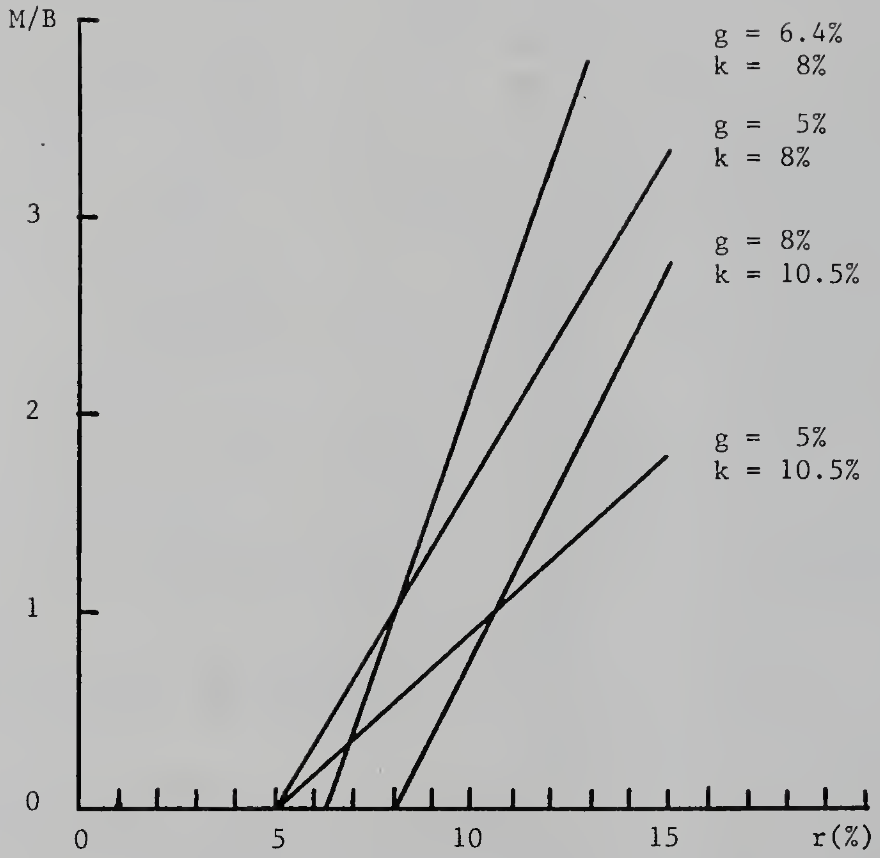

Figure 4: Market/Book Ratios With Constant Growth.

Equation: $M/B = (1 - b)r/(k - br)$.

Condition: $g = br =$ constant.

an additional element of earnings growth will occur if the stock is sold at prices above its book value, and earnings growth will be retarded if the sales price is below the book value.[5] The earnings of a utility are dependent upon its book equity, and if stock is sold at prices different from book value, the difference between price and book value accrues to the old stockholders.

Book value, earnings per share, dividends, and stock prices will all grow if stock is sold at prices above book value, and they will all fall if it is sold below. In this section we extend the M/B ratio equation to encompass the sale of common stock.

The Retention Rate

In a Miller-Modigliani world, investors are indifferent to dividends and retention of earnings, which will be reinvested and result in capital gains.[6] Since M-M assume that investors do not distinguish between dividends and retained earnings, the cost of equity capital to the firm is independent of the retention rate; that is, neither k nor the value of the firm is a function of b, according to M-M.

A contrary argument suggests that in a world with taxes and brokerage costs, certain investors might prefer capital gains to dividends; capital gains tax ratios are lower, and capital gains taxes can be deferred until some point in the future. Other investors may prefer current dividends to future capital gains: uncertainty increases as one projects farther into the future, so potential long-term capital gains may be regarded as

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[5]If a rights offering is used, then the stock split effect of underpricing must be taken into account. The relevant book value is B_0 after adjusting for this stock split effect.

[6]F. Modigliani and M. H. Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment", American Economic Review, June 1958; and "Correction", American Economic Review, June 1963.

more risky than current dividends, causing investors to discount expected dividends at a lower rate than expected capital gains. That is, the cost of capital for a firm paying out a high proportion of its earnings as dividends might be lower than one retaining a relatively high proportion of its earnings, ceterus paribus. Both lines of reasoning disagree with the Miller-Modigliani assumption that investors are indifferent concerning dividends or capital gains, and both suggest that the cost of equity capital is indeed dependent on the retention rate, i.e., that k is a function of b. (M-M argue that the two forces are offsetting, with the result being an empirically observed independence of k on b.)

If this functional relationship were definitely known to exist, and if the function were defined, then this information could be incorporated into the M/B model. Since the question is still open to discussion, this M/B model opts for the Miller-Modigliani position that the cost of equity capital is independent of the retention rate. This choice seems superior to defining, perhaps erroneously, a function relating k to b.

One is also faced with the possibility that management could change the retention rate every dividend period. Indeed, one observes small, periodic retention rate fluctuations in many utility companies. A general practice is to maintain constant dollar-amount dividends per share through time with occasional increases, as permanently increased earnings per share permit. A stable dividend per share reduces risk in the investor's eyes.[7] Firms take pride in a long record of uninterrupted dividend payments. Earnings per share seldom exhibit the stability of dividends per

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[7]Richard Schramm and Roger Sherman, "Profit Risk Management and the Theory of the Firm", Southern Economic Journal, Vol. 40, No. 3 (January 1974), pp. 353-363.

share. Earnings fluctuate as dividends are held constant; consequently, the retention rate varies from period to period. This point is confirmed in Table 1 by data from a few illustrative firms. Although these retention rates do vary from year to year, they are ususally of the same general magnitude as the long-term average for a particular company. Year-to-year changes result largely from variations in earnings rather than from changes in retention-rate policy.

Although the firm's managmeent could make major and frequent alterations in its retention rate by changing the dollar amount of dividends paid out, this procedure is not generally accepted behavior in the business community. In a study by Brigham and Pettway,[8] a majority of financial managers questioned indicated that they would not be willing to change their dividend policy significantly under normal circumstances. The retention rate seems to be regarded as a constant by management, and probably also by investors, at least in an expectational sense. Since investors seem to expect a reasonably stable retention rate, in a M/B model built on expectations for the future, a constant retention rate is a plausible assumption.

The retention rate has an important bearing on the growth rate of earnings of the firm; this relationship is shown in the next section.

The Two Components of Growth

There are two elements of growth of earnings for a utility: (1) growth from retention of earnings, g_1, and (2) growth from sale of new stock, g_2. Our previously discussed growth variable, g, is a combination of these two

[8]E. F. Brigham and R. H. Pettway, "Capital Budgeting By Utilities", Financial Management, Vol. 2, No. 3 (Autumn 1973), pp. 20-21.

TABLE 1

THE RELATIVE STABILITY OF RETENTION RATES AND DOLLAR AMOUNTS OF DIVIDENDS PER SHARE FOR SELECTED ELECTRIC POWER FIRMS

	Allegheny Power System		American Electric Power		Rochester Gas & Electric		Washington Water Power	
Year	b%	$D	b%	$D	b%	$D	b%	$D
1954	38.73	.57	33.50	.49	30.09	.52	14.25	.81
1955	38.08	.64	38.21	.56	34.63	.52	18.12	.86
1956	33.83	.71	32.61	.63	30.79	.54	20.58	.91
1957	32.56	.75	34.54	.68	29.25	.56	22.87	.94
1958	33.59	.75	29.43	.75	38.05	.56	19.32	1.00
1959	32.29	.80	28.88	.79	47.32	.62	24.94	1.00
1960	29.18	.85	27.94	.86	40.60	.64	17.02	1.00
1961	28.80	.86	24.47	.90	42.46	.66	18.82	1.00
1962	28.38	.91	31.09	.96	47.00	.69	19.16	1.00
1963	28.12	.96	30.66	1.07	47.99	.75	20.91	1.01
1964	28.14	1.01	29.02	1.15	50.77	.78	21.00	1.06
1965	29.69	1.08	29.11	1.23	51.27	.80	22.16	1.08
1966	29.70	1.15	30.56	1.35	50.28	.85	24.51	1.12
1967	30.42	1.20	26.85	1.46	51.15	.92	25.14	1.18
1968	30.90	1.24	27.04	1.54	53.98	.95	28.10	1.21
1969	31.81	1.29	27.77	1.60	53.44	1.02	26.95	1.28
1970	34.25	1.32	27.75	1.66	48.06	1.10	26.65	1.32
1971	35.56	1.36	29.81	1.70	42.82	1.13	27.63	1.36
1972	40.50	1.40	33.17	1.76	46.64	1.17	29.21	1.39
Mean	32.34		30.13		44.03		22.49	
σ	3.74		3.21		8.03		4.20	

factors:

$$g = g_1 + g_2.$$

Here g is equivalent to the g defined in Equation 7, where retention of earnings was the only source of growth (i.e., $g_2 = 0$),

$$g_1 = br,$$

while the growth from sale of new stock is described by Equation 10, which is derived in Appendix D:

$$g_2 = \frac{P_o(1 + s)}{P_o + sB_o} - 1. \tag{10}$$

Here s is the rate of growth in total equity from the sale of new common stock; P_o is the market price per share; and B_o is the book value per share.

In the case where M/B = 1.0 (i.e., $P_o = B_o$), g_2 will equal zero; this can be seen by substituting B_o for P_o in Equation 10. If, however, M/B > 1.0, then the larger the value of s, the greater will be the value of g_2; that is, old stockholders will enjoy larger growth rates in dividends and earnings per share as larger amounts of new stock are sold, provided the market price is above book value. On the other hand if M/B $\leq$ 1.0, then g_2 is negative, and the larger the value of s, the smaller will be g_2, and the greater the dilution of dividend earnings when new stock is sold. At some combination of low M/B and high s, the resultant negative g_2 will offset a positive g_1, causing total earnings per share growth to be negative even for a company that plows back some of its earnings.

Now that we have established the two components of earnings growth, through internal and external equity financing, we can use these to develop a modofied model of market/book ratios.

The Modified Market/Book Equations

Equation 11, which is similar to Equation 9 except that it is modified to show the effects of stock sales on the M/B ratio, is derived in Appendix D:

$$M/B = \frac{r(1 - b)(1 + s) - s(1 + k - br)}{k - br - s} . \tag{11}$$

This equation shows that the M/B ratio is dependent upon the allowed rate of return, r; the retention rate, b; the extent to which outside equity financing is used, s; and the DCF cost of capital, k.

Equation 11 also depends upon the asset growth rate, G. With a constant debt ratio and a constant asset growth rate, the rate of external equity financing is a residual equal to the rate needed to make up the difference between the asset growth rate and the growth supplied by retention of earnings; that is, $s = G - br$. Consequently, for any given b and r, s varies with G. Alternatively, we can express the assumed constant growth rate as the sum of its parts:

$$G = br + s. \tag{12}$$

We can now substitute Equation 12 in the denominator of Equation 11 to obtain Equation 13:

$$M/B = \frac{r(1 - b)(1 + s) - s(1 + k - br)}{k - G} . \tag{13}$$

In evaluating Equation 13, we are primarily interested in the relationship between M/B and r, since r is a major parameter upon which both utility companies and their regulators focus. Accordingly, we hold constant the values of the other variables and analyze M/B as r changes. As with the no-outside-equity-financing case, however, we still have the choice of holding G constant or letting G = br + s increase with increases in r. This is an important consideration, as M/B rises exponentially with r if G is permitted to vary, but M/B is approximately linear if G is held constant.

As explained earlier in this chapter, it is probably more realistic to hold G constant than to let it vary, at least within a "reasonable" range of values for r. Under the assumption that G is constant, Figure 5 shows how M/B varies with r at different asset growth rates. The main features of the figure may be summarized as follows:

1. The relationship between M/B and r is approximately linear for relevant ranges of r when G is constant.

2. When r = k, M/B = 1.0 regardless of the asset growth rate, the retention rate, or the outside equity financing rate.

3. Whenever r > k, M/B is larger for higher values of G, and conversely if r < k. That is, given two firms with the same allowed rate of return, retention rate, and cost of equity capital, but with different asset growth rates, the firm with the higher growth will have the higher M/B ratio if the allowed return is greater than the cost of capital, but a lower M/B ratio if less than the cost of capital.

4. The M/B ratio is most sensitive to changes in r if the asset growth rate is large. For instance, with G = 10 percent, a small change in r produces a substantial change in M/B, whereas, with G = 0 percent, the same small change in r produces a much smaller change in M/B.

The third and fourth points above are particularly interesting. If a utility is in a rapidly growing service area, a value of r only slightly less than k will produce a very low M/B ratio; conversely, if r is even

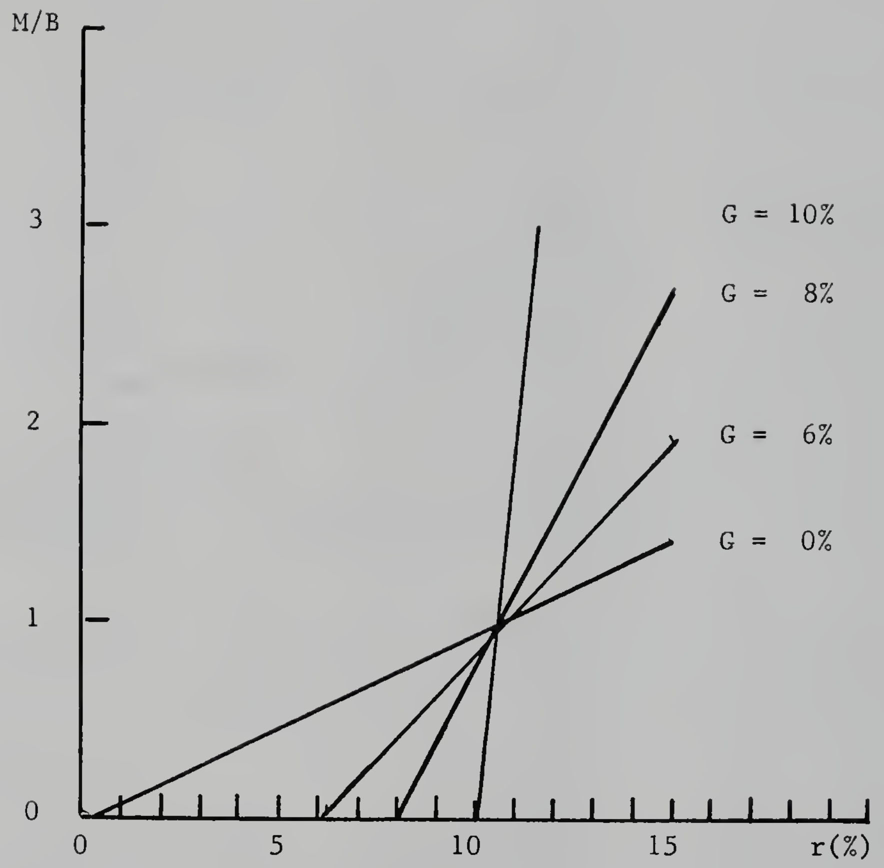

Figure 5: Market/Book Ratios With Sale of Stock.

Equation: $$M/B = \frac{r(1 - b)(1 + s) - s(1 + k - br)}{k - br - s}$$

Conditions: $G = br + s = \text{constant}$
$b = 40.0\%$
$k = 10.5\%$

slightly greater than k, the M/B ratio will be relatively high. Thus, utilities in high growth areas are likely to exhibit a relatively high degree of stock price instability in periods when realized rates of return are varying.

Flotation Costs

An additional factor affecting the market/book ratio is the cost involved in floating a new stock issue. Thus far we have implicitly assumed that flotation costs are zero, i.e., that new stock can be sold to net the company the current market price. Clearly this is not a realistic assumption; as a result, the model must be further expanded to allow for flotation costs.

There are actually two types of flotation costs: (1) the specific costs associated with underwriting an issue, including whatever underpricing might be necessary to sell the issue, and (2) the more subtle impact of a continual increase in the supply of a given stock. The specific costs associated with a given flotation, as a percentage of the funds raised, is designated by the term F. Assume first that a stock is selling at \$50 per share before a new financing is announced, that selling efforts enable the underwriters to market the stock at \$50, and that underwriting costs are \$2 per share. In this case, the seller will net \$48 per share, and F = \$2/\$50 = 4 percent. If, however, market pressure caused the stock to decline so that it was sold to the public at \$45 to net the seller \$43, then F = (\$50 - \$43)/\$50 = \$7/\$50 = 14 percent.

If the issue were a "one-time-shot", or at least if issues occurred only every four or five years, the market price would probably rebound to the original \$50 price, assuming the firm earned its cost of capital. If, however, the firm were forced to go to the market every year or two, and investors expected this situation to continue, then the continuous pressure of new shares being put on the market might hold the stock price down indefinitely. Whenever supply increases faster than demand, there will be a tendency for price to decline. Of course, if $M/B > 1.0$, and the sale of stock can be expected to boost earnings (i.e., to increase g_2), then this pressure should not be great.

The percentage flotation cost, F, associated with an individual stock issue is incorporated into Equation 14, which is derived in Appendix E:

$$M/B = \frac{r(1 - b)(1 + s)(1 - F) - s(1 + k - br)}{(k - br - s)(1 - F)}. \tag{14}$$

If $F = 0$, then Equation 14 reduces to Equation 13; but if $F > 0$, M/B is lower than it would otherwise be. If $F = 0$ and $G = br$, then Equation 14 reduces to Equation 9, the basic M/B relationship presented in an earlier section of this chapter.

Figure 6 shows how the M/B ratio varies with r, assuming different values for F. Some interesting features of the figure include the following:

1. If $r = k$, then $M/B = 1$ only if $F = 0$ or if $s = 0$. In the figure, $M/B = 1$ where $r - k - 10.5$ percent only on the line with $F = 0$. In other examples depicted, $M/B < 1$ where $r = 10.5$ percent.[9] Flotation costs do not affect the M/B if no new stock is sold, i.e., if $s = 0$.

2. The higher the value of F, the larger is the value of r needed to attain a specified M/B ratio.

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[9]Where $F > 0$, the cost of capital obtained by selling new stock is greater than k, the DCF required rate of return on the common stock. This point, which is discussed in detail in Weston & Brigham's Managerial Finance, 4th ed., pp. 306-307, explains why the M/B ratio is less than 1.0 if r is set equal to 10.5. The true DCF cost of capital is greater than 10.5 percent if the firm incurs flotation costs; setting $r = 10.5$ implies $r < k$, which leads to $M/B < 1.0$.

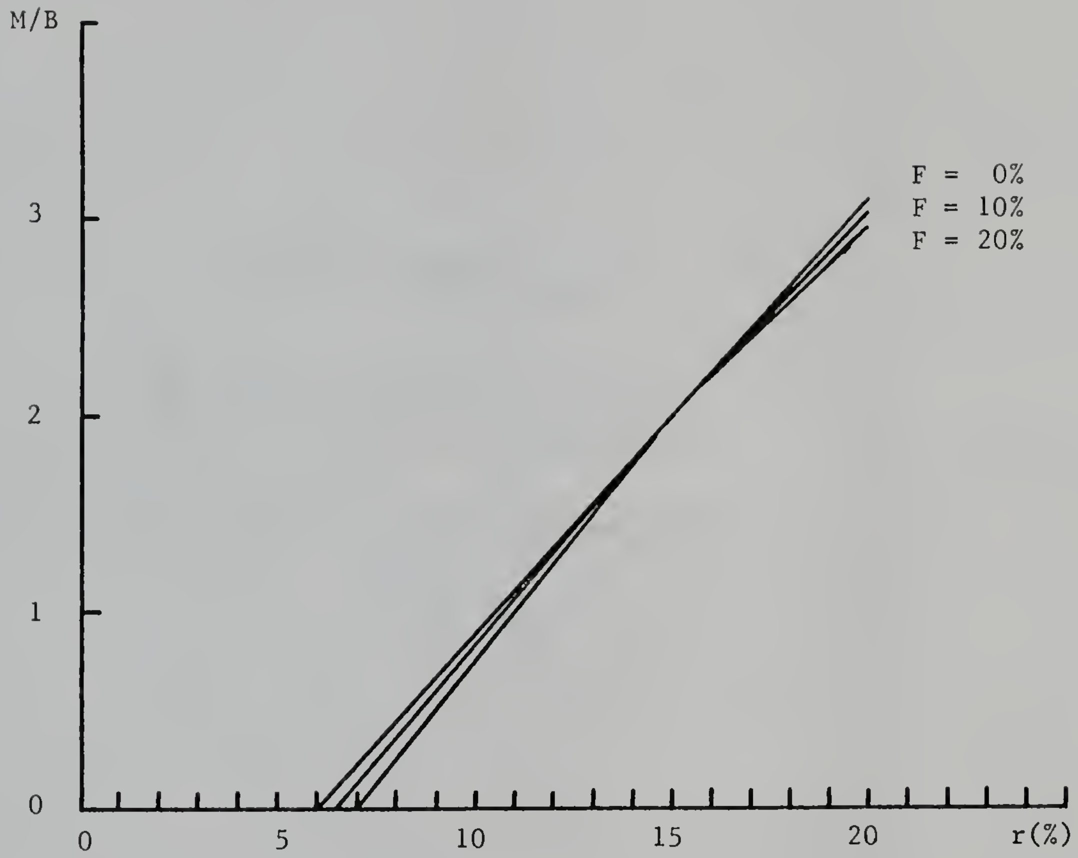

Figure 6: Market/Book Ratios With Sale of Stock and Flotation Costs.

Equation: $$M/B = \frac{r(1 - b)(1 + s)(1 - F) - s(1 + k - br)}{(k - br - s)(1 - F)}$$

Conditions: G = br + s = constant = 6.0%
b = 40.0%
k = 10.5%

3. At the point where r = 15 percent, the firm can finance its 6 percent growth rate through internal equity only. Here the M/B ratio is independent of flotation costs. That is, $G = br$ and $s = 0$ at this point.

4. When a firm finds it necessary to sell stock in order to achieve a particular rate of asset growth, flotation costs decrease the amount of incoming funds, as reflected in the factor $(1 - F)$. In the case where retained earnings, given a specified level for b, exceed the amount needed to finance asset growth, stock may be purchased to reduce the expansion of equity capital. Flotation costs are really brokerage costs, and they increase the amount of outgoing funds, so the correction factor is $(1 + F)$. In this example, the lines bend down past $r = 15$ because, if G, b, and the debt ratio are all to remain constant, then the firm must repurchase and retire stock, and F becomes a brokerage rather than a flotation cost.

Equation 14 is probably the best, or most realistic, model relating M/B ratios to allowed rates of return. If the author were called upon to recommend to a utility commission the allowed rate of return needed to attain a specific M/B ratio, he would use Equation 14 as the basis for the recommendation. The model, however, is subject to several faults which might cause the actual M/B to deviate from the one predicted. As we shall see in Chapter 3, the model is extremely sensitive to both required and allowed rates of return. Thus, when investor expectations are not met, actual M/Bs may vary widely from those calculated using expected values in the model.

Other Market/Book Models

Among the studies concerning the importance of the market value/book value relationship in public utility rate regulation are those of Gordon, Thompson and Thatcher, Morton, Carleton, Myers, and Davis.

Morton[10] considers the proper level of the M/B; Carleton concerns himself with the economic impact of rate decisions under inflation; Davis delves into the impact of regulation on capital budgeting; and the other studies deal with the theoretical relationships among the various financial parameters.

The groundwork for developing a theoretical relationship between the market price and book value was laid by Gordon.[11] His DCF cost-of-capital model ($k = D_1/P_0 + g$) provides the basis from which more complex models have been developed. Gordon assumed that expected dividend yield and expected dividend growth through retention of earnings are the quantifiable determinants of the cost of capital. The model assumes no new financing through sale of stock or bonds. Furthermore, the expected dividend growth, which is the product of the retention rate and the allowed rate of return, is assumed to be constant over time.

This basic model was used by Stewart Myers[12] to demonstrate that the market price will equal the book value per share if the allowed (and actual) rate of return is set equal to the cost of equity capital, i.e., if $r = k$, then $P_0 = B_0$ or $M/B = 1.0$. Essentially, Myers expressed the market/book ratio as a function of the allowed rate of return, the required rate of return, and the rate of earnings retention, i.e., $M/B = f(r, k, b)$.

Gordon later generalized his own model to include circumstances of growth through external funding as well as through retained earnings.[13]

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[10] W. A. Morton, "Risk and Return: Instability of Earnings as a Measure of Risk", Land Economics (May 1969), pp. 229-61.

[11] Gordon (1962).

[12] S. C. Myers, "The Application of Finance Theory to Public Utility Rate Cases", The Bell Journal of Economics and Management Science, Vol. 1, No. 2 (Autumn 1970), pp. 245-270.

[13] M. J. Gordon, "The Cost of Capital for a Public Utility", Unpublished paper, February 1973, University of Toronto.

Thompson and Thatcher[14] built a model relating the allowed rate of return on equity capital and the rate of growth of shares via the market/book mechanism. They asserted that the rate of earnings on equity capital, not just the rate of dividends, should be reflected in the cost of equity capital. T & T assume that a utility's growth rate in total assets is determined by growth of consumer demand, and that asset growth is independent of the retention ratio. Further, they assume a stable capital structure, so the rate of growth of assets is also the rate of growth of equity.

The Thompson and Thatcher net-asset rate of growth, γ, is equivalent in concept to our asset growth rate, G. This equivalency can be shown as follows. First, our ΔS is equivalent to their h:

$$\Delta S = \frac{sSB_O}{(1 - F)P_O} = \frac{\text{growth in total book equity}}{\text{price after flotation costs}} = \begin{matrix}\text{change in number of}\\ \text{shares outstanding.}\end{matrix}$$

$$h = \frac{\Delta S}{S} = \frac{sSB_O}{(1 - F)P_O S} = \frac{sSB_O}{(1 - F)P_O} = \begin{matrix}\text{rate of growth in}\\ \text{number of shares.}\end{matrix}$$

Second, they write the asset growth equation as follows:

$$\gamma = (1 - p)r + P(t)fh \frac{S(t)}{E(t)} ,$$

where

γ = asset growth rate
$P(t)$ = market price of a share at time t
$S(t)$ = number of shares outstanding at time t
$E(t)$ = book value of equity at time t
p = dividend payout ratio
h = growth rate of shares of common stock
f = ratio of net proceeds to market price
r = allowed rate of return.

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[14] H. E. Thompson and L. W. Thatcher, "Required Rate of Return for Equity Capital Under Conditions of Growth and Consideration of Regulatory Lag", Land Economics, Vol. 49, No. 2 (May 1973), pp. 148-162.

Substituting the symbols used in our Equation 14 into Thompson and Thatcher's equation, we obtain

$$G = br + P_o(1 - F)\left[\frac{sB_o}{(1 - F)P_o}\right]\frac{1}{B_o}$$

$$= br + s,$$

which is our Equation 12.

Thompson and Thatcher expressed the M/B ratio as a function of the allowed rate of return, the required rate of return, growth in equity capital from all sources, the dividend payout ratio, and the rate of growth of shares. Their equation is, with α = M/B, as follows:

$$\alpha = \frac{pr}{p - (\gamma - h)} .$$

Substituting our smybols from Equation 14 into their equation gives the following expression:

$$\frac{P_o}{B_o} = \frac{(1 - b)r}{k - G - \dfrac{sB_o}{(1 - F)P_o}}$$

$$= \frac{(1 - b)r}{K - \dfrac{G(1 - F)P_o - sB_o}{(1 - F)P_o}}$$

$$= \frac{(1 - b)r(1 - F)P_o}{k(1 - F)P_o - G(1 - F)P_o + sB_o}$$

$$= \frac{(1 - b)(1 - F)P_o r}{(1 - F)(k - G)P_o + sB_o} .$$

Multiplying both sides of the equation by $\frac{(1 - F)(k - G)P_O + sB_O}{(1 - b)(1 - F)P_O r}$ gives

$$(1 - F)(k - G)P_O^2 + sB_O P_O = (1 - b)(1 - F)P_O B_O r.$$

Dividing through by $P_O B_O$ results in

$$(1 - F)(k - G)\frac{P_O}{B_O} + s = (1 - b)(1 - F)r$$

$$\frac{P_O}{B_O} = \frac{(1 - b)(1 - F)r - s}{(1 - F)(k - G)} .$$

Substituting $G = br + s$, we obtain

$$M/B = \frac{(1 - b)(1 - F)r - s}{(1 - F)(k - br - s)} .$$

Their equation, although somewhat different than our Equation 14, leads to the same conclusion, namely, that market price will equal book value per share if $r = k$ and there are no flotation costs, but, M/B will be less than unity if there are positive flotation costs whenever $r = k$ and growth is positive.

Thompson and Thatcher rewrite both the growth equation and the M/B equation to express r in terms of net asset growth and in terms of the M/B. Given a set of values, <u>including an M/B value</u>, they solve these equations simultaneously for r and h. This system finds the allowed rate of return and the rate of growth of shares necessary to produce the given M/B.

Carleton[15] argues that the cost of equity capital responds to monetary changes and that these changes were not adequately considered by Thompson and Thatcher. He addresses the problems of inflation and regulatory lag and proposes a partial solution by an alternative method for calculating the equity base; however, he then notes there is a legal precedent[16] against his suggestion to allow after-the-fact for return on equity in constructing the rate base.

Davis' study[17] concerns the relation of growth, allowed rates of return, and capital attraction to capital budgeting. He addresses the problem of how to account for these three factors in the capital budgeting process. His assumptions are largely consistent with ours, as are his conclusions. He concludes that in order to insure consistent growth at a constant rate over the planning horizon, the allowed rate of return should be set at the investor discount rate, corrected for flotation costs, plus the growth rate, also corrected for flotation costs and any imperfection in the capital market response.

The market/book valuation models illustrate that the market price can be expected to be lower than book value per share if the allowed (or actual) rate of return is less than the stockholders' required rate of return, i.e., $M/B < 1.0$ when $r < k$. If new stock is sold under these circumstances, the original stockholders' claim to earnings is reduced,

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[15] W. T. Carleton, "Rate of Return, Rate Base and Regulatory Lag Under Conditions of Changing Capital Costs", Land Economics.

[16] Galveston Electric Co. v. City of Galveston, et al., 258 U.S. 388 (1922).

[17] Blaine E. Davis, "Investment and Rate of Return for the Regulated Firm", The Bell Journal of Economics and Management Science, Vol. 1, No. 2 (Autumn 1970), pp. 245-270.

relative to the claims of the new stockholders. Repeated offerings of new stock to the public at prices below book value causes the deterioration of an early owner's portion of earnings over time. Consequently, the financial community recognizes that the sale of new stock at a price below book value is undesirable. Graham, Dodd and Cottle recognized this sentiment when they stated, "If a utility company's earnings were restricted to a level that supported common stock prices at say, not more than 10 percent above book value, then utility equities would lose a major part of their investment appeal...."[18]

Summary

This chapter examined DCF rate of return models previously used in regulatory proceedings, then developed a new model suitable for such use. In all of the models, the market/book ratio is forced to unity (M/B = 1.0) if the regulatory body allows a return exactly equal to the cost of equity capital (r = k). If flotation costs were zero, then with an M/B = 1.0, equity financing would leave old stockholders' financial position unchanged, whereas their position would be improved if M/B > 1.0 or worsened if M/B < 1.0. In reality, problems will arise if a company must sell new stock at a time when its M/B is exactly equal to unity. Flotation costs, including fees to investment bankers and downward stock price pressure from the increased supply of the firm's securities, would promptly drive the M/B below unity, causing the old investors a loss on stock price.

To allow for the sale of new equity, various expert witnesses have suggested that market/book ratio should be somewhat above unity. In an

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[18] B. Graham, D. C. Dodd, and S. Cottle, Security Analysis, 4th ed. (New York: McGraw-Hill Book Company, 1962), p. 598.

attempt to understand these proposals and to define more clearly the relationships involved, this chapter developed a relatively complete market/book model. With this expanded model, we see that a generally linear relationship exists between M/B and the allowed rate of return. Given a combination of variables, we can use the model to determine the rate of return on book equity necessary to achieve a target M/B ratio. At this point, however, the question of an appropriate target M/B ratio is still open. The question is addressed in Chapter 4, but first, in Chapter 3, we test the M/B model to see just how well it actually explains empirical M/B ratios.

CHAPTER 3

EMPIRICAL TESTS

The model developed in the preceding chapter is based on a number of assumptions; to the extent that the assumptions are not realistic, then relationships predicted by the model will not hold in the real world, and the model will not be useful for regulatory purposes. Accordingly, it is necessary to test to see whether or not the postulated relationships hold. The major test involves generating data on such factors as the expected rate of return on book equity, the expected asset growth rate, flotation costs, and the required rate of return; inserting these values into the M/B model; and comparing the predicted M/B ratios for a sample of companies with their actual M/B ratios. To the extent that the model is an accurate representation of reality, and that we can develop reasonable proxies for investors' expectations regarding the independent variables, a close relationship will exist between the "calculated" or predicted M/B values and the actual M/B ratios.

The first section of the chapter delineates the factors that are taken into account by potential investors and security analysts in the process of forming expectations about the future financial performance of individual firms: (1) the required rate of return on equity (k), (2) rate of return on book equity (r) investors expect the Commission to permit, (3) the expected retention rate (b), (4) the expected rate of growth in total book value from the sale of common stock (g_2), (5) the expected growth rate in assets (G), and (6) expected flotation costs (F). Since all of these variables represent expectations of future events, they cannot be measured directly, but, rather, must be proxied in some manner on the basis of existing ex post data.

Given the basic input data, in subsequent sections we go on to develop calculated or predicted M/B ratios for a sample of electric utilities, to compare these predicted ratios with the companies' actual M/B ratios, and to test the statistical significance of the findings. The results do turn out to be statistically significant, although some companies' actual M/B ratios are quite different from the predicted values. A careful analysis of these cases reveals that the model is quite sensitive to certain ones of the input variables, and slight errors in the variables can lead to large errors in the calculated M/B ratios. This sensitivity suggests both the critical importance good input data and also the need for extreme care in using the model for regulatory purposes.

The Independent Variables

The model is built on expectations about the future. The market price of a stock depends upon the cash flow stream (dividends and capital gains) the investor expects, and the rate at which he capitalizes that income stream. Both dividends and capital gains depend upon the firm's earning ability and the proportion of earnings that are retained. Growth in earnings and dividends is determined by the rate of return earned on common equity, the rate of earnings retention, and the sale of new stock. Since all of these variables relate to future occurrences, ex ante values are the proper ones to use in testing the model.

Equation 15, which we regard as the most realistic model and which is the primary one used for the empirical tests, is repeated here for clarity:

$$M/B = \frac{r(1 - b)(1 + s)(1 - F) - s(1 + k - br)}{(k - br - s)(1 - F)} . \qquad (15)$$

Ex ante values are needed for each of the independent variables in Equation 15: r, the expected rate of return; b, the retention rate; s, the growth rate in total book value from sale of common stock; k, the investors' required rate of return; and F, the flotation costs expressed as a percentage of the funds raised.

The dependent variable, which is the market/book ratio, M/B, is a known quantity at any particular time t, and it is determined by values which investors expect the independent variables to assume in the future. Although we know investors do not expect the independent variables to remain constant over time, we believe that investors do expect these variables to fluctuate within a fairly narrow range, and that the mean of this range is used when evaluating the value of the stock. For example, investors will expect the retention rate to vary somewhat due to changes in earnings, but in investment decisions they analyze the stock with a specific value of b in mind. Our task is to determine the value of this future value of b as estimated by investors. Clearly, past values of b will be a major determinant of the expected future b, but just as clearly, the average value of b in the past is not necessarily the value investors project for the future.

Some variables may be expected to change in the future; for example, a particular company's asset growth rate, G, might be expected to remain high for a few years, then to decline. If we know the time path of this expected growth rate, we can calculate an average growth rate--a single value--for use in fitting the model. In any event, the task is to determine from ex post data, ex ante values of the independent variables.

Having done so, we can use these values in Equation 15 to calculate the M/B ratio. If the model is a good representation of the market valuation process, and if we have proxied the expectations reasonably well, the calculated M/B ratios will be close to the actual ratios.

The Allowed Rate of Return on Book Equity (r)

Since the allowed rate of return, r, is a key determinant of price in this valuation model, we must determine what values are in investors' minds at present concerning future values of r. Investors consider many factors in reaching this judgment, including (1) the past returns actually achieved by the company, (2) the relation of these past returns to the returns explicitly allowed by the regulatory agency in rate findings, (3) the average returns earned by the industry, (4) the relation of the firm's rate of return to the industry average, (5) the rate of return on bonds and other alternative investments, (6) the riskiness of the stock, and (7) coverage ratios.

An investor or security analyst would be interested in past rates of return for a firm, since this is solid evidence of past achievements. Also, the trend of past rates over time might offer a first clue to future rates. But earnings and rates of return cannot necessarily be expected to continue on an established course of growth or decline; other factors must also be considered. In the case of utilities, particularly electric utilities, demand and asset growth over the long run has been demonstrated to be closely related to population growth,[1] although recent experience during and following the energy crisis of 1973 suggests a certain degree

[1] J. B. Cohen and E. D. Zinbarg, Investment Analysis and Portfolio Managment (Homewood, Illinois: Dow-Jones-Irwin, Inc., 1967), pp. 253-254.

of price elasticity not heretofore thought to be important. Here, then, are two exogenous factors affecting demand which are certainly considered by investors.

Normalized rates of return

The earnings of any business are affected by random economic factors that cause revenues and expenses to fluctuate from year to year. Investors, however, cannot anticipate each random fluctuation when forming earnings expectations. Instead, they project a rate of return that is either constant or steadily changing, while recognizing that random events will occur and will affect future net income. Hence, when they compare past predictions to actual returns, they find that the two seldom, if ever, coincide.

One method used to smooth out past random fluctuations and thus better predict future trends is least-squares regression. Applying least-squares regression to past rates of return minimizes the expected value of the squared error in prediction, forcing all predicted values to lie on one curve or line. Investors might accept the regression equation derived from past data as a fair approximation of predicted rates of return. Realized rates of return, r, are regressed as the dependent variable against time, t, (years), using a linear equation of the form $r = B_0 + B_1 t$, where B_0 is a constant and B_1 is the regression coefficient. We use both the "normalized" values from the regression line, as illustrated in Figure 7, as well as individual annual values in the empirical tests of the model.

"Zone of reasonableness"

The regulatory climate is also quite important to the utility

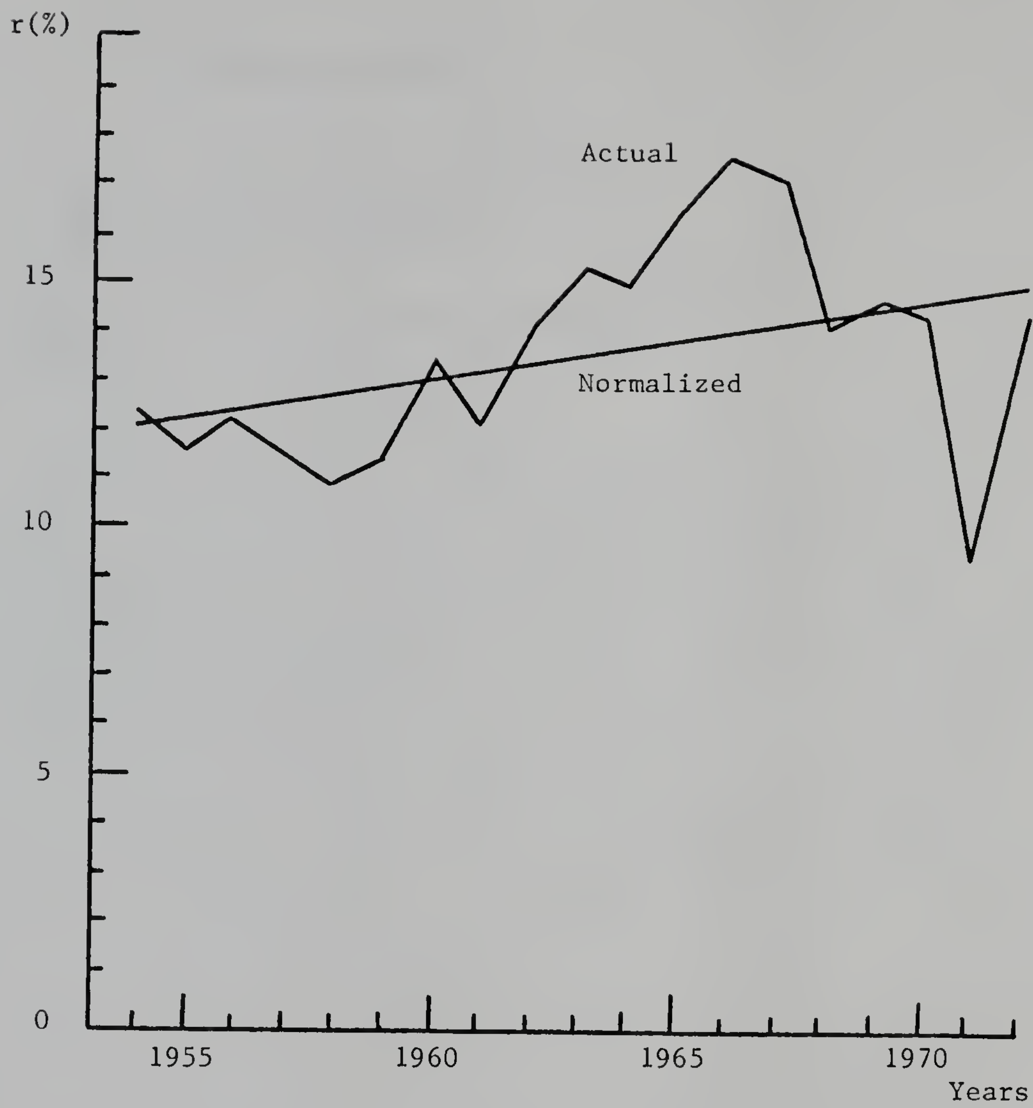

Figure 7: Actual and Normalized Rates of Return for Tampa Electric Company.

Source: Calculated from the Compustat Annual Utility Tape.

because the maximum rate allowed is determined by a regulatory commission. The relationship of the company's recent returns to generally allowed returns for the jurisdiction would be of significance to the analyst. Regulatory commissions often think in terms of a range within which the rate of return is reasonable or "fair." If this range were rising gradually over time, perhaps because of inflation and a rising debt ratio, a regulated firm's return pattern might be something like that depicted in Figure 8. When a rate increase is granted, the utility's rate might jump to the target rate of return. The firm might maintain this rate of return, or the rate might fall under inflationary pressures or rise if conditions of increasing productivity existed. If the commission perceives that the zone of reasonableness is rising faster than the company's return, the firm will soon find itself at the bottom of the range. At this time, the regulators will presumably grant another rate increase that will put the firm back near the target. This repeated action could cause a sawtooth earnings pattern such as that shown in Figure 8. The astute investor would recognize this phenomenon and be aware of impending rate cases and potential rate adjustments. He would then look at past returns with an eye to the future, and anticipate that past rates might be adjusted.

The average returns earned by the industry in general, and in particular by those companies within the same regulatory jurisdiction as the firm in question, would also offer insights into the expected rate of return on equity. Over the period from 1954 through 1972, the average rate of return for three Florida companies exceeded the national average by from one to two percentage points; see Figure 9.[2] The same figure also

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[2]One could argue that this premium indicates a lenient commission, that is reflects a higher cost of capital caused by risk differentials,

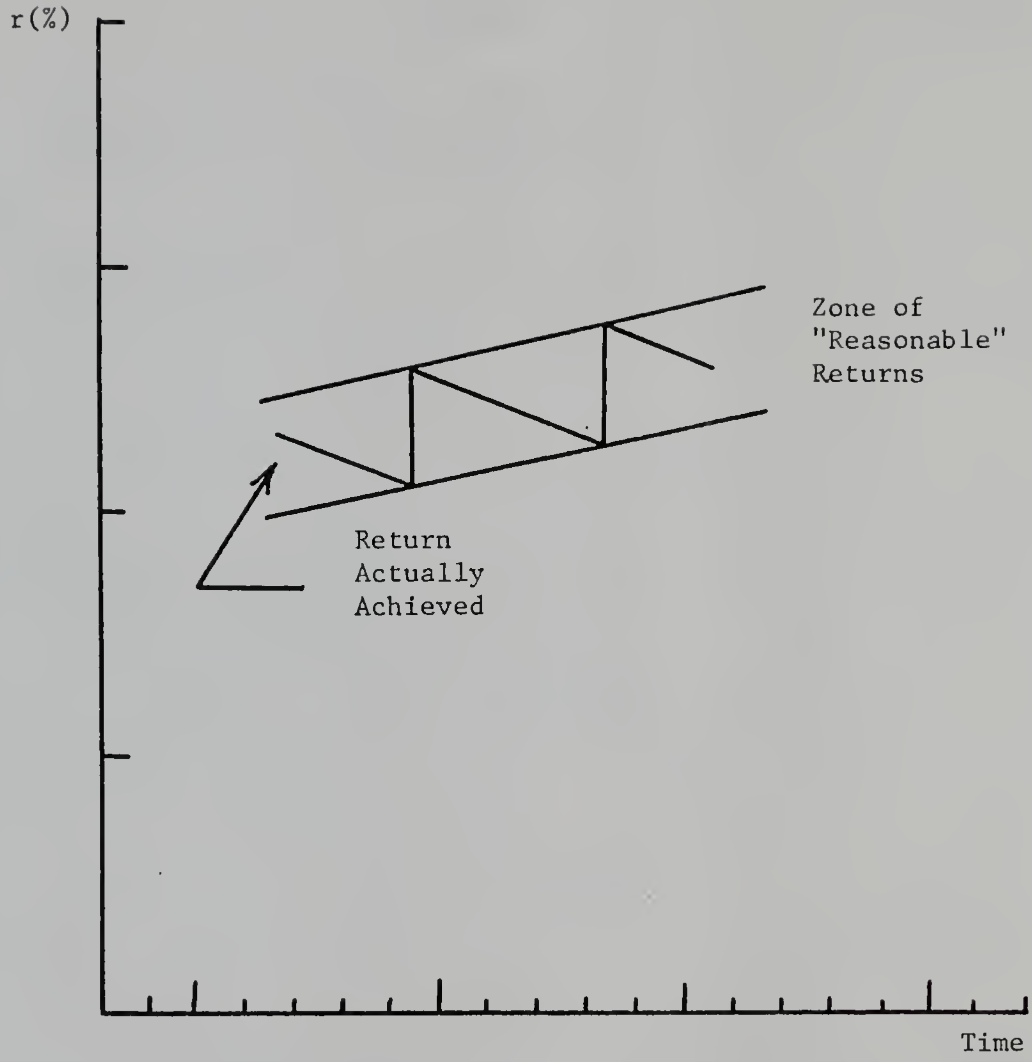

Figure 8: Hypothetical Pattern of Rates of Return for a Regulated Utility.

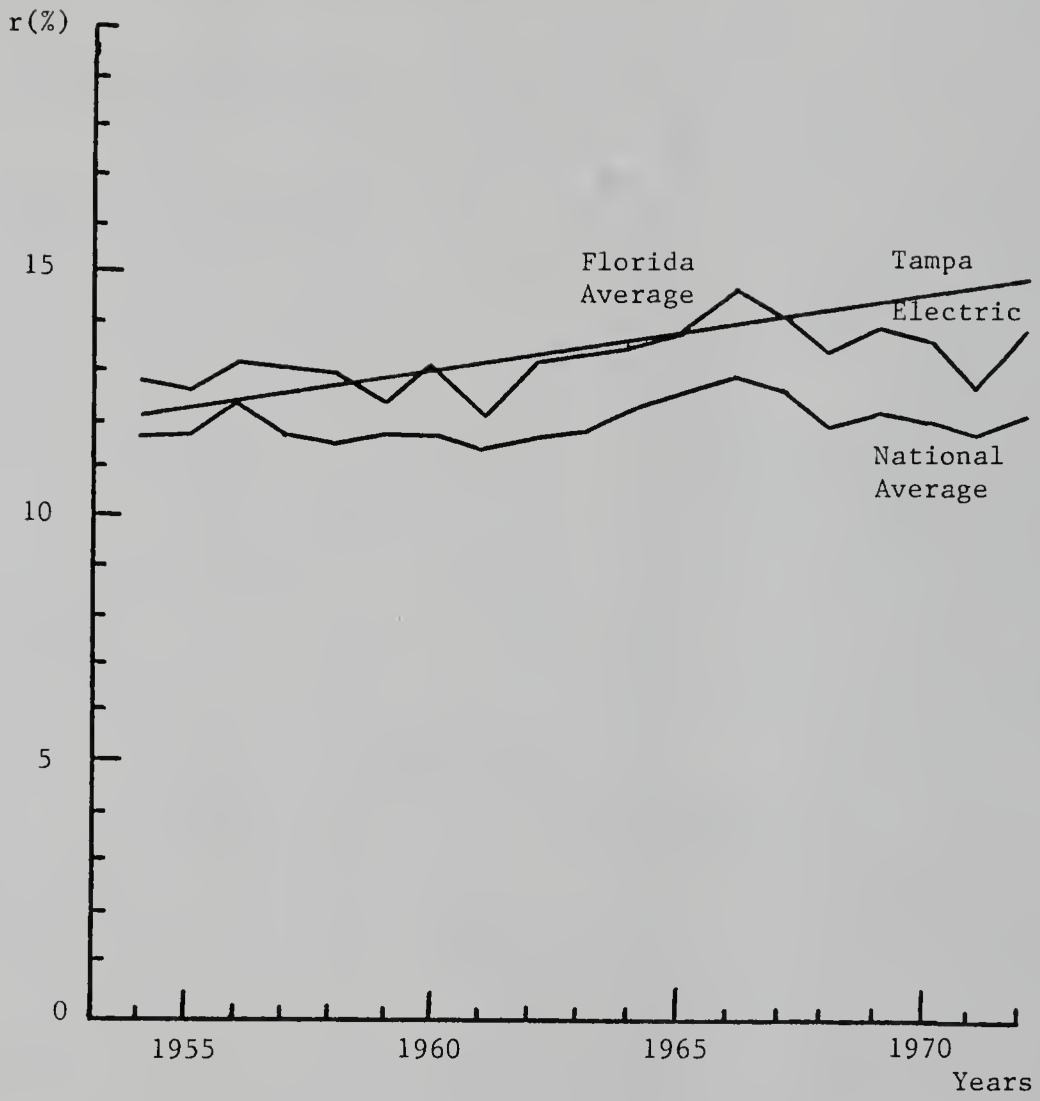

Figure 9: Rates of Return for Tampa Electric Company and Regional and National Averages.

Conditions: Tampa Electric Company data are normalized by least-squares regression.
The Florida average is the arithmetic average of data for three electric utilities.
The national average is the arithmetic average of 23 electric utilities from throughout the nation.

Source: Calculated from the Compustat Annual Utility Tape.

shows that Tampa Electric Company's rate of return has historically fluctuated about the Florida average, sometimes higher and sometimes lower. One would expect that any individual firm would tend to follow the jurisdictional average rate rather closely, perhaps with some adjustment for relative riskiness as reflected in the debt ratio, so if the individual firm's return were to diverge from the jurisdictional average, the regulating body could be expected to take steps to bring the company back into line.

Debt ratio

The debt-to-total asset ratio is another factor that influences the level of rates of return. Higher debt ratios imply higher risk because of higher fixed interest payments, and lower coverage ratios. Thus, a firm with higher than average debt could be expected to have a consistently higher than industry or jurisdictional average rate of return, and conversely for a firm with a lower than average debt ratio.

Putting the factors together to estimate r

Many factors have been mentioned as having an influence on the formation of investors' expectations. The investor, trying to assess future earnings prospects for a given firm, would presumably look at all of these factors, pull them together in some fashion by assigning weights to each reflecting their relative importance, and reach a projected value for the rate of return, r. This process might be formalized, rigorous, and consistent, or it might be quite informal and impressionistic. Institutional

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that it is a necessary premium needed to attract capital to companies growing more rapidly than the national average, that it reflects low "quality" earnings representing in large part an allowance for funds used during construction, or all of these factors. We have not analyzed *why* the differential existed.

investors are likely to make relative formal estimates, individual investors to make informal judgment (although individuals could base purchase decisions on analysts' recommendations, which might, in turn, be based on formal analysis.) If we knew the factors and weights used in the aggregate by investors at any given point in time, then we could incorporate these factors into a model to estimate r, which could then be used in the market/book model for one particular year. If these aggregate assessments and weights were known to be stable from year to year, the same evaluation procedure could be used annually. Correspondingly, they could be altered to reflect known shifts in the estimation parameters. Unfortunately, neither the variables nor the weights are known for sure, so our estimated values for expected r could differ markedly from those of investors. Such differences would cause the calculated and actual M/B ratio to differ.

The Retention Rate

As with r, we are really concerned with future retention rates, but lacking clairvoyance, we can only form expectations and estimates of future values. Investors presumably begin with past retention rates and, as a first approximation, assume that similar levels and trends will continue in the future. Upon closer examination, they may discover that b appears to be a direct function of the rate of return, that is, $b = f(r)$. This is a reasonable expectation in view of the fact that many companies tend to maintain a reasonably stable dollar dividends per share over time, with occasional increase, while trying to avoid decreases. Thus, in a year when the rate of return rises, yet dollar dividends stay the same, the retention rate would rise, and conversely when the rate of return falls. A firm with wide fluctuations in earnings would generally pay out a low proportion of earnings to be sure that its dividends are protected from having to be reduced in years when earnings are low. Consequently, firms with unstable earnings often have higher retention rates than those with more stable earnings. This factor would be reflected in past data and could be expected to continue into the future, barring drastic changes in the nature of the firm or its product market. Since the retention rate is subject to random fluctuations, the least-squares technique can be used to normalize retention rates; thus, past retention rates were regressed against time, and the normalized values were used as proxies for investors' expectations of the effective rate.

The past and expected future growth of the firm's demand should also be taken into consideration when determining expected values for b. If, for example, a firm has been experiencing rapid growth for some period, and had a had a high retention rate during this time, it apparently was using a large portion of its earnings to finance the expansion. If a slower growth rate is forecast for the future because demand is leveling off, then the company's financing needs would probably diminish, allowing a higher portion of earnings to be paid out as dividends. Under such circumstances an investor might reasonably anticipate lower retention rates to accompany lower growth rates.

The debt-to-total asset ratio may affect the retention rates of different companies. A firm with a higher debt ratio than another would have a lower borrowing capacity, <u>ceterus paribus</u>, and it might be forced to finance a higher proportion of its capital needs through equity, and specifically by retaining earnings. Thus, a firm with a high debt ratio might also be expected to have a relatively high retention rate.

Growth Due to Sale of Stock

When a firm finds that retained earnings plus new debt are insufficient to meet its financial requirements, it must turn to external equity financing. Utility companies faced with a high growth in service demand and a capital intensive production process, are often in this situation, so outside equity financing does affect investors' expectations regarding utilities.

The variable s is defined as the growth rate in total book equity resulting from the sale of common stock. When funds are needed and sale of common stock is the method of financing decided upon, the number of new shares can be found by dividing the total dollars needed by the expected sales price of the stock. Let S be the total number of shares outstanding before the new stock is sold, and let B_o be the pre-sale book value per share. The total book value before the stock sale is then SB_o, and the amount raised by the sale is sSB_o. The number of shares that must be sold at price P_o, after a flotation cost of F percent, is:

$$\Delta S = sSB_o/P_o(1 - F).$$

We can rearrange this equation to show s is a function of the market/book ratio, P_o/B_o and the percentage change in the number of shares outstanding, $\Delta S/S$:

$$s = \frac{\Delta SP_o(1 - F)}{SB_o} = \frac{\Delta S}{S} \quad \frac{P_o}{B_o} \quad (1 - F).$$

If, for example, shares were increased 10 percent, with a market/book ratio of 2.0 and a flotation cost of 10 percent, then s would be 18 percent (.10 x 2.0 x .9 = .18). If the M/B was 1.0, then s would be nine percent

(.10 x 1.0 x .9 = .09).[3]

If the rate of return and the retention rate are both high, so that much expansion is being financed through earnings retention, then s may be small, perhaps even zero. Further, companies tend to sell stock periodically, using changes in their debt ratios to take up the slack between equity issues so at times s will be zero for a few years, and then, in a year when common stock financing is undertaken, have a substantial value. Security analysts recognize this periodic equity financing, so they tend to use a smoothed or average annual s, rather than the actual values. In the M/B model, we need a long-run annual expected value for s rather than the on-again, off-again values actually observed.

Several alternative smoothing techniques might be used. First, we could use a least-squares regression to get a trend line over time, then use the predicted value for each year as the expected value of s. But, this procedure might not capture long-run expectations if there were long periods with no stock sales and occasional years with large stock sales.

A second alternative involves assuming that the target proporation of equity in the firm's total capitalization is a constant, or, as is more often stated, that the debt-to-total asset ratio is constant. With this assumption, the rate of growth of equity is the same as the rate of growth of debt, and, therefore, the same as the rate of growth of total assets. Since the total growth in equity comes from both earnings retention, br, and sale of stock, s, this rate is the sum of the two parts, br = s.

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[3]Note, however, that the relationship is not causative: s is not determined by the M/B; rather, s is determined by the amount of financing needed. Thus, s is specified exogenously in the derivation of ΔS and survives further derivations to play an important role in the final M/B ratio.

Given the assumption of a constant debt-to-total asset ratio, total asset growth, G, equals the equity growth rate. That is, G = br + s. Hence, s can be calculated as s = G - br, where G is the change in total assets during period t divided by the asset value at the beginning of the period, and b and r are determined as previously described.

Under the second procedure, s is a residual dependent upon the total asset growth, the retention rate, and the rate of return; given values for these variables, s is automatically determined. The really critical issue is the asset growth rate, G. Consider an electric utility. Its demand depends primarily upon population growth, industrial use, introduction of new, electricity-consuming appliances and equipment such as air conditioning, upon the general health of the economy, and upon the price of electricity. Electricity has historically been thought of as rather price inelastic. However, the recent energy crisis has led to a reconsideration of the elasticity question. Usage of electricity has declined, perhaps because of rising prices but also perhaps because of a patriotic desire to conserve energy.

If price elasticity is low, then we can conclude that factors exogenous to the model determine utility demand, i.e., that finding s as a residual is valid. Since utilities have a responsibility to serve all demands presented to them, their total asset growth is an exogenous variable, determined by growth in demand. Plant expansion must occur at a rate which will enable the companies to meet the public's demand. Total asset growth, G, is not limited to growth that can be financed through earnings retention, br; if G exceeds br, then retained earnings must be supplemented by sale of debt equity. Although new bonds and new common stock are not always issued simultaneously, compaines try to maintain a fairly consistent debt-equity relationship over time. Hence, it does not seem unreasonable to assume a constant debt-to-total asset ratio and to calculate $s = G - br$. We must, of course, have reasonably good values for G, b, and r if our estimate of s is to be a good one.

Actual values for G vary from year to year, since large plant additions occur in certain years while lesser growth takes place in others. Accordingly, most security analysts use an average growth rate in their projections. This average growth rate can be proxied, for each utility, by running a least-squares regression of G against time. The predicted value from the regression equation is a good first-approximation estimate of the long-term asset growth rate. Trends are not always continued, however, and analysts might recognize that during any given period of time even normalized values of G could differ from the long-run growth rate needed in a model such as Equation 15. Suppose, for example, that during a sample period a particular company's G is 25 percent. No analyst would project such a high growth rate; rather, he would constrain G to a more reasonable (lower) level.

Flotation Costs

Flotation costs are represented in Equation 15 as the variable F, which includes all costs associated with a new issue of common stock expressed as a percentage of the equity capital thus raised. The percentage flotation costs associated with issuing new stock affect the M/B ratio because a portion of the new dollars invested in the firm is absorbed as an issue cost, thus is not available for the purchase of productive assets. Flotation costs depend upon a number of factors. First, the larger the size of the issue, the lower the percentage flotation cost other things the same. Thus, very large firms generally lower percentage costs than smaller companies simply because their stock issues are larger. The reputation of the company and the strength of the stock at the time of the issue also affect flotation cost. A temporary depression in stock price resulting from the pressure of a new issue in the marketplace is considered a part of the flotation cost. This element of cost may not exist if the firm is in favor with the investment community so that the demand for the stock is sufficient to offset the increase in supply caused by the new issue. Such intangible elements of cost are difficult to ascertain on either an <u>ex ante</u> or an <u>ex post</u> basis. The security analyst, nonetheless, may anticipate a temporary price depression in forming expectations about the future value of a stock.

Another type of price depression is possible from the issue of new stock: there may be a gradual price decline due to a gradually increasing supply of stock brought about by frequent trips to the market. This cost is not a flotation cost in the sense intended in Equation 15, because it is not associated with one particular issue. Instead, the investor would recognize this erosion of earnings as an additional risk and would, accordingly, require a higher rate return in order to be induced to invest in or to maintain a position in a given equity security.

The total costs of flotation expected to accompany future stock issues, as seen by the potential investor, would be the proper value to use in calculating the percentage flotation costs, F, for use in Equation 15. With this variable now defined, one may turn to the remaining variable in the model, the investors' required rate of return.

<u>The Required Rate of Return</u>

The rate of return required to attract capital plays an important role in the determination of the market/book ratio. This required rate of return is expressed as follows:

$$k^*_k = R_F + P_i. \qquad (16)$$

Here k^*_i is the required rate of return; R_F is the risk-free rate of return, and P_i is a risk premium.

Long-term government bond yields are used as the risk-free rate. Government bonds are risk free in the sense of being free from default risk. If one buys a long-term government bond and holds it to maturity, he knows exactly what his cash flow will be over the life of the investment. Since he knows these cash flows with certainty, there is no risk involved.

Several factors influence the risk premium. First, the general nature of the business in which the firm is engaged would be considered. Since we are dealing with regulated utilities, an analyst would narrow the field further to the specific type utility, for example an electric power company. Closer examination would reveal that the processes by which some firms operate are different from those of others and may affect their riskiness. A firm that uses nuclear power to generate electricity may face a different level of risks than one which, for example, generates electric power in fossil fuel.

Political risk is particularly important to regulated utilities. Each company is limited in its freedom to increase prices, in the services is offers, and the territory it serves. In many instances the regulatory officials are publicly elected, a situation which causes direct political pressure to enter into the regulatory process. In addition to the risks inherent in regulated businesses, political risks are brought to bear through external groups organized to support such causes as environmental protection.

Once the levels of business and political risks have been determined, the analyst will consider the firm's financial risk. Financial authorities agree that a company's cost of equity capital is functionally related to the level of debt in its capital structure. The exact nature of the function has been the subject of considerable discussion during recent years.[4] One may generalize that increased debt in the capital structure accentuates the variance of earnings, thus causing increased risk to the owners of the firm. To compensate for the increased risk brought about by the use of financial leverage, investors require higher returns from more highly levered firms, *ceterus paribus*. An analyst would consider a firm's debt/total asset ratio as a guide to the individual company's risk *vis-a-vis* other firms in the same industry with the same business and political risks. He would then presumably adjust his required rate of return upward if the firm's debt ratio were above industry average and downward if it were below industry average. The precise amount of the adjustment would be largely a matter of judgment. The potential investor might receive assistance or at least gain assurance from the bond ratings published by Moody's Investors Services, Inc. and Standard and Poor's Corporation. The risk classifications reflected in the bond ratings could be extended to encompass the risk of returns to common equity.

Having considered the above risks, the analyst will decide upon a risk premium. The sum of the riskless rate and the risk premium is the required rate of return. If investors can reasonably expect to receive this required rate, they will commit funds to the firm; otherwise, they will not. Equation 1 states this proposition symbolically and is referred

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[4] See J. F. Weston and E. F. Brigham, *Managerial Finance*, 4th ed. (New York: Holt, Rinehart and Winston, Inc., 1972), Appendix A to Chapter 11, pp. 337-40, for a discussion of "The Leverage Controversy."

to as the capital market line (CML). From year to year (or period to period) the capital market line may shift vertically and may change slope, as illustrated in Figure 10.[5] If the riskless rate, R_F, rises, while the risk premium, P_i, remains unchanged, then the required rate of return, k^*_i, will rise by the same amount as the risk-free rate. The risk premium for any class of risky assets, however, need not remain constant over time, and it can change the slope of the capital market line whether or not R_F changes. Alternatively, an individual security can change from one risk class to another as economic conditions and financial factors within the company change.

Suppose, for example, that in 1954 investors were willing to accept 2.53 percent riskless return and required an additional premium of 0.40 percentage points for utility company bonds rated AAA by Moody's. The required rate on AAA utility bonds would be 2.93 percent, corresponding to the point located by k^*_{1954} and AAA_1 in Figure 10. Using these two points, we can construct the capital market line CML_{1954}. The rate of return required on the common stock of a utility with AAA rating would be somewhat above the rate required on the firm's bonds.

Between 1954 and 1965, the average utility's debt ratio fell from 66 percent to 61 percent; see Figure 11. This reduction in financial leverage was largely responsible for a reduction in risk premiums on AAA utility bonds: the average risk premium was down to only 0.29 percentage points in 1965. The slope of the capital market line was correspondingly

[5] In this dissertation, we do not treat explicitly that body of theory known as the Capital Asset Pricing Model. No attempt is made herein to measure risk by beta coefficients; rather, more traditional measures of risk are employed.

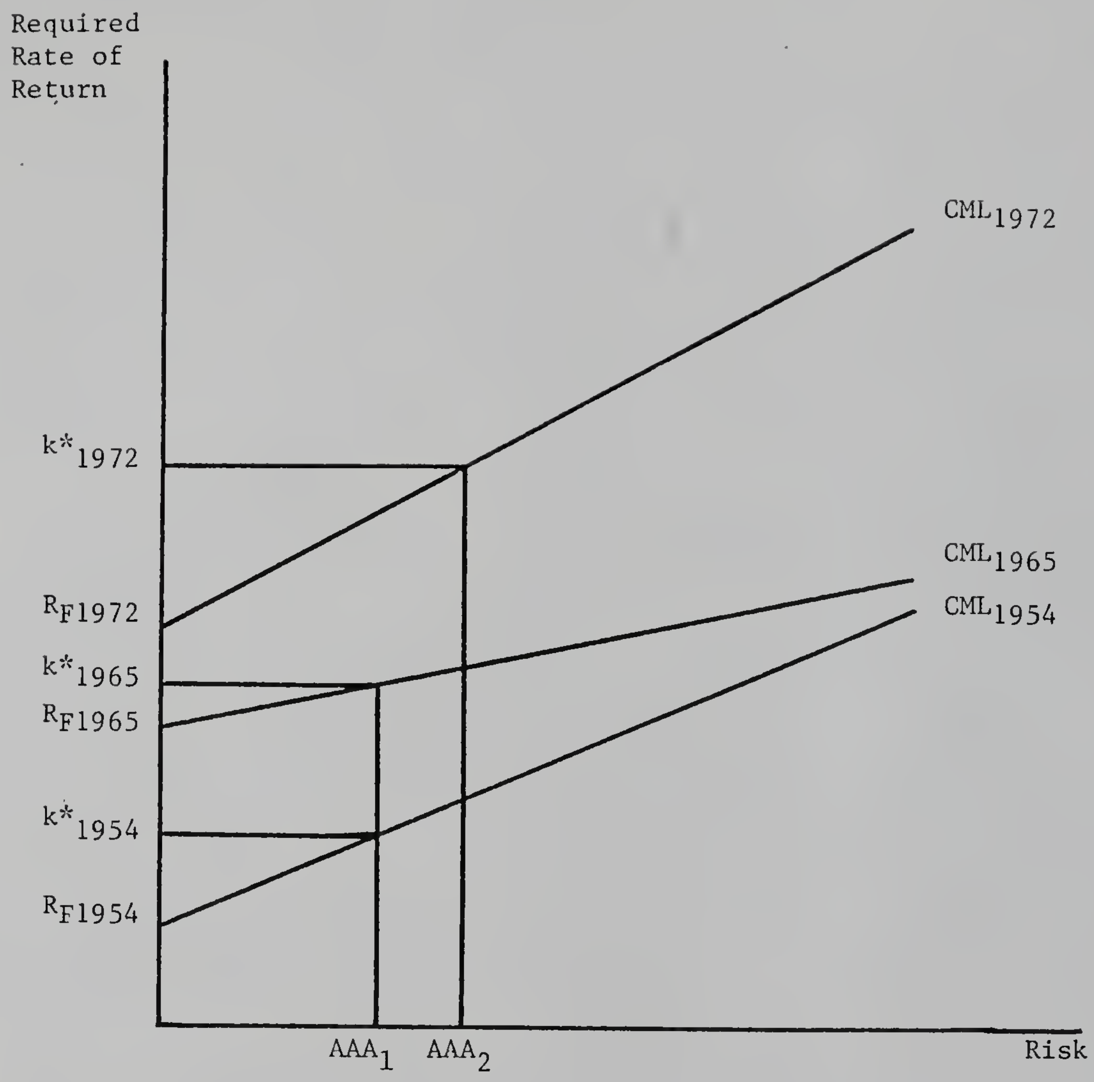

Figure 10: Hypothesized Shifts in the Capital Market Line.

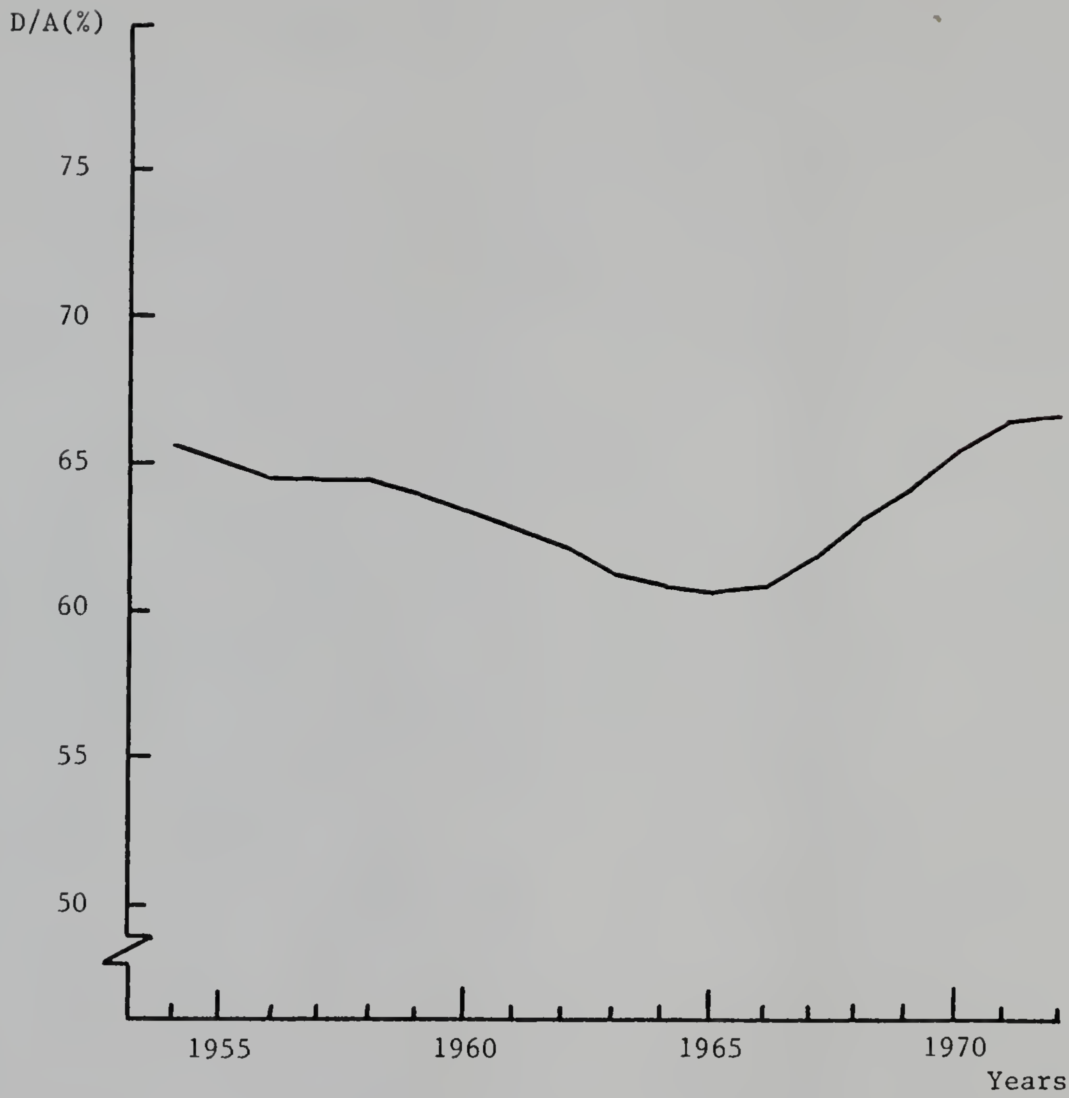

Figure 11: Electric Utility Industry Average Ratio of Total Debt to Total Assets.

Conditions: Total debt includes preferred stock.
The industry average consists of data from 23 electric utility companies.

Source: Calculated from the Compustat Annual Utility Tape.

less steep during that period. The risk-free rate, however, had increased to 4.21 percent by 1965 so that the total return on AAA utility bonds was 4.50 percent. Accordingly one can see that the capital market line indicated by these figures shifted upward and decreased in slope between 1954 and 1965 to a position like CML_{1965}.

By 1972 the riskless rate had risen to 5.63 percent and the risk premium on AAA utility bonds to 1.83 percentage points, producing a total required return of 7.46 percent. Assuming the designation AAA represented the same level of risk in 1972 as in 1965, these data indicate that the capital market line shifted upward and increased in slope between 1965 and 1972. The industry average debt ratio also increased to 67 percent during this period, resulting in bond downgradings; both factors suggest that the industry, on average, was being perceived as increasing in risk, i.e., moving out the horizontal axis and up the CML of Figure 10.

The degree of riskiness attributed to AAA utility bonds vis-a-vis alternative investment opportunities probably increased to a position such as AAA_2 in Figure 10. During 1965 AAA utility bonds yielded 0.05 percentage points more than AAA corporate bonds, whereas by 1972 the yield spread had increased to 0.49 percentage points as shown in Table 2. This change might indicate that the risk differential between utility bonds and corporate bonds increased between 1965 and 1972; alternatively, it might simply reflect the fact that utilities were, during this period, borrowing much more heavily than industrials, and an excess supply of utility bond in an imperfect market might account for the difference.

Although the exact interchange of risk and return between these classes of securities is unknown, it is reasonably certain that the average utility security moved outward to a higher risk level by 1972. A

TABLE 2

YIELDS-TO-MATURITY FOR MOODY'S AAA UTILITY BONDS AND AAA INDUSTRIAL BONDS DURING THE PERIOD 1954 - 1972.

Average Percentage Yields-To-Maturity

Year	AAA Utility Bonds	AAA Industrial Bonds	Yield Spread
1954	2.93	2.82	0.11
1955	3.09	3.00	0.09
1956	3.39	3.30	0.09
1957	3.96	3.76	0.20
1958	3.87	3.61	0.26
1959	4.49	4.27	0.22
1960	4.47	4.28	0.19
1961	4.37	4.21	0.16
1962	4.35	4.18	0.17
1963	4.27	4.14	0.13
1964	4.42	4.32	0.10
1965	4.50	4.45	0.05
1966	5.19	5.12	0.07
1967	5.58	5.49	0.09
1968	6.22	6.12	0.10
1969	7.12	6.93	0.19
1970	8.31	7.77	0.54
1971	7.72	7.05	0.67
1972	7.46	6.97	0.49

Source: Moody's Bond Survey (September 30, 1974), and Moody's Industrial Manual (1970), (New York: Moody's Investors Service, Inc.).

combination of three factors--an increase in the riskless rate, an increase in the slope of the capital market line, and an outward shift of utilities as a risk class--consequently caused investors to require higher returns from utility securities than in previous years. All of these factors would enter a potential investor's analysis of the securities markets and would affect his expectations about future returns and return requirements. The solution finally reached would be used for the required rate k* and, assuming capital market equilibrium, for the expected rate of return $\dot{k}$ in Equation 15; thus, these factors would affect market/book ratios.

Ex Post Variables

The preceding discussion has centered on the ex ante variables which should be used in Equation 15 to predict market/book ratios. Because of the nature of the variables, all of which are based on investors' expectations about the future, they cannot be determined exactly from ex post data. Still, expectations are based in part on historical data, so we need to find out what data are available and how they may be used to approximate the desired ex ante values.

One cannot look backwards to a past year and determine exactly what investors' expectations for the future were at that time. Financial records, however, reveal the occurrences which did take place, namely, the income statements and balance sheets for public utilities are available. A large amount of data has been accumulated by Standard and Poor's Corporation in the Compustat Annual Utility Tape for use with computerized analysis. The tape provides annual income statement data and year-end balance sheet data. Using the available data, we may approximate the needed variables as closely as possible.

Each value needs to be calculated as of some point in time. Considering which point in time to use--for example, end-of-year, middle-of-year, or beginning-of-year values--brings up the fact that certain variables are flow variables, whereas others are stock variables. Earnings (a flow variable), for instance, are generated over the course of a year; whereas book value (a stock variable), is measured as of a particular date. Should the rate of return on book value be calculated on the basis of the book value as of the first day of the year or as of the last day of the year when the earnings were produced from assets all during the year? Should the market/book ratio be calculated with data representing only one point in time? This association of flow and stock variables may generally be acceptable, but in an instance where, for example, a firm doubles its asset holdings in one year, perhaps through purchase of another company, the earnings flow is not actually generated from the asset base as measured exclusively at either the beginning or the ending of the year. Misleading values could emerge under such conditions. In anticipation of this problem, the set of test values was calculated using averages of beginning and end of year data. The market price for any given year, for example, is taken as the sum of the closing price of the prior year and the closing price of the current year divided by two. Average book values and average total asset values are calculated similarly. Although the Compustat data bank includes 20 years of data, 1953 through 1972, the above averaging procedure reduced the number of observations for each variable to 19, covering years 1954 through 1972.

The market/book ratio is calculated as the average price for the year divided by the average book value per share for the year. The book value per share is calculated by dividing the total book value by the number of shares of common stock outstanding. This calculation and the others which follow are summarized in equation form in Table 3. Since averages of year-end per share data are used in this ratio, the values must be adjusted for any stock splits or stock dividends which took place during the year, because sensible averages could not be obtained otherwise.

The actual rate of return on book equity is calculated as the earnings available for common stockholders during the current year divided by the average book value for the year.

Dividends and earnings are available on the tape and are used to calculate the retention rate. The dividend payout rate is calculated by dividing the dividends for the year by the earnings for the year. The retention rate is then found by subtracting the dividend payout rate from unity.

The rate of growth in total assets is found by dividing the change in total asset value from the beginning of the year to the end of the year by the beginning asset value. The rate of growth in total book value from the sale of stock is the growth rate in total assets minus the product of the retention rate times the realized rate of return.

The debt-to-total asset ratio is calculated as the sum of annual average long-term debt, short-term debt, and preferred stock divided by their sum plus the book value of common equity. The sum of year-end figures for each component is divided by two to get the average value for each year; however, since this division occurs in both the numerator and the denominator, the twos cancel out and would be redundant in the equation given in Table 2.

The _ex post_ variables must be further refined after they are taken from the tape but before being used for empirical testing. To better approximate the _ex ante_ variables described earlier, one needs to estimate

TABLE 3

EQUATIONS USED TO CALCULATE EX POST VALUES OF THE VARIABLES IN EQUATION 14 DIRECTLY FROM THE COMPUSTAT ANNUAL UTILITY TAPE.

Definitions of Symbols

M/B = market/book ratio
P = price per share of common stock
BV = total book value of equity
S = number of shares of common stock outstanding
r = actual rate of return on book equity
b = retention rate
E = total earnings available for common shareholders
D = total dividends paid
G = rate of growth of total assets
s = rate of growth of total book equity from sale of stock
A = total asset value
D/A = ratio of total debt, including preferred stock, to total assets
LTD = value of long-term debt
STD = value of short-term debt
PFD = value of preferred stock
t = time period (year) t.

The Market/Book Ratio

$$M/B_t = (P_{t-1} + P_t)/(BV_{t-1}/S_{t-1} - BV_t/S_t).$$

The Actual Rate of Return on Book Equity

$$r_t = E_t/[(BV_{t-1} + BV_t)/2].$$

The Retention Rate

$$b_t = 1 - D_t/E_t.$$

The Rate of Growth in Total Book Value From Sale of Stock

$$G_t = (A_t - A_{t-1})/A_{t-1} \quad \text{and}$$

$$s_t = G_t - b_t r_t.$$

TABLE 3, continued

The Debt/Total Asset Ratio

$$D/A_t = \frac{LTD_{t-1} + LTD_t + STD_{t-1} + STD_t + PFD_{t-1} + PFD_t}{LTD_{t-1} + LTD_t + STD_{t-1} + STD_t + PFD_{t-1} + PFD_t + BV_{t-1} + BV_t}$$

an expected value or trend line value for the realized rate of return on equity, the retention rate, and the total asset growth rate. The annual values for each of these variables were regressed over time (years) using the least-squares technique with the equation form y = a + bx in the Regression Analysis Program for Economists.[6] The actual values and the normalized or predicted values are illustrated in Figure 12 and enumerated in Appendix H for Florida Power Corporation. The normalized values represented by the straight line are the values used in subsequent testing for the realized rate of return and the retention rate. The total asset growth rate appears to need additional constraining before it is relied upon as a long-term estimate of growth for the utility firm.

Although certain companies such as Florida Power Corporation encountered total asset growth rates in the range of 10 to 15 percent, normalized, it seems unrealistic to assume that such growth will continue indefinitely, or that investors expected a continuation of such rates of growth. In all likelihood their ex ante expectations should be more closely aligned with longer term growth rates of population, gross national product, or electric power production. A total asset growth rate of six percent per annum was judged to be a reasonable long-term growth expectation for the "average" firm in the electric power industry.[7] In order to recognize individual differences among companies, a functional relationship was hypothesized in form of Equation 17.

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[6]William J. Raduchel, Regression Analysis Program for Economists, Version 2.7 (Harvard University, February 22, 1972).

[7]Calculated from data presented in Cohen and Zinbarg, p. 254. Clearly, the asset growth rate, measured in dollars, is dependent upon the rate of inflation in utility plant construction costs. During most of the period studied, construction costs were not going up rapidly, and the inflation that was taking place was being offset to a degree by economies of scale that served to keep capital costs per unit of service reasonably constant.

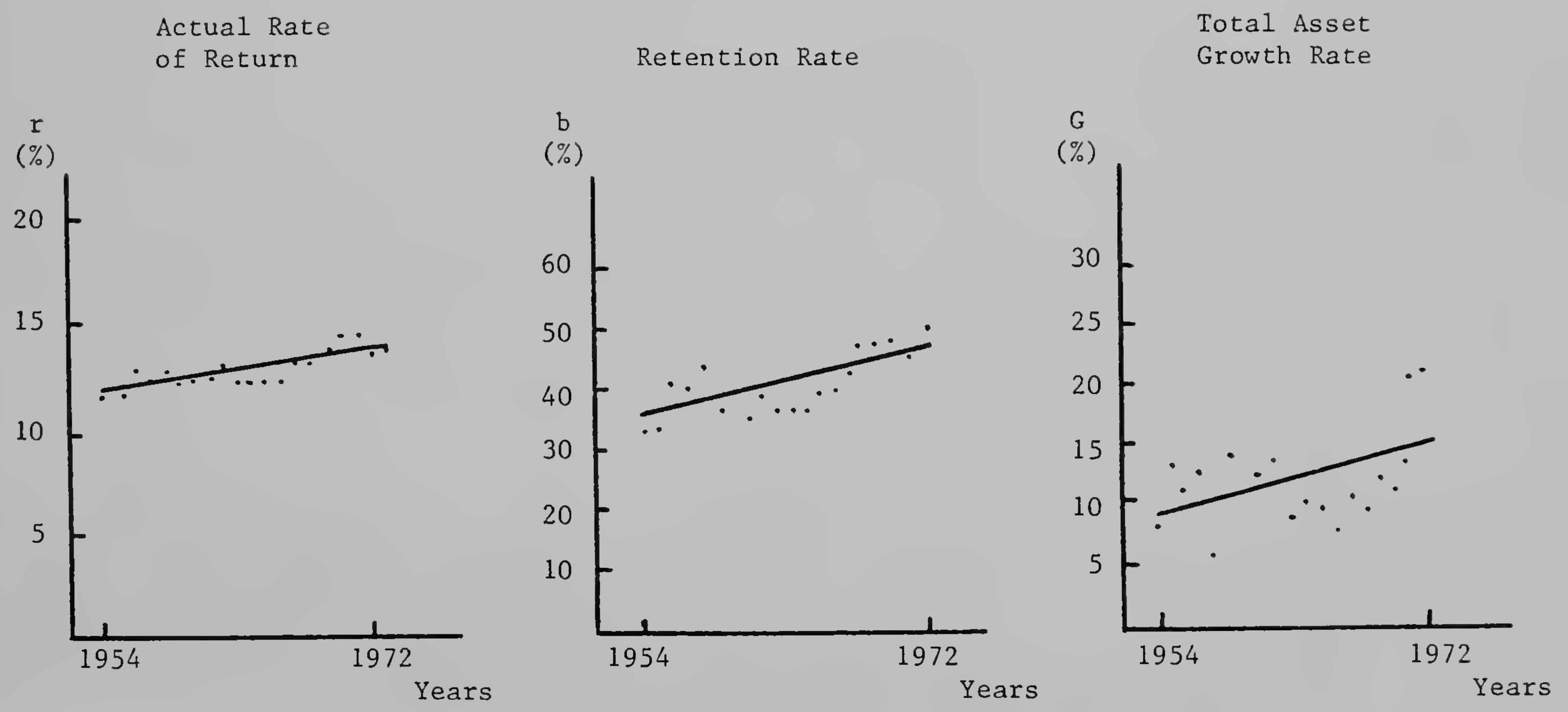

Figure 12: Comparison of Normalized and Actual Data for Florida Power Corporation.

Source: Calculated from the Compustat Annual Utility Tape.

$$G = G_I + a(G_i - G_I). \tag{17}$$

Here G is the growth rate used to approximate the ex ante rate from the determined long-run industry growth rate, G_I, and adjusted for the individual firm's actual growth rate, G_i. If the company's growth is greater than the projected long-term industry growth, then the estimated G is increased by a proportion, a, of the difference, and decreased if the individual firm's rate is less than the average. The proportion of the difference used in subsequent calculations is 60 percent; that is a = 0.60. The resulting G is then used to calculate the growth rate in total book equity due to sale of stock, s.

The final variable that needs to be estimated before values can be substituted into Equation 15 is the required rate of return, k*. As shown in Figure 10, the required rate is composed of a risk-free return plus a risk premium associated with the individual firm. The yield on AAA utility bonds represents the minimum yield acceptable to investors for the level of risk faced by the least risky utility bonds. This yield, averaged for each year, is available in Moody's bond survey and is used as a proxy for the riskless rate in subsequent calculations.[8] To this AAA bond yield a risk premium must be added to approximate the return required to the "average" firm's common stock. Then, since each firm represents a separate set of risks, each must have an individual risk premium that may be more or less than the industry average. Perhaps the key distinguishing feature in risk determination during the 1950s and

[8]Even AAA corporate bonds are not riskless, so the risk premium used for equity in the subsequent analysis is somewhat lower than it would be had U.S. Treasury securities been used to represent the riskless rate.

1960s was the debt ratio. In order to take into account this important variable, the model used to generate risk premiums adjusts the "average" risk premium according to the firm's debt ratio. This is accomplished by determining the industry average debt ratio and multiplying the assigned industry premium, P_I, by the ratio of the firm's debt ratio to the industry's debt ratio, as indicated in Equation 18:

$$k^*_i = R_{AAA} + P_I \left[\frac{(D/A)_i}{(D/A)_I}\right]. \tag{18}$$

This adjustment has the effect of increasing a firm's risk premium if its debt ratio is above industry average and decreasing the premium if the ratio is below the industry average.

With the data needs outlined above, the next step is to choose a sample of firms with the necessary data.

Selection of the Sample

Some regulatory jurisdictions require that rate base valuation be based on original cost, while others allow "fair" value in rate base determination.[9] Only firms in regulatory jurisdictions using original-cost valuation of assets for rate purposes are used in the sample. Inter-company differences in earnings and prices arising from rate base valuation differences are likely to be minimized by using only original cost companies. Further, many electric utility firms use accelerated depreciation methods for tax purposes, but the reporting of depreciation expenses to the public is not uniform throughout the industry. The

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[9] Alfred E. Kahn, The Economic of Regulation, Vol. I: Economic Principles (New York: John Wiley & Sons, Inc., 1970), pp. 32-35.

regulatory commission must decide whether tax savings from accelerated depreciation are to be "flowed through" to investors or "normalized" over the life of the investment. With normalization, the tax savings are level from year to year, while under flow through the tax savings are larger during the early years of the investment's life and smaller during later years. A firm with relatively new assets would flow through greater tax savings than a firm with relatively old assets, whereas the same two firms would report similar tax savings if the effects were normalized. For the sake of comparability, only firms using normalized depreciation tax savings are included in the sample.

A third criterion for company selection relates to the fiscal year used. Compatibility of fiscal years among companies in the sample is desirable in order to eliminate seasonal differences which might occur. Fiscal years ending on December 31 tie in with the Compustat market value data because all annual closing prices are calendar year end prices, not fiscal year end prices. Only firms with fiscal years ending December 31 were included in the sample of utilities.

The Compustat Annual Utility Tape has the electric utilities separated into two groups according to whether they use normalized or flow through depreciation tax reporting. The group using normalized data was screened for those companies with fiscal years ending December 31. These firms were then checked to be sure that all the necessary data was available before being included in the sample. The firms in the resulting sample were checked by hand against the Public Utility Reports to find those with original cost valuation of the rate base. This final screening process left a sample of 23 electric power firms to be used in the ensuing empirical tests. The firms in this sample are listed in Appendix G.

Least-Squares Regression Analysis

This section explains the use of least-squares regression analysis to establish whether or not statistically significant relationships exist among the variables estimated *ex post* for use in Equation 15. Results of this analysis are summarized in the text, and the regression statistics are presented in detail in Appendix I.

The Regression Equation and Results

A least-squares regression using historical, cross-sectional data assigns weights (coefficients) to each independent variable considered. The resulting t-values indicate whether or not each independent variable is statistically significant in determining the dependent variable, the market/book ratio in this case. A least-squares regression minimizes the expected value of the squared error in prediction, and all predictions are forced to be on the resultant equation line. The regression coefficients serve to correct systematic measurement errors in the independent variable. For example, if there were a systematic downward bias in estimating the values of the growth variables, the net contribution of growth in determining M/B ratios would not be diminished; instead, the value of the regression coefficient would be increased enough to offset the measure error.

The coefficient of determination, R^2, for the regression equation shows the amount of variation in the dependent variable which is "explained" by the independent variables in the sample. However, R^2 is known to be a positively biased estimate of the true coefficient of determination for the underlying population. "...(T)he bias in R^2 is no greater than the ratio of the number of independent variables to the number of observations in the sample.[10] For the sample of 23 electric utilities, the maximum bias would be 4/23 or 0.1793. The Barton coefficient of determination, $\bar{R}^2$, is corrected for this bias and presents a more reliable estimate of the explained variation.[11]

In order to determine an appropriate mathematical form for the equation to be used in the market/book problem, one may examine the theoretical relationships within a relevant range of values. Given hypothetical, but reasonable, values, Equation 15 approximates linearity as depicted in Figure 13. Constant asset growth is assumed in order to obtain this result. In view of this relationship, the following regression equation form was chosen:

$$M/B = B_0 + B_1 r + B_2 b + B_3 G + B_4 (D/A) + \varepsilon \qquad (19)$$

The dependent and independent variables are identified in the previous section of this chapter as ex post approximations of the desired, but unobtainable, ex ante variables. The intercept term, B_0, and the coefficients, B_1, B_2, B_3, and B_4, are to be determined from the data through the least-squares regression, and ε is an error term. This equation is reminiscent of several stock price models tested by Gordon, Friend and Puckett, and Bower and Bower,[12] in that they also considered price or price used in a ratio as the dependent variable and various measures of earnings, dividends, leverage, and growth as the independent variables.

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[10]D. B. Montgomery and D. G. Morrison, "A Note on Adjusting R^2", The Journal of Finance, Vol. 28, No. 4 (September, 1973), p. 1011.

[11]A. P. Barton, "Note on Unbiased Estimation of the Squared Multiple Correlation Coefficient", Statistica Neerlandica, Vol. 16, No. 2 (1962), pp. 151-63.

[12]H. Russell Fogler, Analyzing the Stock Market: A Quantitative Approach (Columbus, Ohio: Grid, Ind.), 1973, pp. 179-92.

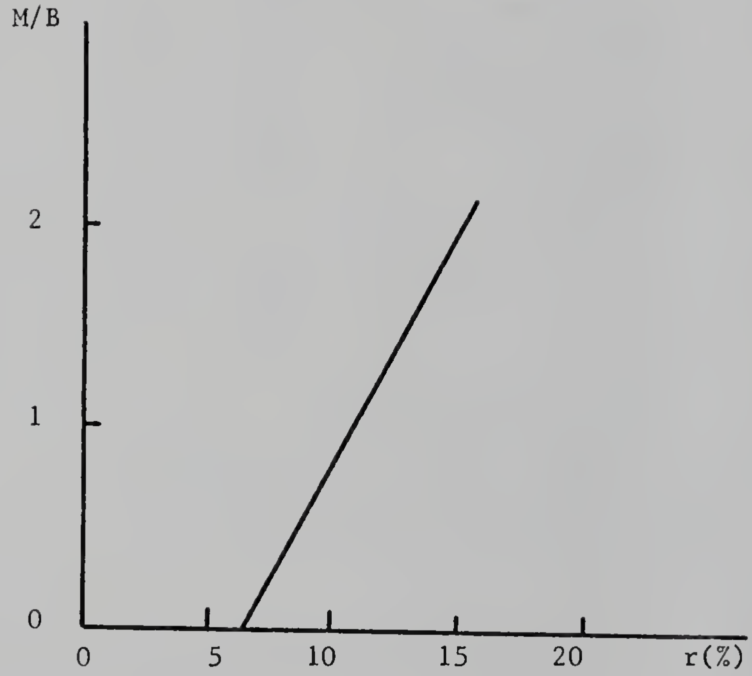

Figure 13: Market/Book Ratios Approximating Linearity.

Equation: $$M/B = \frac{r(1 - b)(1 + s)(1 - F) - s(1 + k - br)}{(k - br - s)(1 - F)}$$

Conditions: k = 10.5%
b = 40.0%
G = 6.0%
F = 10.0%

The data tested in Equation 19 are taken from the Compustat Annual Utility Tape in the form illustrated earlier in Figure 7. The market/book ratio, M/B, and the debt ratio, D/A, are used as extracted from the data bank. The realized rate of return, r, is normalized over the 19-year test period, as are the total asset growth rate, G, and the retention rate, b, before being used in the regression. The process of normalization by least-squares regression of the variable against time was explained previously in this chapter.

A cross-sectional regression was performed on the data for 23 companies during each of the 19 years in the period 1953 through 1972, inclusive, using the Regression Analysis Program for Economists.[13] The resultant Barton's coefficients of determination ranged from 0.5836 in 1972 to 0.7614 in 1964, indicating that the independent variables explained between 58.36 percent and 76.14 percent of the variation in the market/book ratio in all years. In 12 out of the 19 years, 70 percent or more of the variation was explained by the independent variables, as indicated by the regression statistics presented in Appendix I.

T-values indicate the significance of each independent variable in predicting the dependent variable, assuming that the multicollinearity between variables is insignificant.[14] The t-values in Appendix I show that the normalized rate of return, r, is a significant determinant of the market/book ratio, M/B, in each of the 19 years at the 0.10 level. The retention rate, b, and the debt ratio, D/A, are significant in only six

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[13] William J. Raduchel, Regression Analysis Program for Economists, Version 2.7 (Harvard University, February 22, 1972).

[14] The correlation coefficients among the independent variables were found to be generally insignificant as shown in Appendix N, so multicollinearity does not present a problem in the regression analysis.

years and two years, respectively. Apparently b and D/A are less important in investors' analyses and evaluations of stock prices than is r.

The total asset growth rate, G, was significant and positively related to the M/B ratio from 1953 through 1968. The maximum t-value for G occurs in 1961, after which time its magnitude decreases gradually until it becomes insignificant in 1969 and 1970, and then the coefficient turns negative during 1971 and 1972. Reference to Figure 16 in Chapter 4 shows that the average market/book ratios for electric utilities declined steadily from 1965 through 1972. As the M/B fell, the contribution of G to the regression fell, and it finally became negative. This finding supports the theoretical position that growth is desirable and exerts a positive pressure on price when a firm's M/B is greater than unity, and is undesirable, having a negative effect on price when a firm's M/B is less than unity.

Potential Problems in Regression Analysis

The results of a regression analysis can be invalid if the data do not meet certain requirements. One of these requirements is that multicollinearity does not exist among the independent variables. Fortunately, the simple correlation coefficients among the independent variables indicate that multicollinearity is not a significant problem in this study. (See Appendix J.) Another potential problem is spurious correlation. The fact that both the dependent variable, M/B, and the independent variable, r, have the book value per share as the denominator could cause spurious correlation; that is, the reported correlation between M/B and r might be unduly influenced by their common denominator. In the case under consideration, one would expect a high degree of correlation between price and earnings per share, the numerators of M/B and r. The correlation between M/B and r consequently cannot be attributed to the division by book value, and the potential problem of spurious correlation appears not to be an issue in this case.

Empirical Tests with the Model

In this section market/book ratios are calculated using the M/B model, and these predicted values are compared to the actual values by regressing the latter against the former. The results are summarized in the text, while the detailed tables are presented in Appendices O and P. The sensitivity of the model to variations in the data is discussed in order to show the importance of careful data specification.

Market/Book Ratio Calculations

By now one realizes that Equation 15 is a model based on *ex ante*, or expected, data. It is impossible to look to historical data to determine exactly the values that investors were expecting for a particular period of time. One is able to observe the values of the rate of return earned on stockholders' equity and the retention rate for a given year in the past. Normalization of these variables over the 19-year test period in order to approximate investors' expectations was discussed previously. The firm's asset growth rate was normalized over the test period, but it was tempered with the estimated long-run growth for the industry of six percent while allowing for individual company growth rates according to Equation 15.

The rate of return required by investors, k*, was determined by Equation 16, using Moody's AAA utility bond rate as the "risk free" rate. An average risk premium for the industry was assigned each year, and the individual company's premium was above or below the industry average according to whether its debt ratio was above or below the industry average for the period. The industry average risk premium was chosen as described below. Flotation costs were assumed to be ten percent of the issue price to allow for both underwriting charges and underpricing "pressure" when common stock is issued.

Calculations were performed with data from the sample of 23 companies, and these predicted M/B values are compared to actual values for 1972 in Appendix K and for 1970 in Appendix L. Moody's AAA utility bond rate, which averaged 7.46 percent during 1972, was used as the risk free rate of return in determining k. The risk premium was varied from approximately 3.0 percent to 4.6 percent, causing the industry average required rate of return to vary from 10.5 percent to 12.1 percent. The predicted M/Bs were sometimes quite close to the actual M/Bs, but sometimes they were not. Regressing the predicted M/B values against the actual values gave Barton's coefficients of determination that ranged from 0.5828 to 0.6004. The highest $\bar{R}^2$ occurred when the risk premium was set at 4.28 percent; assuming the M/B model expressed in Equation 15 is a valid representation of the way M/B ratios are determined, the average risk premium for the sample companies' common stock in 1972 was about 4.28 percent.

Using Moody's AAA utility bond rate of 8.31 percent for 1970 and varying the risk premium as in 1972 caused the industry average required rate of return to vary from 11.3 percent to 12.9 percent. The resultant M/Bs are compared to the actual M/Bs in Appendix L, where one finds that Barton's $\bar{R}^2$ ranged from 0.4761 to 0.5057. In this set of calculations the $\bar{R}^2$s increased as the risk premium decreased, so that the highest $\bar{R}^2$ resulted from the lowest premium.

The fact that higher coefficients of determination occurred with higher risk premiums in 1972 than in 1970 suggests that the slope of the capital market line increased from 1970 to 1972, that the risk of the industry increased, or both. In reality, both events probably occurred.

Sensitivity of the Model

Equation 15 is extremely sensitive to small changes in the values of the variables, particularly r, G, and k. Since the denominator contains the term (k - br - s) and since G is assumed to equal br + s, the M/B can become extremely large as G approaches k; it can be undefined if G equals k; or it can become negative if G exceeds k. Constraining G to a long-term expected value relieves the problem but does not do away with it entirely. The model is also sensitive to changes in b and F, but to a lesser degree.

As an illustration of the intricacies involved, consider the following example: Letting r = 11.9 percent, b = 33.7 percent, k = 10.0 percent, s = 4.5 percent, and F = 10.0 percent, results in M/B = 1.99, as calculated from the model. Reducing k by one percentage point to 9.0 percent causes M/B to increase to 6.15. Holding k at 10.0 percent while increasing s to 5.5 percent causes M/B to increase to 3.77. One can see that the correct specification of variables is of utmost importance when attempting to use this model. Because of the relationship between k and G, the model was more prone to produce abnormal M/B ratios for firms with unusually high growth rates than for firms with lower growth rates.

Cost of Capital Calculations

Discounted cash flow techniques are often used in regulatory proceedings as a method of determining the cost of equity capital for the firm. Although the calculations in the prior section were directed at specifying the market/book ratio, Equation 15 could be used to calculate the cost of equity capital, k, as shown in Appendix M. To accomplish this end, the observed market/book ratio would be used as input data to the equation, and k would be calculated. This procedure is potentially useful, but since the M/B model does not predict actual M/B ratios very well--the R^2 values were in the range of .47 to .60--which is not sufficient for one to place a great deal of reliance on the outcome of either M/B or k.

Summary

This chapter discusses the theoretical ex ante variables upon which the discounted cash flow valuation model is based. Since investors' expectations, per se, are not observable historically, this chapter presents data which the potential investor might consider in forming his expectations about the future. As with all DCF models, the specification of expected future values requires a substantial degree of judgment. The judgments presented in this chapter are, of course, open to both criticism and refinement.

Data was gathered for a sample of electric utilities normalizing depreciation tax savings and operating in original-cost rate base jurisdictions. The data was fitted to regression Equation 19, and M/B ratios were calculated using Equation 15. The predictive power of the regression equation was superior to that of the M/B model as evidenced by the coefficients of determination. The linear multiple regression equation explained between 58 percent and 76 percent of the variation in M/B ratios, but calcuations using Equation 15 explained only some 48 percent to 60 percent of the variation.

Both equations point to the fact that the allowed (or actual) rate of return and the asset growth rate are the most significant determinants of the M/B ratios. The most serious problem encountered in the use of either equation is that of data specification; whereas the potential dangers of multicollinearity and spurious correlation appear to be minor with this sample. Equation 15 is highly sensitive to small variations in input data, so anyone attempting to calculate market/book ratios, allowed rates of return, or costs of capital with it or a similar model, as might be done in rate cases, should use caution and judgment.

CHAPTER 4

TOWARD A "FAIR" MARKET/BOOK RATIO

Economic theory suggests that unity is a fair M/B arising from the return to capital achieved by a firm operating under pure competition in a noninflationary setting. However, since inflation is a fact of life, this conclusion is of limited value in an uncertain, oligopolistic, inflationary world. The ability of a utility to attract new capital in an uncertain economic environment without unduly harming its existing stockholders is a critical consideration in fairness to consumers as well as to owners and is one of the criteria for fairness established in the Hope case.[1] The ratio of the market price of a firm's stock to its book value offers some practical guidance toward fairness, and the M/B ratio is widely recognized in the financial community as being a significant variable.

This chapter examines the competitive market approach to regulating a natural monopoly, i.e., one with decreasing long-run average costs, and we suggest a similar application of the principle in the increasing-cost case. The problem of capital attraction is then discussed in terms of consumers versus investors. The difficult problem of inflation and how it may be dealt with through accounting practices are then aired. Finally, a practical approach to using an M/B model in the regulatory process is presented along with an acknowledgement of certain problems which may be

[1] FPC v. Hope Natural Gas Company, 320 U.S. 591 (1944).

encountered in its use in a rapidly changing economic environment.

Competitive Market M/Bs

This section first examines the studies of Myers[2] and Leland[3] relating the economic model for natural monopolies (decreasing long-run average costs) to the competitive, and therefore fair, rate of return in utility regulation. Later in the section we delve into the competitive market approach to regulation of monopolies facing increasing costs.

The rate of return that would exist in a competitive market is proposed as "fair" by Stewart C. Myers,[4] and ideal regulation would eliminate monopoly profits and force the firm to accept the competitive return. Regulation may, however, eliminate monopoly profits without reaching the competitive solution of investment, output, or prices. Nonetheless, if the aim of regulation is to eliminate monopoly profits, then "Regulation should assure that the average expected rate of return on desired new investment is equal to the utility's cost of capital."[5] This principle follows from defining "fair return" in terms of the competitive model since the equilibrium return to capital is precisely the amount required to attract capital to that industry or firm. Myers specifies that this principle is strictly an *ex ante* concept and that the existence of a competitive market does not require expectations to be realized for any asset.

To implement this concept of fair return, the regulatory authority

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[2]S. C. Myers, "The Application of Finance Theory To Public Utility Rate Cases", The Bell Journal of Economics and Management Science, Vol. 3, No. 1 (Spring 1972), pp. 58-97.

[3]H. E. Leland, "Regulation of Natural Monopolies and the Fair Rate of Return", The Bell Journal of Economics and Management Science, Vol. 5, No. 1 (Spring 1974), pp. 3-15.

[4]Myers, pp. 79-80.

[5]Myers, p. 80.

would, with no lag, set prices so that total expected revenue equals the sum of expected operating costs and depreciation, plus a fair return to capital. The return to capital would be the product of the firm's cost of capital measured at the beginning of the period times the rate base at the start of the period. The rate base would have to represent the competitive market value of the firm's assets, that is, the value of the assets in long-run equilibrium in a competitive market. The competitive market value is the original cost of the assets less economic depreciation, whereas book value is original cost less accounting depreciation. A fair solution will not result using the accounting book value unless it equals the competitive market value. In practice, rate base valuation remains a thorny problem.

Using the competitive market return as the fair return has the advantages of (1) allowing a low cost of capital, since investor-borne risk is small, and (2) ease of administration. Rate cases would be frequent but routine. Disadvantages are (1) that all uncertainty about operating costs is borne by consumers even though this allocation of risk may not be optional, and (2) that little incentive is provided for efficiency in operating or capital budgeting procedures. Conscious use of regulatory lag, however, could provide the needed incentive for efficiency with this approach to regulation.

A similar approach was taken by H. E. Leland when he proposed the following definition:

> A "fair return" to capital is a pattern of profits across states of nature just sufficient to attract capital to its present use, which is equivalent to the stock market value of the firm, V, equalling the value of the firm's assets, K^o.[6]

[6]Leland, p. 7.

He frames his presentation in terms of a naturally monopolistic industry, that is, one which has long-run decreasing average and marginal costs, as shown in Figure 14. Although monopolies often achieve an efficient use of inputs, given a level of outputs, they often do not achieve an efficient level of output. From the viewpoint of social welfare they produce too little, q_m, and charge too much, p_m, as determined by the intersection of the marginal cost and marginal revenue curves. The regulators would choose to limit the firm's price to p* and force it to produce quantity q*, as determined by the intersection of the average cost and demand curves.

In a competitive environment under long-run equilibrium the return to suppliers of capital is exactly the amount needed to keep capital in the industry. If π^* were the competitive return and K^o were the total book value of the firm, then the corresponding "fair" return r would be $r = \pi^*/K^o$. The total market value of the firm, V, could be determined by $V = \pi^*/r$. Thus the market value equals book value in the competitive, long-run equilibrium model. If the unregulated monopoly earns excess profits of π_m then its market, π_m/r, is greater than the competitive (and book) value, π^*/r, since $\pi_m > \pi^*$.

Leland develops the argument that although this solution is from a certainty model, similar results obtain under uncertainty. If the expected competitive profit pattern were $\varepsilon(\pi^*)$, then the expected fair rate of return would be $r^* = \varepsilon(\pi^*)/K^o$. Risk aversion on the part of investors will require a higher expected profit from a riskier firm to generate the same market value as a less risky firm. Leland states that a regulatory agency "would be ill-advised" to limit expected returns to r*, for the results would be neither technical efficiency nor maximal output. Allowing

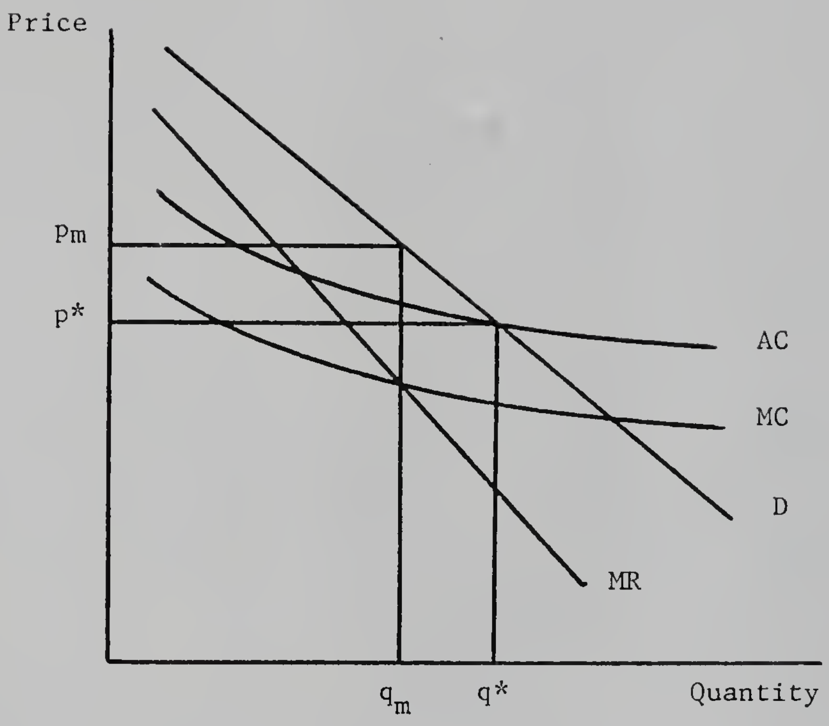

Figure 14: Revenue and Cost Curves for a "Natural" Monopoly.

Source: H. E. Leland, "Regulation of Natural Monopolies and the Fair Rate of Return," The Bell Journal of Economics and Management Science, Vol. 5, No. 1 (Spring 1974), p. 8.

some rate of excess profits greater than r*, which also allows market value to exceed book value during regulatory lags, may be an effective incentive for introduction of new technology. An admitted problem in the implementation of competitive market regulation is specifying competitive market values of assets.

In summary, both Myers and Leland used economic models for natural monopoly and pure competition, imposing the profit level of the latter on the former as a means of determining the fair return; that is, they say the monopoly is earning a fair return if all "excess" profits have been eliminated by regulation. Using the profits, thus determined, along with the competitive market value of the firm's assets, they determine the fair rate of return long sought by regulatory agencies. The market value of the utility's assets will necessarily equal their competitive market value. Both authors recognize that determination of the competitive market value of assets is a major, unsolved problem faced in rate cases. The rate base (asset value) usually accepted is an accounting-determined value, sometimes with an *ad hoc* adjustment intended to bring it nearer a replacement value. Practically speaking, this proposal would force the M/B to unity. Myers and Leland also recognize additional problems involving uncertainty and incentives for efficiency.

Capital Attraction

In order to consider the capital attraction standard set forth in the Hope case, it may be useful to discuss the economic interdependence between consumers of utility services and suppliers of capital, and their mutual dependence upon regulatory commission. Carleton pointed out a wealth distribution problem in applying a price-determined allowed rate of return to an accounting-determined book value of equity.[7] The discounted cash flow (DCF) procedure used in many rate decisions today estimates a cost of equity capital, k, that is constant over time because this assumption is in the estimation procedure. If this k is then taken as the allowed rate of return (k.e., $r = k$), and if expectations are realized over time so that r does, indeed, equal k, then the market price would equal the book value per share at any time as long as all asset growth is financed through retention of earnings.

Fluctuations in investor expectations may occur throughout time and cause fluctuations in the M/B. If these fluctuations in k (the cost of equity capital or the required rate of return) are small and around the assumed "constant" value of k, then the accompanying fluctuations in M/B would be transitory. The regulatory body would not try to correct short-term inequalities between price and book value by adjusting the allowed rate of return to fulfill temporarily changed expectations. A problem of circularity would emerge rapidly if r were adjusted to equal k on a short-term basis, for the capital market's valuation of the firm's risk could be altered by the regulatory decision. A change in risk class would change the rate of return, k, required to induce investors to furnish capital to the utility. If the regulating body again adjusted r to meet the new k, one could only expect another movement in k, followed by a compensating adjustment in r, and so forth.

With the assumptions of a constant k and expectations that are realized, one could calculate a pro forma book value, B_t, for any time, t, given the information r, B_{t-1} and D_t, as $B_t = B_{t-1}(1 + r) - D_t$. This one-period

[7]W. T. Carleton, "Rate of Return, Rate Base and Regulatory Lag Under Conditions of Changing Capital Costs", Land Economics (July 1974).

model can be generalized to

$$\overline{B}_t = B_0(1 = r)^t - D_1(1 + r)^{t - 1} - D_2(1 + r)^{t - 2} - \ldots - D_{t - 1}.$$

This procedure determines a rate base, $\overline{B}_t$, founded on investors' expectations rather than on accounting values. $\overline{B}_t$ would seem to be an appropriate base for use with a rate of return determined from investor expectations. Actually, both the rate of return required by equity investors and the rate base are determined jointly over time. Regulatory practice determines each separately. In rate cases, k and r are regularly updated to market conditions, while the rate base is left at book value.

The procedure for calculating both the allowed rate of return and the rate base from market values has economic appeal but conflicts with legal precedent set in the Galveston case.[8] The most prominent argument against after-the-fact allowance for k in constructing the rate base is that it capitalizes "'earnings deficiencies',"[9] which reduces risk to owners (stockholders) and reduces managerial incentives for efficiency. Suppose, for example, that the mean value of k shifts permanently to some value $\overline{k}$, and there is a one-period lag before r is adjusted to equal $\overline{k}$ (i.e., r does not equal k for one period); then the market price, P_t, does not equal book value per share, B_t, for one period. The market price will be less than or greater than book value according to whether r is less than or greater than $\overline{k}$. The resultant "effects through earnings retention and reinvestment in rate base assets will be permanently capitalized into B_t from period 2 onward."[10] If the change in k is an increase, as in the

[8] Galveston Electric Co. v. City of Galveston, et al., 258 U.S. 388 (1922).

[9] Carleton, p. 5.

[10] Carleton, p. 6.

case of inflation, for example, then the investors suffer a loss of earnings permanently foregone because of the application of an allowed rate of return to the now-undervalued rate base.

In the quest of fairness, should these costs be borne by the stockholders alone? Or should the cost be borne by the customers of the utility? Or should it be shared by investors and consumers? Contrast the situation of the shareholders of a utility with that of the owners of an unregulated firm, who generally accept the risk of such losses as a matter of course. The management of an unregulated company has an obligation to protect the investment capital supplied by the stockholders by improving operating efficiencies and raising prices, as it perceives the capital markets' required rate of return rising. If conditions persist so that a particular product or service is no longer profitable to a company, management may choose to discontinue that product or service in the best interests of the owners of the firm. Any time that management fails in its efforts to maintain the value of the firm's capital, the losses accrue to the stockholders. The equity owners knowingly accept the risk of capital losses when they accept the potential for capital gains and future dividends.

Similarly, the management of a rate-regulated firm has an obligation to protect the investment of its stockholders. Management has also been considered, traditionally, to have the additional obligation to serve all demand requirements presented to it. This obligation arises in part from the lack of alternatives available to the consumer, since there are neither feasible substitutes nor other suppliers in a monopolistic situation. When events exogenous to the firm's control cause the market's mean required rate of return to rise permanently, e.g. from k to $\overline{k}$, management must try to increase the company's return accordingly. Often they must concentrate on seeking cost savings, because the option of raising prices is delayed by the regulatory agency or blocked entirely, but if the firm was operating efficiently before the change in k, then it simply cannot cut costs to raise r. Unlike the unregulated firm, a utility seldom has the luxury of discontinuing a service that becomes unprofitable. Because of the restraints under which utilities operate, and the dual nature of their responsibilities, managements sometimes must make decisions giving higher priority to consumer interests or regulatory policy than to the interests of the stockholders. In view of the fact that management is not always allowed to work for the stockholders' best interests, can these investors be expected to absorb all losses which occur? This question, essentially, is the one posed by Carleton. His proposal for calculating a rate base from investor expectations answers that the consumer should share the cost.

There is, of course, another side to the coin. Where the mean expected rate of return on equity shifts permanently <u>downward</u>, through no fault of management, the additional profits earned during the lag before the allowed rate of return is adjusted downward are shared between the consumers and equity owners under Carleton's plan. His position should be commended for recognizing the changing economic environment and the inadequacy of traditional regulatory procedures to deal fairly with the attendant problems.

Assuming that the investors in a utility company continue to accept the potential dividends and capital gains in exchange for the risk of capital losses, the expected rate level and resultant M/B should be important considerations in their decisions to commit funds to the enterprise. Selling new stock when the M/B is less than 1.0 results in the attribution of previously existing stockholders' wealth. Yet the new stock owners get a fair deal; they obtain the going market rate on their funds. If the sale of stock at a price below book value is regarded as a one-time-shot, then the firm should be able to attract new capital even when the M/B is less than 1.0. However, if recurring sales are expected, then the current "new stockholders" will be among the old stockholders next go around, and they will suffer capital losses. If there is uncertainty about the possibility of new below-book sales, investors will recognize this risk and account for it by increasing their required rates of return, k.

Since certain firms can and do attract new capital even when their M/Bs are less than 1.0, one must wonder just how low the M/B could go before new investors would cease to find the potential gains attractive, and old investors would demand that assets be liquidated. AT&T, for example, could surely have a successful stock flotation even if its M/B were 0.8; but, whether or not it could successfully sell new stock if its M/B were 0.2 is an open question. Presumably the lower limit for attracting capital is M/B = 0.0, since stock "sold" at a price of $0.00 per share attracts no capital whatever. Any accompanying flotation costs would reduce the existing capital.[11]

Even if the new investors find an investment situation attractive when the M/B < 1.0, is the attraction of their capital to the firm at the expense of the existing owners "fair" to these old owners? Management certainly has a responsibility to the owners of the firm, and a sale at less than book hurts the existing owners. A dichotomy of responsibility

[11]Actually, one can use the model expressed in Equation 15 to determine the feasibility of stock sales. Under any set of growth--rate of return--cost of capital conditions where M/B > 0, then stock sales would be useful so long as these sales did not exceed the amounts inherent in the calculated s value.

is apparent when a firm's management brings in new owners (i.e., issues new stock) to the detriment of the firm's original owners. This dichotomy exists when a public utility's management recognizes and accepts the obligation to serve the public's demands. The firm's rates are regulated so that it cannot increase output prices to improve the M/B; nonetheless, it needs additional capital to meet growing demands.

The regulatory agency, likewise, has a dual obligation--both to owners and consumers. The regulating commissions have often been considered guardians of the consumers, since their existence arises out of the possibility of economic exploitation by a state-granted monopoly. The responsibility of the regulators to the utility owners is clearly recognized in the broadly defined concepts of fairness in legal proceedings, such as the Bluefield and Hope cases.

Since management and the regulators share responsibilities for the welfare of both owners and consumers, which decision center is ultimately responsible for setting the M/B level, <u>ex ante</u>? Management has in its direct control several important variables, among which are the retention rate, the decision to sell or not to sell new stock, the initiative for encouraging cost efficiencies, and the choice of depreciation methods. Through these factors management exerts much control over the realized rate of return. The regulatory body, however, has authority over the actual rate of return earned, hence on the <u>ex ante</u> expected rate of return, which is, at least theoretically, the most significant of all controllable variables. It seems then that from a decision-making standpoint, the regulators bear major responsibility for a firm's market price and M/B.

Factors exogenous to these decisions also affect the market price and need to be taken into consideration. Among these are capital market line shifts, which are discussed in the inflation section of this chapter, and technological improvements. The latter can come within the scope of management decisions, for example, the decision to switch from fossil-fueled electric plants to nuclear-fueled plants when capacity increases are necessary. Management must, of course, recognize that their efforts may be hampered or thwarted by outside interests, such as environmental groups, and consider the attendant costs and risks in their decision processes.

Technological advances that produce substitutes, which tend to replace the good produced or service rendered by the utility, may fall outside the scope of decisions of either the management or the commission. But this risk is no different for regulated utilities than for non-regulated companies, so it creates no unique problem and is not important to the present analysis.

In summary, two questions raised and discussed, but not resolved, are: (1) "What is a 'fair' M/B?" and (2) "Should an M/B be different from 1.0 in an inflationary environment?" The thrust of several arguments is that a regulated utility's M/B should be great enough to allow for capital attraction. In non-inflationary time, an M/B of unity would be desirable were it not for flotation costs involved in selling new stock and temporary market price fluctuations. An appropriate M/B should be sufficiently above 1.0 to compensate for these two factors. Under conditions of inflation, the problem is more difficult and the answer less clear. With inflation, either a higher M/B should be tolerated or rate base adjustments should be made to recognize the combined effects of inflation and regulatory lag. The problems of inflation are discussed at greater length in the next section of this chapter.

Market/Book Ratios Under Inflation

Profit rates of unregulated firms tend to rise during inflationary periods because (1) the value of the dollar depreciates, causing higher dollar profits, assuming that both output prices and input costs rise proportionately, and (2) accounting-determined book value of assets is lower than replacement value. Firms in regulated industries, on the other hand, find it difficult to maintain profits levels and market/book ratios under inflation.[12] Regulation limits a utility's ability to increase its rate of return on equity, even during an inflationary period. It may not be able to sustain its market price or earn the opportunity cost of capital available to unregulated firms. "...(I)f the 'integrity' of the common stockholders' capital is to be maintained, the stock, in time of reasonably normal securities markets, must command an average market price sufficiently above book value <u>at least</u> to offset the decline in the value of the dollar. And since price is a function of earnings, regulation should allow sufficient earnings for this to happen.[13]

Functional Relationships

A firm should have a market value equal to its book value on the first day of its existence, if the individual assets have been correctly valued according to their expected future earning power. If this correct asset valuation is also the price actually paid and recorded for each asset, then the sum of these individual values should be the book value of the firm on the first day of the firm's existence, before depreciation charges have been incurred. Investors may, however, assess the future earnings prospects and risk for the firm as a whole at a higher or lower level than the total asset book value. In this case marginal investors may drive the

[12]Walter A. Morton, "Risk and Return: Instability of Earnings as a Measure of Risk", Land Economics, May 1969, p. 258.

[13]B. Graham, D. L. Dodd and S. Cottle, Security Analysis, 4th ed. (New York: McGraw-Hill Book Company, 1962), p. 597.

stock price either up or down according to their expectations. An illustrative case is that of Communications Satellite, whose common stock price climbed abruptly immediately following its initial issue. Investors apparently believed that the Federal Communications Commission would allow the company to earn more than its cost of capital. Investors evidently did not properly take into account the fact that Comsat is a regulated public utility. Eventually, as investors reassessed the situation, their enthusiasm declined, as did the stock price.[14]

In the absence of inflation and flotation costs, this first-day, one-to-one relationship between market and book values would continue as long as the firm earned exactly the rate of return required by equity investors. If, on the other hand, inflation were present, the M/B would be affected according to how the actual rate of return compared with investors' expectations. One can illustrate the consequences easily using the no-stock-sales, no-flotation-costs model developed in Chapter 2. Capital market theory describes the rate of return required by investors, $k*_i$, as a risk-free interest rate, R_F, plus a risk premium, P_i, applicable to a particular firm, i, at a particular point in time. This relationship, presented earlier as Equation 1, is known as the securities market line:

$$k*_i = R_F + P_i.$$

If $k*_{oj}$, R_{Fo}, and P_{oi} are the required rate of return, the risk-free rate, and the risk premium, respectively, when no inflation is expected, than an inflation premium, I_k, will have to be added when the threat of inflation becomes imminent. The securities market line can be rewritten as

[14]E. F. Brigham, Testimony before the Federal Communications Commission, Docket No. 16070, October 26, 1971.

$$k^*_i = R_{Fo} + P_{oi} + I_k$$

or

$$k^*_i = k^*_{oi} + I_k.$$

Turning to an individual company, and assuming security market equilibrium so that the expected rate of return, k, equals the required rate, k^*_i, one can drop the i subscripts to write

$$k = k_o + I_k \tag{20}$$

for a period of inflation.

This increase, I_k, can come from three sources: (1) an increase in the risk-free rate, (2) an increase in the risk premium, and (3) a change in the risk class of the company. The first source is explained by observing rising interest rates on Government bonds in periods of increasing inflation. The securities market line intercept shifts upward when this increase occurs. The investment community will explicitly acknowledge the securities market line shift by expecting higher rates of return on book value. Whenever possible, firms will raise prices and seek more efficient methods of operating to raise their dollar returns and rates of return on book equity.

A second source of potential increase in the required rate of return is the risk premium. It could increase because the market required a higher premium for all securities of the initial risk class involved, causing the slope of the securities market line to increase.

A third possible way for the required rate of return of a single firm to increase is for the market to judge that the firm has become more risky and to move it into a higher risk class. A utility may not be able to sustain its market price in the wake of inflation because of regulatory restrictions; that is, the regulators may either not recognize the securities market line shifts (intercept or slope) or not allow needed rate adjustments, or they may do so with long lags. This is the risk recognized by Morton when he discussed risk in terms of maintaining the value of invested capital.[15] A utility that is considered to have little risk in periods of stable prices might be considered more risky when prices are rising rapidly. Investors may recognize considerable political risk in that the regulatory agency may not allow output price increases sufficient to offset rising costs. Realization of this situation could cause a given utility to shift to a higher risk class.

All three inflation-induced increases in rate-of-return requirements are combined into the single inflation premium, I_k, as used in Equation 20.

Typically, the unregulated firm responds to rising costs by raising its output prices. When dollar profits increase faster than book value, the firm realizes higher rates of return. The utility must depend upon the regulatory agency to authorize price increases in order for it to increase its rate of return. If r_o is the preinflation allowed rate of return, then the firm's allowed return with inflation is:

$$r = r_o + I_r. \tag{21}$$

It is useful to examine the effects of inflation on the market/book ratio. We may approach this task by substituting the inflation-swelled rates of return of Equations 20 and 21 into the previously derived M/B equation,

[15] Morton, p. 254.

$$M/B = \frac{r(1 - b)}{k - br},$$

and then analyzing the effects. As a first example, let the rate of inflation expected by investors be I_k. Suppose this expectation causes the required rate of return on equity to become $k_o + I_k$. If the actual rate of return, r_o, does not respond at all, the M/B will fall, as inspection of the following equation reveals:

$$M/B = \frac{r_o(1 - b)}{(k_o + I_k) - br_o}.$$

The denominator increases while the numerator remains unchanged, causing the M/B to increase.

As a second example, suppose only the allowed rate of return rises by I_r, while the required rate, k_o, remains unchanged:

$$M/B = \frac{(r_o + I_r)(1 - b)}{k_o - b(r_o + I_r)}.$$

Inspection of this equation reveals that the numerator rises and the denominator falls, causing the M/B to rise.

As an example, assume both investors' expectations and allowed rates of return rise by the same amount, $I_k = I_r$:

$$M/B = \frac{(r_o + I_r)(1 - b)}{(k_o + I_k) - b(r_o + I_r)}.$$

One might expect no change in the M/B. However, this is true only if r_o equals k_o, i.e., M/B = 1.0. If r_o is less than k_o, then the M/B will increase upon the addition of equal increments to r_o and k_o, whereas the M/B will fall if r_o is greater than k_o.

The change in M/B resulting from a given increase in the required rate of return will not be exactly offset by an equal increase in the allowed rate of return unless r_o is equal to k_o, i.e., M/B = 1.0. Under conditions where r_o does not equal k_o, what inflation premium, I_r, must be added to the allowed rate of return in order for the firm to maintain its preinflation M/B after investors increase their return requirements by I_k? Appendix N shows that for the M/B to remain constant, the ratio of I_r to I_k must be equal to the ratio of r_o to k_o; that is, the following relationship must hold if a firm's M/B is to be unaffected by inflation:

$$\frac{I_r}{I_k} = \frac{r_o}{k_o} . \tag{22}$$

This relation holds for $r_o \gtrless k_o$, i.e., M/B $\gtrless$ 1.0.

For example, assume that the following conditions prevail for a utility: r_o = 11.00%, k_o = 10.50% and b = 40.00%. Using Equation 9, we calculate M/B = 1.08. Suppose economic conditions change so that investors required an inflation premium of I_k = 5.00%. In order for the firm to maintain its 1.08 market/book ratio, the regulatory agency must allow an increase, I_r, in the firm's rate of return calculated by Equation 22 as follows:

$$\frac{I_r}{.05} = \frac{.1100}{.1050} ,$$

$$I_r = 0.524 \text{ or } 5.24\%.$$

Under the stated conditions, the allowed rate of return must rise 5.24% to offset the downward pressure on M/B caused by a 5.00% rise in investor requirements. The post-inflation required rate of return will be 15.5% (k_o + I_k), and the allowed rate will be 16.24% (r_o + i_r), if the M/B of 1.08 is to be preserved.

The circumstances which actually arise in the operation and regulation of a utility may not meet the requirement set forth in Equation 22, so the resultant M/B will actually depend upon the extent to which the inflation premium is absorbed into r and k. An expanded numerical example might be helpful in clarifying these relationships.

A set of assumed conditions, and the resulting market/book ratios for a rate-regulated firm, are displayed in Table 4. The firm is assumed to have a constant retention rate of 40 percent, an initial required rate of return of 10.5 percent, and an initial allowed rate of return of 11 percent. In the first case, there is no inflation, so the inflation premiums are both zero, and the M/B is 1.08. If an inflation premium of five percent is requred by investors as in case 2, but the regulatory agency does not respond, causing the allowed rate of return to remain at the preinflation level, then the M/B plunges to 0.59.

In the third case, assume the regulators decide to allow only an M/B of 1.00. Using Equation N-3 from Appendix N, the regulators can calculate the response necessary to achieve this goal. Specifically, they would have to increase the allowed rate by 4.5 percent in order for the firm to be able to have an M/B of 1.00.

Case 4 shows the effect of allowing an increase in the return exactly equal to the increase in the required return. The firm can achieve an M/B of 1.05, which is lower than the preinflation level. Case 5 shows that for the utility to preserve its original M/B of 1.08, the regulatory authority must increase the allowed rate 5.24 percent. The agency can calculate this I_r from Equation 22 in the text.

If an M/B has been agreed upon, then this analytical procedure can assist the regulating body in the impact of inflation; the example in

TABLE 4

EXAMPLE OF HOW INFLATION AFFECTS THE MARKET/BOOK RATIO

$$M/B = \frac{(r_o + I_r)(1 - b)}{(k_o + I_k) - b(r_o + I_r)}$$

$b = 40.0\%$ $k_o = 10.5\%$ $r_o = 11.0\%$

Case	I_k	I_r	M/B
1	0	0	1.08
2	5.0%	0	0.59
3	5.0%	4.50%	1.00
4	5.0%	5.00%	1.05
5	5.0%	5.24%	1.08

Table 5 illustrates this point. The capitalization rate of ten percent is assumed for convenience of calculations and is constant throughout the example. Before inflation occurs, \$100 in equity is needed to produce goods and services worth \$100 in sales. After expenses of \$90, a \$10 profit remains. This profit is capitalized at ten percent to give a market value of \$100. Therefore, the market/book ratio is 1.0, and the rate of return on both book and market equity is ten percent.

Now suppose that all prices double, so that sales, expenses, and the investment required for new facilities all double. The unregulated company achieves a rate of return of 20 percent and a market/book ratio of 2.0 in the new economic environment. On the other hand, assume that the regulated company is allowed only a ten percent return on book equity; it can raise its prices only enough to generate sales of \$190, even though its expenses doubled to \$180. As a result, the regulated firm has a market/book ratio of 1.0 and a rate of return on book equity of ten percent.

Would this treatment of a regulated company be "fair" in the Hope sense? The owners of the regulated firm, who are forced to accept \$10 in profits with an M/B of 1.0, are not realizing earnings comparable to those of the owners of the unregulated firm, who recieve profits of \$20. The proposal that a utility's M/B should be 1.0 even under inflationary conditions seems to violate the Hope case concept of fairness.

The new company in Table 5 purchased its assets at inflated prices, so that its book equity is twice that of either old firm. Whether it is regulated to a ten percent rate of return or unregulated, the new company earns a \$20 profit and has an M/B of 1.0. In this case, the M/B equal to 1.0 does seem to meet the fairness criteria, because the owners get the same amount of postinflation purchasing power, \$20, as do the owners of the unregulated firm.

TABLE 5

MARKET/BOOK RATIOS AND INFLATION

	Book Equity	Sales	Expenses	Profit	Cap. Rate	Market Value	Market Book	ROR Book
Regulated or Unregulated Co. Before Inflation	$ 100	$ 100	$ 90	$ 10	10%	$ 100	1.00	10%
Unregulated Co. With Inflation	$ 100	$ 200	$ 180	$ 20	10%	$ 200	2.00	20%
Regulated Co. With Inflation	$ 100	$ 190	$ 180	$ 10	10%	$ 100	1.00	10%
New Co. With Inflation	$ 200	$ 200	$ 180	$ 20	10%	$ 200	1.00	10%

An illustration of how the market value of a firm can increase because of inflation is cited in Fortune. Assume that a steel company requires a return of ten percent to justify investment in a new plant with a capacity of five million tons per year. Costs in 1973 of borrowing money and constructing the plant would require an investment of about $500 per ton of shipping capacity. In order to earn the required ten percent return, the price of steel would have to be approximately $250 per ton, which was 25 percent higher than the prices prevailing at that time. If these increased prices were applied to products shipped from existing facilities, which cost an average of $275 per ton of capacity, the return on stockholders' equity could reach 25 percent.

This example was presented by an investment analyst to explain why "nobody either here or abroad can afford to install all the needed capacity unless prices do go up."[16] If one extends the example, he can see that the new firm, which earns exactly the required rate of return, would have a market value equal to its book value, i.e., M/B = 1.0. The older firm, however, would be earning more than the required rate and would have a market value above book value, i.e., M/B > 1.0. Apparently, practical people in the investment world recognize the relationship between rising input and output prices and a firm's ability to attract capital. This situation may or may not be thoroughly understood by many federal and state commissions responsible for regulating public utility product during inflation.

The market/book ratio of any particular firm confronted with an inflationary environment appears to be dependent on (1) its ability to preserve

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[16] Marilyn Wellemeyer, editor, "A Surprising Story in Steel", Fortune, December 1973, p. 64.

its profit margins by raising prices or improving efficiency and (2) the size of its preinflation investment compared with its postinflation investment. In the case of regulated utilities, the ability to raise prices is quite limited. The fact that most utilities have been operating for many years suggests large investment prior to recent infation. A somewhat contradictory, or at least offsetting, argument is that many of these same utilities have also been investing heavily in recent years to meet expanding demand. The pre- versus postinflation problem evades generalization. Extensive studies are needed to sort out and balance the facts.

Capital Values--Historical Considerations

The commingling effects of depreciation, length of asset life, and inflation on the "real or economic capital" of a firm were studied by George A. Christy and D. Terry Reitan. They point out that depreciation allowances are insufficient to replace utilities' plant and equipment at the end of its life cycle during inflation because "depreciation flows recover only invested dollars, not invested purchasing power."[17] A firm which has a large portion of its assets invested in short-term assets may be able to maintain most of its purchasing power through the rapid recovery of invested dollars. On the other hand, a firm like an electric or communications utility will lose purchasing power over the 20 or 30 year life of many of its assets. The replacement cost of a long-term asset may be two or three times the dollar amount recovered through depreciation. Managements are faced with the problem of raising enough extra

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[17]George A. Christy and D. Terry Reitan, "Inflation and the Mining of Utility Captal", presented at the annual meeting of the Financial Management Association, San Diego, California, October 1974, p. 2.

capital to make up the difference between the amount needed for asset investment and the amount made available through depreciation. Often they are forced to sell new stocks and bonds just to replace old assets without expanding service.

Industrial firms have a higher percentage of short-term assets, and they are unregulated so that they can raise output prices as costs and plant values increase. This leads to the expectation that the market/book ratios of industrials would be less affected by rapid inflation than are those of utilities and, as shown in Figure 15, this hypothesis is correct. The market/book ratios of two samples of electric utilities have declined since 1965, while the industrial sample's M/B has declined, increased, declined, and increased again with only a small overall change.

J. Rhoads Foster takes a different approach to the equity value problem by restating accounting book values in current-dollar terms to reflect the ravages of inflation. Current-dollar values are higher than accounting values according to the age of the firm's assets and the rate of inflation. Foster calculated ratios of the Consumer Price Index with 1972 as the latest year so that $CPI_{1972}/CPI_{1972} = 1.0000$, $CPI_{1972}/CPI_{1971} = 1.0330$, ..., $CPI_{1972}/CPI_{1954} = 1.5565$. Working with AT&T data, he multiplied the addition to capital in any given year by the CPI ratio for that year to get the current dollar value of the addition. The sum of the annual additions gives the total current dollar value of capital for the years summed.[18]

In this distribution, current-dollar book equity values were calculated for three samples of firms using book values from the Compustat data

[18]J. Rhoads Foster, "A Study of the Fair Rate of Return For Southern Bell Telephone and Telegraph Company, State of Florida", February 1973 (Washington, D.C.: Foster Associates, Inc.).

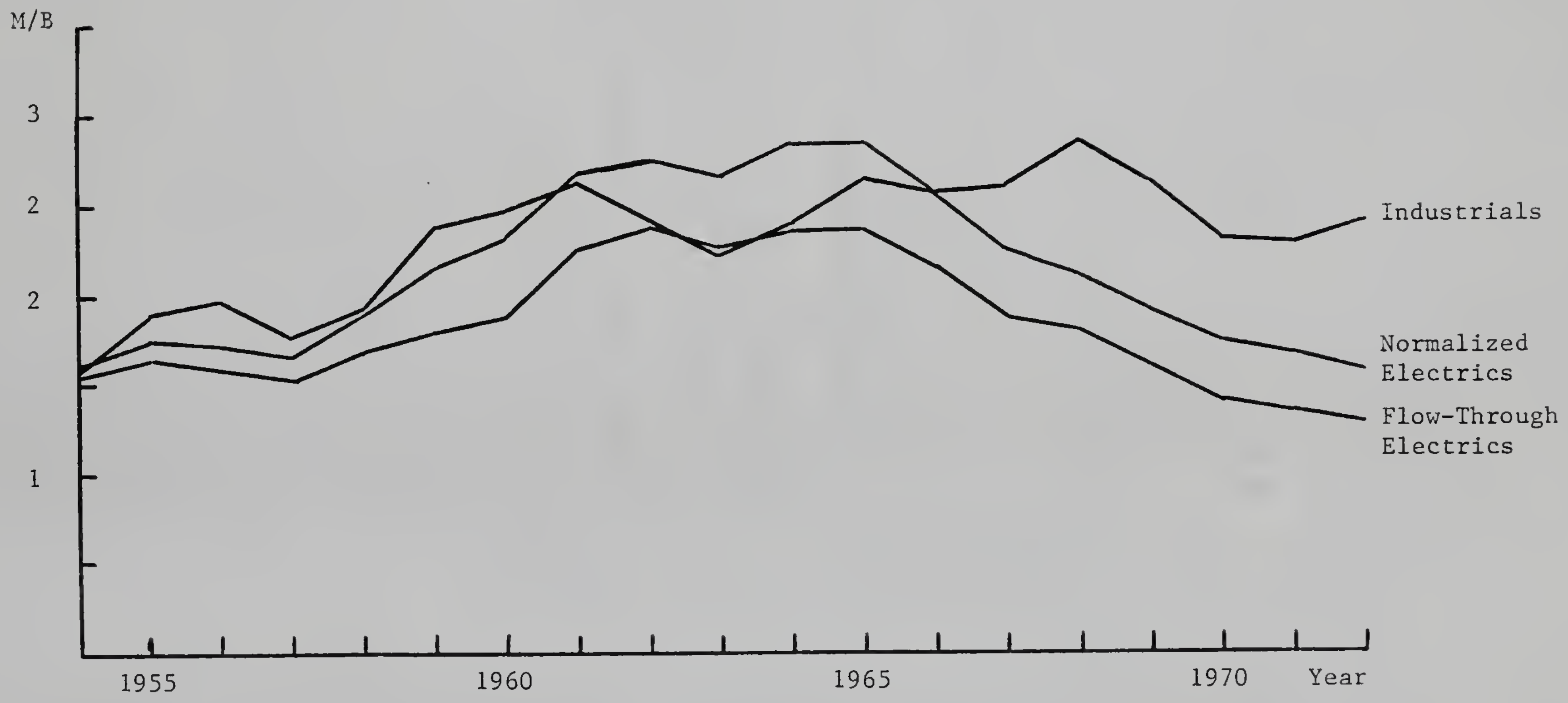

Figure 15: Trends in Market/Book Ratios.

Source: Calculated from the Compustat Annual Utility Tape and the Compustat Annual Industrial Tape.

tapes and the Consumer Price Index.[19] The samples were drawn from the Compustat classifications of flow-through electric companies, normalized electric companies, and industrial companies. These current-dollar equity values were then used to calculate annual average equity values, and the corresponding "market/book" ratios. Figure 16 gives a comparison of current-dollar market/book ratios of utilities and industrials during the period from 1954 through 1972; the curves are similar to those in Figure 15, but at a lower M/B level. All three samples begin the period with M/Bs around 1.5, then climb appreciably up until 1965. Both utility samples drop back near or below the 1.0 level by 1972, while the industrial sample remains near 2.0.

The relative seriousness of the impact of inflation on utilities _vis-a-vis_ industrials is emphasized by the M/B ratios in Table 6 for 1965, the year when the current surge of inflation began in the United States, and for 1972, the latest year for which data are available. The M/B ratios for all three samples were well above 2.0 in 1965. By 1972 only the industrials' M/B remained above 2.0, having fallen about nine percent, while the M/Bs of both the flow-through and normalized electrics fell by over 45 percent.

Perhaps even more revealing is the comparison of M/B ratios figured on a current-dollar basis for the same period. The current-dollar M/B of the flow-through electrics fell about 41 percent, ending up below 1.0, while the normalized electrics' fell approximately 40 percent during the same period. The industrials, on the other hand, fall only about two percent. Thus, when inflation is taken into account in the value of equity,

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[19]See Appendix O for sample calculations of current-dollar equity values.

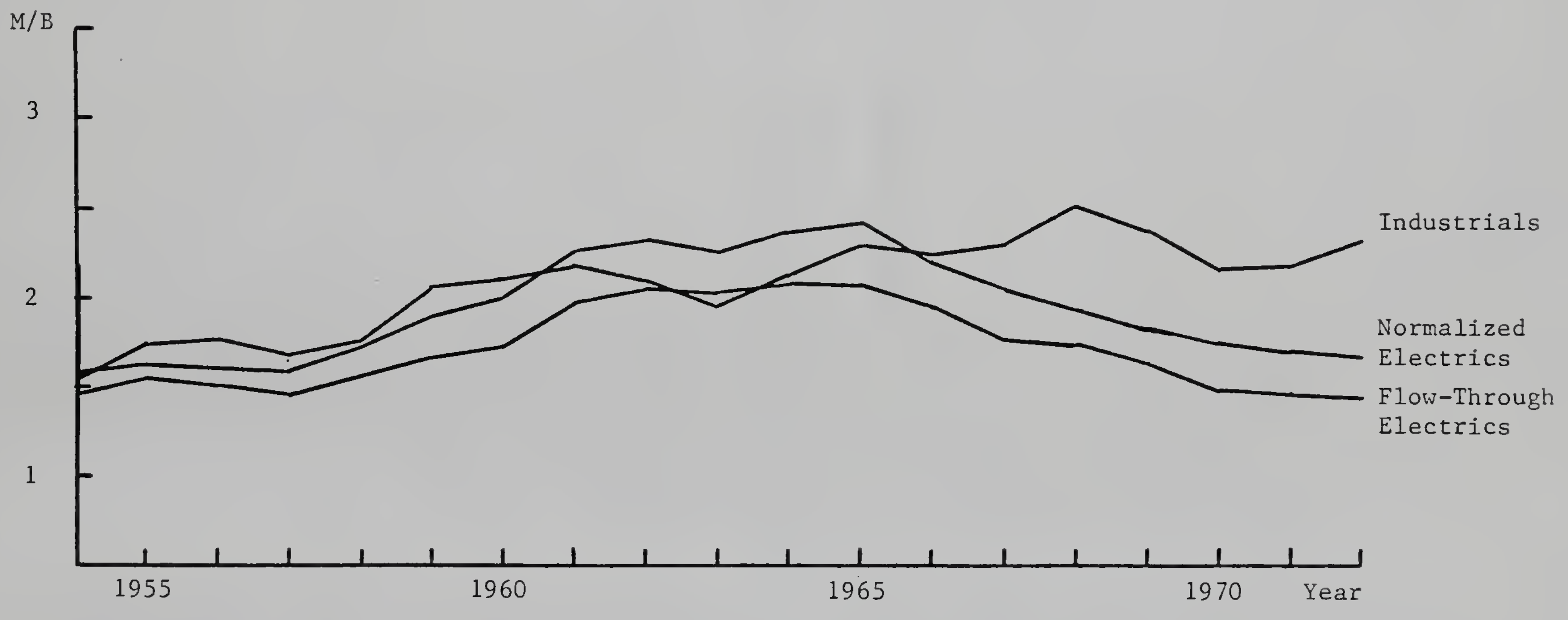

Figure 16: Trends in Current-Dollar Market/Book Ratios.

Source: Calculated from the Compustat Annual Utility Tape, the Compustat Annual Industrial Tape, and the Consumer Price Index.

TABLE 6

MARKET/BOOK RATIOS COMPARED TO CURRENT-DOLLAR MARKET/BOOK RATIOS

	40 Flow-Through Electrics		44 Normalized Electrics		213 Industrials	
	M/B	CD M/B	M/B	CD M/B	M/B	CD M/B
1965	2.36	1.58	2.85	1.91	2.64	1.79
1972	1.26	0.94	1.55	1.16	2.41	1.83
Change	-1.10	-0.64	-1.30	-0.75	-0.23	+0.04
Percentage Change	-46.61%	-40.51%	-45.61%	-39.27%	-8.71%	+2.23%

Source: Calculated from the Compustat Annual Utility Tape, the Compustat Annual Industrial Tape, and the Consumer Price Index.

the industrials fared much better than the electric utilities during the inflationary period of 1965 through 1972.

Equity owners of regulated companies are at a disadvantage compared with owners of unregulated firms when inflation exists. The former are not allowed the increases in market value of their investment that they could have enjoyed had they chosen a company operating in an unregulated industry. To compensate for this apparent inequity, regulatory agencies should consider the market/book ratio in conjunction with the allowed rate of return on equity, not solely the latter, in rate decisions. A utility's capacity to provide expectations of capital gains comparable to alternative investments in other firms, regulated or unregulated, may be a critical factor in an investor's decision to commit capital to the enterprise. Capital attraction may be a serious difficulty for utilities under traditional regulatory procedures during rapid inflation.

Capital Values--Accounting Practices

Traditional accounting practice is to record the dollar price of an asset at the time of purchase and to depreciate that value by either straight line or accelerated methods. During the life of the asset a divergence of market value from book value occurs as the owners assess the earnings potential as greater or less than the amount expected when the asset was recorded in the books. Although this long-existing practice is ingrained in the thinking of the financial community, alternatives have been suggested to recognize price level changes and have been summarized by the Financial Accounting Standards Board (FASB).[20]

[20]Financial Accounting Standards Board, FASB Discussion Memorandum: An Analysis of Issues Relating to Reporting the Effects of General Price Level Changes in Financial Statements (1974).

Certain state regulatory agencies recognize the asset value phenomenon and attempt to correct the problem by allowing replacement costs in rate base valuation. This process, however, is somewhat cumbersome and, necessarily, somewhat subjective due to the character of the assets involved.

Recent proposals in the accounting profession would advance the art of corporate valuation and, consequently, the practice of rate regulation by accounting for inflation directly in the income statement and balance sheet. Financial statements comparing three methods of inflation accounting are shown in Appendix P and are analyzed here for the effects each would have on the M/B approach to utility regulation.

The first method is delineated in the Accounting Principles Board (APB) Statement Number 3.[21] Dual financial statements are presented: one set with conventional book values and one with inflation adjustments. In the adjusted balance sheet, monetary assets are carried at face value, while the periodic purchasing power loss from holding these monetary assets is shown in the adjusted income statement. The net effect of the losses on monetary assets and the gains on liabilities are carried through the income statement to the retained earnings account on the balance sheet. Nonmonetary assets are revalued each accounting period to reflect the price level change, as are capital stock and old retained earnings. The balance sheet, therefore, reflects not only normal business operations but also price level changes.

This process may provide increased dollar earnings to support the

[21]American Institute of Certified Public Accountants, Accounting Principles Board, "Financial Statements Restated for General Price Level Changes," Accounting Principles Board Statement No. 3 (1969).

market price according to the monetary-nonmonetary asset mix. It also raises the book value of assets, thereby raising the rate base. The exact effect of the market/book ratio is difficult to determine because investor expectations must be evaluated in light of dual financial statements. Assuming that regulatory agencies would accept the restated financial documents, the rate of return on book value need not be increased by the commission to offset inflation; it would be increased _de facto_ because a constant rate would be applied to an increasing rate base. The increase in actual rate of return, r, relative to investor return requirements, k, determines the effect on the M/B ratio as explained with the models in the prior section and in Chapter 2. If r and k are rising at the same pace, then the M/B ratio would remain constant, _ceterus paribus_. Even if investor return requirements outstripped the actual (or allowed) return, causing the M/B ratio to fall, the decline would be less precipitous than if r were being applied to a traditional book value rate base.

The second method of accounting for inflation has been presented by the Indiana Telephone Company.[22] Their method, which also utilizes dual financial statements, is essentially that suggested by the APB, but refined in the matter of timing. Gains and losses on monetary assets and liabilities are deferred until such time as they are actually realized (e.g., until a loan is retired). A new account is added to the balance sheet: Unrealized Gains or Losses on Monetary Assets and Liabilities. This account is properly considered a part of stockholders' equity, as it will eventually be recognized in the income statement and reflected in retained earnings.

[22] Indiana Telephone Company, _Annual Report_ (1972).

The effects of this accounting procedure would be similar to that of the APB method, but the dollar earnings adjustments would be delayed until the deferrals were consummated. The potential divergence between the de facto rate of return (on traditional book value) and the investors' required rate of return appears greater than in the APB method because of the lag between the time that inflation occurs and the time it is recognized in the income statement. The mix of monetary and nonmonetary assets, and the mix of paid-in capital and liabilities, along with the timing aspects, would determine the year-to-year effects on realized rates of return, investors' expectations, and the market/book ratio.

A third approach to inflation accounting, the inflation reserve method, is presented by Surendra P. Agrawal in a position paper currently under consideration by the FASB.[23] This method is the most straightforward of the three discussed here and focus sharply on the cost of inflation while maintaining traditional asset valuation; further, Agrawal's method requires only one set of financial statements. The annual loss from inflation is calculated by applying the past year's inflation rate to the "contributed risk capital" (i.e., paid-in equity, generally common stock). This loss from inflation, much like depreciation, is a noncash expense item on the income statement. The resultant reduction in retained earnings is balanced by a new equity account plainly labeled Inflation Reserve; that is, inflation losses are transferred from retained earnings to an inflation reserve. Book value of total equity is unaffected as are values of all other balance sheet accounts except Retained Earnings and Inflation Reserve. The income

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[23] Surendra P. Agrawal, "Accounting for Price Level Changes," position paper submitted to the Financial Accounting Standards Board (1974).

statement shows the cost of inflation directly as an expense during each accounting period, while the balance sheet builds up a reserve to show the cumulative effects over the years.

The firm's cash flow is increased by the inflation expense, just as it is by depreciation or depletion allowances. Thus, the problem posed by Christy and Reitan, that of inadequate depreciation for asset replacement, is alleviated by this proposal. The firm would experience lower earnings if it were not allowed to raise its prices enough to offset the inflation expense. This, however, is what happens currently as inflation takes its purchasing power toll unacknowledged. If the commission approves price increases sufficient to maintain the firm's allowed rate of return, then the regulated utility is able to combat inflation much on the same basis as unregulated companies. With inflationary risk thus minimized, the utility would have the _ex ante_ opportunity to maintain a predetermined market/book ratio. The problems of purchasing power attrition and earnings dilution would be reasonably well resolved. The cash flow effects, ease of understanding, and maintenance of traditional accounting valuation procedures favor the inflation reserve method.

Critics of the two general price level methods of inflation accounting point out that dual financing statements would be confusing to all but the most expert readers. Furthermore, differences between the statements would be ever-increasing as long as the price-level changes continued in only one direction. The distinction between monetary and nonmonetary assets might foster bad business practices, such as excessive trading on the equity and untimely reductions in quick assets. These criticisms have not been adequately examined.

The inflation reserve method draws fire as having the potential to add to the price spiral. Critics, however, overlook the fact that adjustments are made for past inflation. After reasonable provisions are made for past inflation losses, prudent management would have no reason to seek further price increases.

Adoption of any of these three practices would let investors know that the costs of inflation are being recognized in the books of the firm. From a regulated utility's viewpoint, the price level changes would be recognized in the rate base value and/or as expenses of doing business. The market/book ratios would be expected to fare better than under current accounting practices.

Market/Book Ratios in Regulation

The market/book mechanism can provide guidance to the regulatory authority charged with the responsibility of setting utility rates which allow a fair return to the owners of the firm while not permitting the extraction of excess profits from consumers. Equity investors expect a return on their funds that compensates them according to the riskiness of the investment. Morton defines risk as "the chance that the value of invested capital may not be maintained. Since the value of capital depends on earnings power, risk is the chance that earning power will not be maintained on a level equal to the opportunity cost of capital."[24] The opportunity cost of capital is a return of pure interest plus a compensation for risk. Since the M/B reflects the value of the investors' capital, risk is also the chance that a company will not

[24]Morton, p. 254.

maintain an M/B ratio as high as those of other companies (or industries) which compete for capital. "The equity securities of the lower earnings industry will sell in the market at a lower market-to-book ratio than will those of higher earnings industries, and these comparative market-to-book ratios are a rough indication of the ability of a firm to maintain the integrity of its invested capital as compared to other industries.[25] Thus, there is the potential for using the M/B ratio in rate cases as one means of determining whether or not the Hope criteria are being met or will be met by the pending rate decision.

If the M/Bs of other industries are of concern in utility regulations, which other industries? Only those industries which compete with the utilities for capital need concern us. Yet in a sense all other industries compete with utilities for the investing public's capital. To recognize this competition, Robichek suggested the M/Bs of utility companies should be approximately the same level as the M/Bs of other companies. For comparison one might use an average from a sample of regulated firms such as Moody's 24 utilities or of unregulated firms such as Moody's 125 industrials.[26] An average M/B for a cross-industry sample of unregulated firms could be considered fair for utilities insofar as the M/B reflects a firm's ability to earn the opportunity cost of capital. The possibility of increasing the rates of return allowed utilities to the extent that their market/book ratios would be comparable to those of industrial companies may not be politically feasible because of the wide gap that has developed since 1965. The equalizing of market/book

[25]Morton, p. 230.

[26]Alexander A. Robichek, Testimony of, Washington Utilities and Transportation Commission v. Pacific Northwest Bell Telephone Company, Cause No. U-71-5-TR, September 27, 1971, p. 1568.

ratios of utility and industrial concerns might become more nearly politically feasible in the event that an indefinitely continuing price control mechanism were established to combat inflation. In that situation, all industries would be substantially regulated, and the market values of many industrial firms might decline. In the absence of such an occurrence this approach is unlikely to gain wide acceptance.

During the period since 1972, the last year shown in Figure 15, market/book ratios of many industrials have dropped dramatically, and many utility stocks have fallen well below the 1.0 level. The market/book ratios for the Standard and Poor's 125 Industrial Average and the Dow-Jones Industrial Average were estimated at 1.6 and 1.2, respectively, as of June 14, 1974,[27] which are low compared to the industrial sample's M/B of 2.4 for 1972 in Figure 15. When M/Bs are falling as in the current inflationary environment, should "normal" market/book ratios established in noninflationary periods be taken as standards of comparison? Or should the benchmark be composed of the latest available figures? If the former, and currently higher, standard is chosen and maintained throughout an inflationary era, the consumers would be forced to bear the brunt of the price level increases, as was earlier pointed out. If the latter benchmark were accepted, the M/B of the chosen industry sample could conceivably drop significantly below 1.0. In this situation, one might find himself in the position of advocating a market/book ratio less than unity as fair, which might be satisfactory under the circumstances.[28] The implications of this situation are not totally clear, except that

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[27] A. F. Ehrbar, "When Book Value Matters, and When It Doesn't," Fortune (July 1974), pp. 57-62.

[28] On the other hand, if a utility has an M/B below 1.0 and is forced to sell stock to raise capital to meet service demands, its earnings base will be eroded. Industrial companies, on the other hand, are never

great numbers of equity owners throughout many industries would be faced with potential losses in the event of new equity financing. As rates of return were allowed only below the cost of equity capital, the market/book ratios might be forced lower, thus posing even greater potential dangers to the owners. Where this path might lead remains open to inquiry.

In order to eliminate the problem of interindustry differences, utility industry averages might be used as guides to the acceptable level of M/Bs for utility firms. In fact, this general approach was presented as testimony by Peter M. Gutmann in two actual rate cases.[29] The method he presented for deriving the fair rate of return on common equity is summarized in four steps.

> 1. Select a sample of utility companies which are representative of the risk class of the company whose case is being considered.
>
> 2. Find the price/book value ratio for each of several time periods for each company in the sample. Use annual average market and book values per share. Use earnings per share divided by average book equity per share as the rate of return on book value. Make a scatter diagram with market/book ratios on the vertical axis (dependent variable) and rates of return on the horizontal axis (independent variable).
>
> 3. Fit a least squares regression line of the general form $P_o/B_o = a_o + a_1 r$.
>
> 4. Use this relationship for the sample to determine the fair rate of return for the company.

The fair rate of return is defined as that rate required to raise additional capital by equity financing, or "the minimum rate necessary to

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forced to invest. This could lead one to conclude that utility M/B ratios should always exceed 1.0.

[29] Peter M. Gutmann, "The Fair Rate of Return: A New Approach," Public Utilities Fortnightly, Vol. 87, No. 5 (March 4, 1971), pp. 41-44.

attract adequate equity financing to meet the capital needs of the utility."[30]

Gutmann pointed out that the market/book ratio would equal unity for some particular rate of return. "This rate of return is clearly less than the fair rate of return. One important reason is that any sale of new common stock would undoubtedly depress the market price below the book value."[31]

Data from samples of electric and gas companies during the years 1967-69 were collected. Following steps (1) through (4) above, Gutmann derived regression equations that explained from 45 percent to 70 percent of the variation in the market/book ratios. The average market/book ratio in each year was suggested as a fair ratio for the subject company in that year. Applying standard deviation statistics to this ratio would suggest a range for the market/book value and a range for the fair rate of return in that year, as shown in Figure 17. A rate of return on book equity within the indicated zone might be considered fair or reasonable as compared to other regulated firms of similar risk characteristics. This range could be used by the regulatory authority as a guide in determining what rate of return to allow.

Gutmann's approach is the important factor here, not the exact standards of application. No particularly strong evidence, for example, comes forward to impart virtue to the use of <u>one</u> standard deviation in determining the zone of reasonable returns. One-half of one standard deviation, or two standard deviations, or some other number might just as well have been used. However, the approach does provide another

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[30] Gutmann, p. 42.

[31] Gutmann, p. 43.

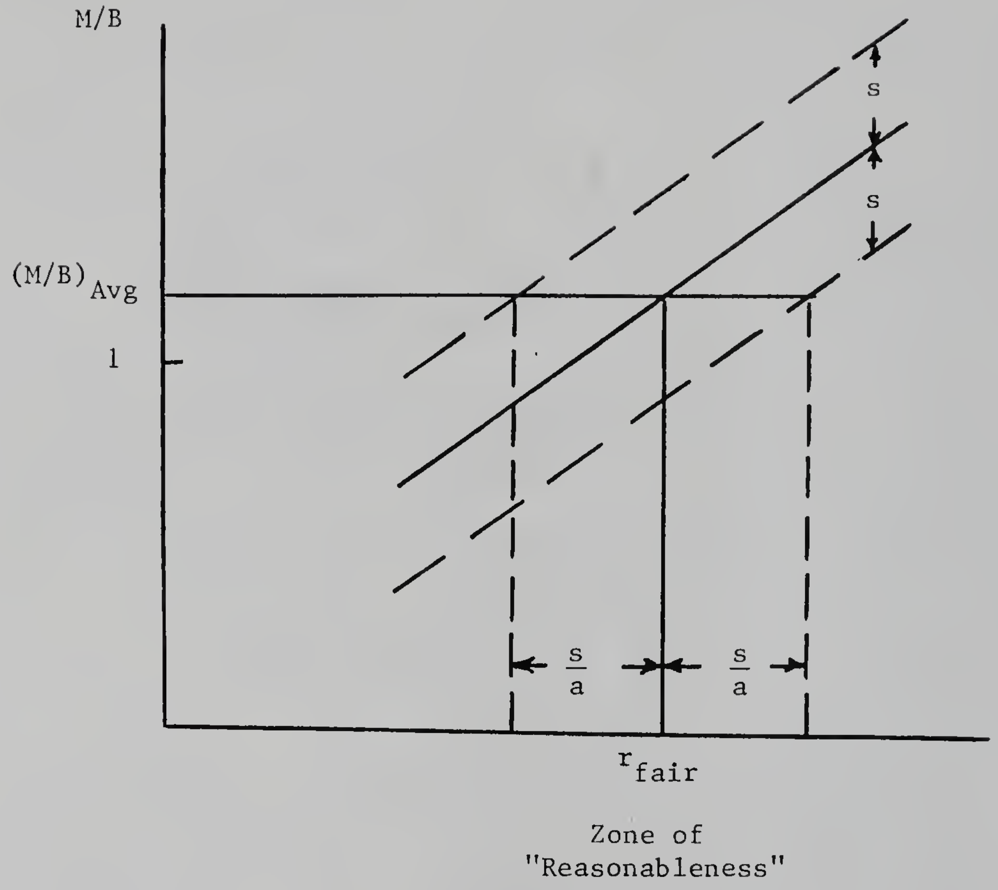

Figure 17: An Approach to Setting Fair Rates of Return.

Source: Peter M. Gutmann, "The Fair Rate of Return: A New Approach," Public Utilities Fortnightly, Vol. 87, No. 5 (March 4, 1971), p. 44.

parameter for consideration in rate cases.

The use of actual averages of the industry being regulated as a test of reasonableness or fairness involves a degree of circularity. Judgment as to reasonableness should not be based on the rates of return allowed by other regulatory agencies. Decisions that were deemed fair in the past would not necessarily be reasonable under current and expected conditions. The circularity can be avoided by using unregulated as well as regulated industries as a basis for comparison.[32]

A problem which could stir up controversy in rate proceedings is the choice of an "industry" from which to derive data. Even if the industry were well chosen, basing rate decisions on industry averages could lead to erroneous results because of differences among individual companies. Tradiational investment literature has recognized that "what the appropriate price premiums should be will vary from company to company, depending upon a number of factors."[33] This fact is implicitly recognized by the regulatory process, since every company is considered individually in light of the particular circumstances surrounding the case. The general economic environment, including inflation, should also be among the factors taken into consideration.

Summary

This chapter reviews a conglomeration of economic, accounting, and financial theory. All of these subjects contribute to the central theme of determining a fair market/book ratio. The economic model generates solutions for regulated monopolies that are similar to those that would

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[32]Foster, pp. 33-36.

[33]Graham, Dodd and Cottle, p. 598.

occur if the monopolies were actually operating in purely competitive markets. It is argued that this profit level can be considered "fair" for a utility, as a competitive environment is widely heralded by western economists as an appropriate economic situation.

Economic theory assumes properly valued assets, and this leads to a problem when one considers the current inflationary environment. The earning power of assets may cause their current-dollar value to differ from their book values. When this occurs, a conflict of interest arises between consumers and owners of a utility under present regulatory practices. The market/book ratio could be used as an additional parameter in rate cases as an indication of whether or not the court-established standards of comparable returns, financial integrity, and capital attraction are being met.

In order for these standards to be met during substantial inflation, the M/B model indicates that increasing rates of return are necessary under current accounting systems. A glance at recent historical trends in market/book ratios shows much more severe decreases in the M/Bs of regulated utilities than of industrial companies. The accounting profession is fully cognizant of the problems businesses face during inflation, and accountants offer three alternative methods to reflect inflation. Although any of these methods would probably improve utilities' chances of maintaining an established M/B, Agrawal's inflation reserve method is the most straightforward and would be the easiest to incorporate into existing rate regulation.

The conclusion as to what M/B is "fair" for a regulated utility depends upon the circumstances. In a competitive, noninflationary economic environment with perfect regulation and no lags, a market/book ratio of 1.0 would be fair. In the imperfect world where utilities operate, an M/B of 1.0 would still be acceptable if there were no inflation, no flotation costs, and perfect certainty. With inflation, flotation costs, and uncertainty, an M/B greater than 1.0 is required for fairness. The higher level might be comparable to some sample of unregulated firms, although individual companies' differences must be recognized. This higher level is achievable through higher allowed rates of return or through use of accounting methods that allow for inflation.

CHAPTER 5

SUMMARY

Today the great majority of regulated public utilities find their market prices below their book values. If these companies turn to the equity markets for financing through the sale of new common stock, they do so to the detriment of the existing stockholders. These existing stockholders are allocated a less than proportionate share of future earnings when new shares are sold below book value.

Using Gordon's widely accepted discounted cash flow model for valuation of equity, one can show that if a regulatory agency allows and the firm earns the cost of equity capital, then the firm's market price will be equal to its book value per share, assuming no external equity financing. If an inflation premium is added to the investors' required rate of return, the market/book ratio will fall unless a premium of even greater magnitude is added to the allowed rate of return.

Expanding the basic DCF model to allow for the sale of stock, including flotation costs, led to the following equation:

$$M/B = \frac{r(1 - b)(1 + s)(1 - F) - S(1 + k - br)}{(k - br - s)(1 - F)} \qquad (14)$$

With this model, one observes that market price equals book value when the required rate of return equals the allowed rate, flotation costs are zero, and no new stock is sold. If flotation costs are significant, and new stock is sold, then the market/book ratio will be less than unity even when the allowed rate equals the required rate of return. As the allowed rate of return rises, the market/book ratio rises almost linearly, assuming a constant rate of asset growth financed both from earnings retention and sale of new stock.

A difficulty arose in our attempts to test empirically the market/book model. Since ex ante data are required, but are not directly observable, historical values were taken from the Compustat Annual Utility Tape, then used as the basis for deriving expectations. The basic method called for regressing ex post data for the allowed rate of return, the retention rate, and the asset growth rate against time, and to use the derived normalized values as proxies for the required expected values of these variables.

Cross-sectional least squares regression analysis showed that the historical rate of return on equity was the most significant determinant of the market/book ratio, while the asset growth rate was the next most significant. The growth rate exerted a strong positive influence on M/B when M/B was of the magnitude two or three, and had a negative influence when M/B was at or below unity. The other variables were much less significant. The linear regression model explained from 58 percent to 76 percent of the variation in the market/book ratio.

Experiments in the calculation of market/book ratios using equation 14 helped clarify some of the problems encountered in the use of DCF models in rate regulation. While our model explained 48 percent to 60 percent of the variation in historical market/book ratios, numerical analysis demonstrated the extreme sensitivity of the model to the relative values of the variables. This suggests that caution must be used in any attempt to use the model for ratemaking purposes.

A discussion of a fair market/book ratio was included, because if a fair M/B could be specified, then it could be used to help establish a fair rate of return. In a competitive, noninflationary environment a firm would earn a return on equity equal to the return required by suppliers of capital. This competitive return would result in a market/book ratio of unity. If the objective of regulation is to cause regulated monopolies to reach a competitive market solution for price and output, then the market/book ratio prevailing in the competitive market should be fair for the regulated firm, assuming there is no regulatory lag.

In a world of uncertainty, imperfect regulation, regulatory lags, inflation, book values that do not represent the assets' earning power, and flotation costs, our analysis suggests that an M/B greater than unity is desirable. The higher level of M/B might be comparable to that of some carefully chosen sample of unregulated firms, although individual company differences would have to be considered in applying such a standard. The market/book ratios of many firms, both regulated and unregulated, are currently below unity. Thus, one could argue that an M/B below unity is fair for regulated utilities if that is the level existing among unregulated firms. On the other hand, one could also argue that since utilities are forced to sell stock to finance growth, while unregulated firms do not have to expand to meet demand, the minimum acceptable M/B ratio for a utility is 1.0.

This thesis has by no means answered all the questions that are raised regarding the fair rate of return for a regulated company, but it does show some of the ways the M/B ratio concept can be used as an input in rate cases, as well as the limitations of the M/B approach. In many respects, the M/B ratio approach is today where the DCF approach was about ten years ago. Our guess is that the M/B method will gain increasing acceptance in rate proceedings, and that in the not-too-distant future it will have a significant impact on most rate cases. However, as this analysis has indicated, many critical judgments are involved in the use of M/B ratios to determine fair rates of return, so it is vital that the method be used with a great deal of care and caution.

APPENDIX A

NOTATION

Market/Book Model Symbols

b = earnings retention rate

B_{oa} = new book value per share after sale of stock

B_t = book value per share at the end of year t

D_t = cash dividend per share expected during year t

E_t = earnings per share during period t

F = flotation costs associated with selling new stock

g = growth rate of earnings and dividends

g_1 = growth rate of earnings exclusively from earnings retention

g_2 = growth rate of book value per share from sale of new stock

G = growth rate of total assets

I_k = inflation premium added to the required rate of return

I_r = inflation premium added to the allowed rate of return

k = rate of return expected by investors

k_o = rate of return expected when no inflation is present

k^*_i = rate of return required by investors on asset i

M/B = ratio of market value to book value

P_t = market price per share at the end of year t

ρ_i = risk premium for asset i

r = rate of return allowed by the regulatory agency, ex ante; also, the actual rate of return if in an ex post context

r_o = rate of return allowed when no inflation is present

Market/Book Model Symbols - continued

R_F = risk-free rate of return

s = rate of growth in total equity from sale of new stock

S = original number of shares of stock outstanding

Thompson and Thatcher's Symbols

α = market/book ratio

γ = net-asset growth rate

E(t) = book value of equity at time t

f = ratio of net proceeds to market price

h = growth rate of shares of common stock

p = dividend payout ratio

P(t) = market price per share at time t

S(t) = number of shares outstanding at time t

Correlation and Regression Analysis Symbols

D = total debt

TA = total assets

D/A = debt to total asset ratio

R = correlation coefficient

R^2 = coefficient of determination

$\overline{R}^2$ = Barton's coefficient of determination

a = constant term in regression equation

b' = coefficient for r in regression equation

c = coefficient for D/A in regression equation

d = coefficient for b in regression equation

e = coefficient for G in regression equation

Leland's Symbols

p_m = price charged by unregulated monopoly

p^* = price charged by regulated monopoly

q_m = quantity produced by unregulated monopoly

q^* = quantity produced by regulated monopoly

K^o = book value of the firm

V = market value of the firm

π^* = competitive return

r^* = expected fair rate of return

Carleton's Symbols

$\overline{B}_t$ = book value rate base derived from investors' expectations

$\overline{k}$ = rate of return expected by investors after permanent shift in expectations

APPENDIX B

DIFFERENTIATION OF M/B

The differentiation of M/B follows.

$$M/B = \frac{(1 - b)r}{k - br}.$$

Let k = constant, so that

$$\frac{\delta}{\delta r} (1 - b)r = b - b$$

and

$$\frac{\delta}{\delta r} (k - br) = -b.$$

Then,

$$\frac{\delta}{\delta r} (M/B) = \frac{(k - br)(1 - b) - (1 - b)r(-b)}{(k - br)^2}$$

$$= \frac{k(1 - b)}{(k - br)^2}.$$

Also,

$$\frac{\delta}{\delta r^2} (M/B) = k(1 - b) \frac{\delta}{\delta r} (k - br)^{-2}$$

$$= -2k(1 - b)(k - br)^{-3} \frac{\delta}{\delta r} (k - br)$$

$$= -2k(1 - b)(k - br)^{-3}(0 - b)$$

$$= 2k(1 - b)(k - br)^{-3}b$$

$$= \frac{2bk(1 - b)}{(k - br)^3}.$$

Now set the first derivative equal to zero:

$$\frac{\delta}{\delta r}(P_o/B_o) = \frac{k(1 - b)}{(k - br)^2} = 0$$

$$\frac{k - bk}{(k - br)^2} = 0$$

$$\frac{k}{(k - br)^2} - \frac{bk}{(k - br)^2} = 0$$

$$k(k - br)^2 = bk(k - br)^2$$

$$(k - br)^2 = b(k - br)^2$$

$$k^2 - 2kbr + b^2r^2 = bk^2 - 2kb^2r + b^3r^2$$

$$(b^3 - b^2)r^2 + (2bk - 2b^2k)r + bk^2 - k^2 = 0$$

$$b^2(b - 1)r^2 + 2bk(1 - b)r + k^2(b - 1) = 0$$

$$b^2r^2 - 2bkr + k^2 = 0$$

$$r^2 - \frac{2k}{b}r + \frac{k^2}{b^2} = 0.$$

Using the quadratic formula,

$$r = \frac{\frac{2k}{b} \pm \left(\left(\frac{2k}{b}\right)^2 - 4\left(\frac{k^2}{b^2}\right)\right)^{1/2}}{2}$$

$$= \frac{\frac{2k}{b} \pm \frac{4k^2}{b^2} - \left(\frac{4k^2}{b^2}\right)^{1/2}}{2}$$

$$= \frac{\frac{2k}{b} \pm 0}{2}$$

$$r = \frac{k}{b}.$$

Hence, M/B approaches $+\infty$ as r approaches k/b. As r approaches k/b, br approaches k, so that at the limit, equation (9) becomes this:

$$M/B = \frac{(1 - b)\frac{k}{b}}{k - b\frac{k}{b}}$$

$$\frac{(1 - b)\frac{k}{b}}{k - k}$$

$$\frac{(1 - b)\frac{k}{b}}{0} \rightarrow \infty.$$

The general relationship is shown in Figure 18.

Now considering r and b both as variables, the second partial derivative with respect to r and b is this:

$$\frac{\delta^2(M/B)}{\delta r \delta b} = \frac{\delta}{\delta b}\,\frac{\delta P_o/B_o)}{\delta r}$$

$$= \frac{\delta}{\delta b}\,\frac{k(1 - b)}{(k - br)^2}$$

$$= \frac{\delta}{\delta b}\,\frac{k - kb}{(k - br)^2}$$

$$= \frac{\delta}{\delta b}\,k(k - br)^{-2} - \frac{\delta}{\delta b}\,bk(k - br)^{-2}$$

$$= 2r(k - br)^{-3} - 2bkr(k - br)^{-3} - k(k - br)^{-2}.$$

Multiply the last term by $\frac{(k - br)}{(k - br)}$ and combine terms.

$$\frac{\delta^2(M/B)}{\delta r \delta b} = \frac{2kr - 2bkr - k(k - br)}{(k - br)^3}$$

$$= \frac{2kr - 2bkr - k^2 + bkr}{(k - br)^3}$$

$$= \frac{2kr - bkr - k^2}{(k - br)^3}$$

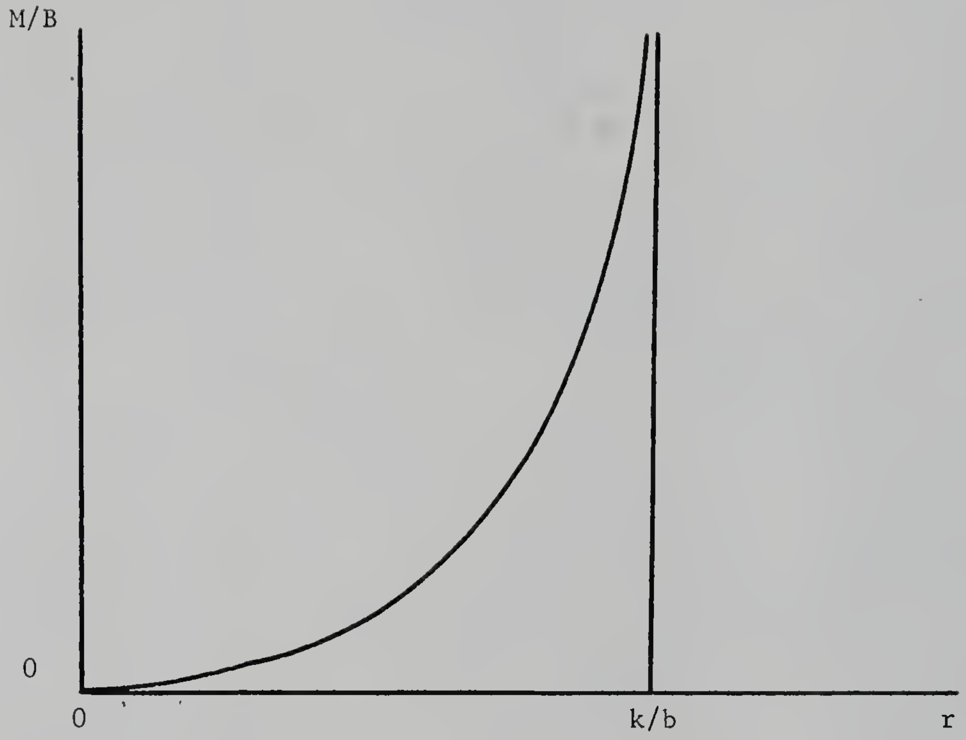

Figure 18: Market/Book Ratio as a Function of Allowed Rate of Return.

$$= \frac{k[r(2 - b) - k]}{(k - br)^3}.$$

This general relationship for relevant values of the variables is graphed in Figure 19. The function approaches positive infinity as b approaches k/r, which follows from the assumption that k > br.

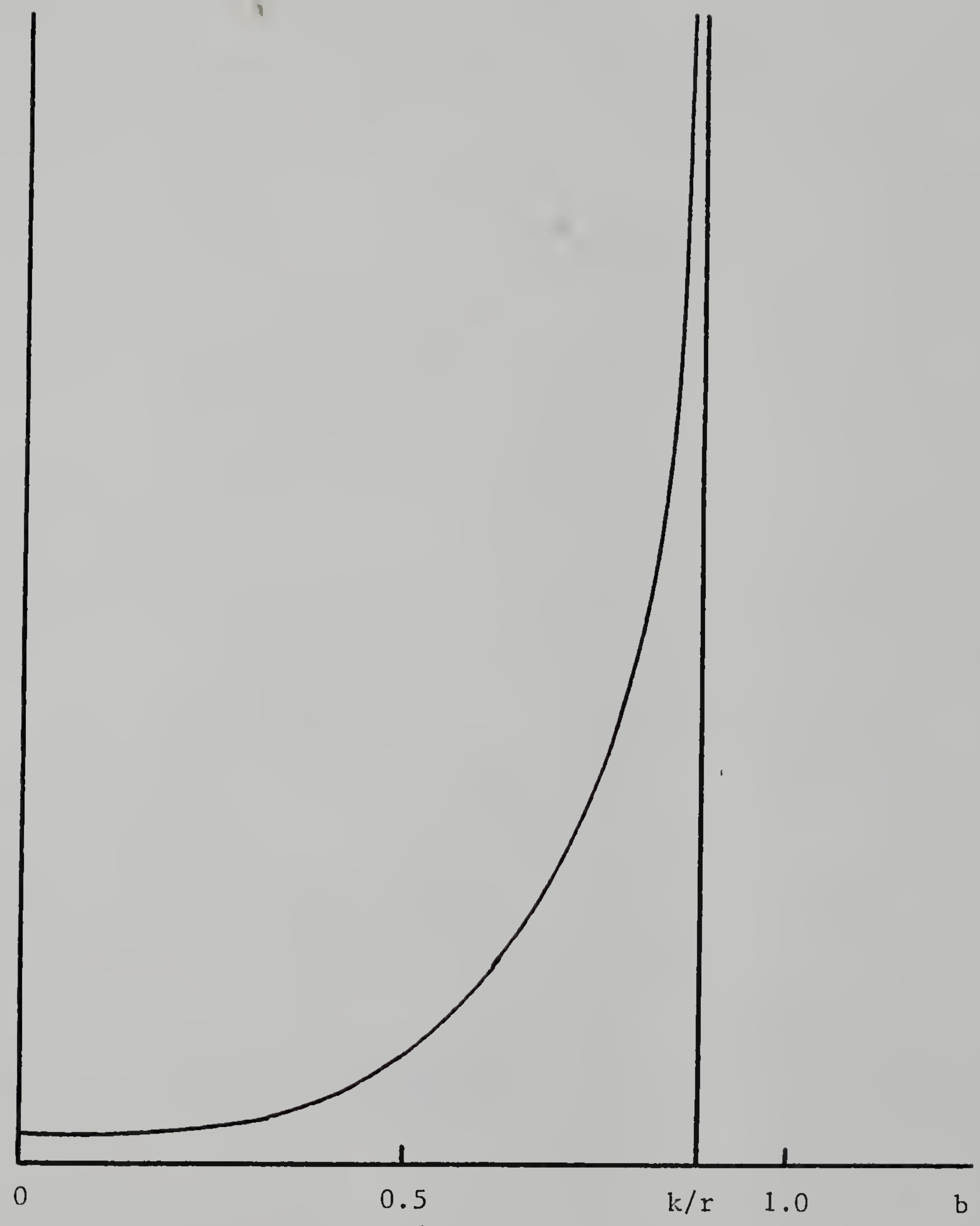

Figure 19: First Partial Derivative of the Market/Book Ratio as a Function of the Retention Rate.

APPENDIX C

THE APPROPRIATE USE OF THE EARNINGS/PRICE RATIO AS THE COST OF EQUITY CAPITAL

The earnings-price ratio, E/P, has been suggested as an estimate of the cost of equity capital, k, for the firm.[1] The rationale behind using the E/P for the cost of equity capital is that investors consider past, current, and probable future E/P ratios in their investment decisions. One may readily infer that the E/P is a poor surrogate for k in some instances, for example, "growth stocks." Such a stock usually demands a high price/earnings multiple (low E/P), reflecting investor expectations of above-normal growth. The correspondingly low E/P does not adequately account for the growth expectations if it is used for k. Under what conditions can E/P be used as an appropriate measure of a firm's cost of equity capital?

Van Horne has developed two cases in which E/P does equal the cost of equity capital.[2] In the first case two conditions must hold. Future earnings per share are expected to be the same as current earnings per share, and 100 percent of earnings is paid out as dividends. Stated in the symbols developed earlier, $E_o = E_t$ and $b = 0$. In terms of discounted cash flow the current price is the sum of an infinite stream of dividends,

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[1]N. C. Lerner, Testimony of, "Before the Florida Public Service Commission," Docket No. 72701-TP (June 1973), Southern Bell rate case.

[2]J. C. Van Horne, Financial Management and Policy, 2nd ed. (Englewood Cliffs: Prentice-Hall, Inc.), pp. 115-117.

$$P_o = \sum_{t=1}^{\infty} \frac{E_t(1 - b)}{(1 + k)^t} .$$

Substitution of $b = 0$ and $E_t = E_o$ and subsequent expansion gives $P_o = E_o/k$. Therefore k equals E_o/P_o under these conditions. The numerical examples in Table 7 demonstrate this situation. The E/P is equal to k_e in every instance. Note that although the rate of return available on reinvestment opportunities, r, must be constant, its relation to k is not critical. That is, r can be less than, equal to, or greater than k; hence, the market/book ratio can be less than, equal to, or greater than 1.00. The most striking feature of this exhibit is that each data item is constant over all four periods and would remain constant <u>ad infinitum</u>.

Now suppose the firm sells new stock so that total earnings grow, even though it retains no earnings, and the rate of return, r, remains unchanged. Assume that book value is increased by $50 in periods 2 through 4 by selling shares of stock at the market price prevailing at the end of the prior period. One sees that E/P is still equal to k in each period, regardless of whether r is less than, equal to, or greater than k. The earnings/price ratio can be used for the cost of equity capital even if the company sells new stock, as long as the rate of return is constant and no earnings are retained.

The original stockholders in the first example in Table 8, where $r < k$ and $M/B < 1.00$, the original stockholders are indifferent to sale of new stock since the market price holds steady at $20. Capital gains benefit the original equity owners in the example where $r > k$ and $M/B > 1.00$.

TABLE 7

E/P AS A MEASURE OF k WITHOUT THE SALE OF STOCK

Example	Period	Aggregate Data: Market Value $	Book Value $	Dividends = Earnings $	Total Number Shares
r < k	1	80	100	8	5
	2	80	100	8	5
	3	80	100	8	5
	4	80	100	8	5
r = k	1	100	100	10	5
	2	100	100	10	5
	3	100	100	10	5
	4	100	100	10	5
r > k	1	120	100	12	5
	2	120	100	12	5
	3	120	100	12	5
	4	120	100	12	5

TABLE 7 - extended

Per Share Data			Rates			
Market Value $/Sh	Book Value $/Sh	Dividends = Earnings $/Sh	r %	k %	E/P %	M/B %
16	20	1.60	8	10	10	80
16	20	1.60	8	10	10	80
16	20	1.60	8	10	10	80
16	20	1.60	8	10	10	80
20	20	2.00	10	10	10	100
20	20	2.00	10	10	10	100
20	20	2.00	10	10	10	100
20	20	2.00	10	10	10	100
24	20	2.40	12	10	10	120
24	20	2.40	12	10	10	120
24	20	2.40	12	10	10	120
24	20	2.40	12	10	10	120

TABLE 8

E/P AS A MEASURE OF k WITH THE SALE OF STOCK

		Aggregate Data				
Example	Time	Market Value $	Book Value $	Dividends = Earnings $	Number Shares Sold	Total Number Shares
$r < k$	1	80	100	8	0.00	5.00
	2	120	150	12	3.12	8.12
	3	160	200	16	3.38	11.51
	4	200	250	20	3.60	15.11
$r = k$	1	100	100	10	0.00	5.00
	2	150	150	15	2.50	7.50
	3	200	200	20	2.50	10.00
	4	250	250	25	2.50	12.50
$r > k$	1	120	100	12	0.00	5.00
	2	180	150	18	2.08	7.08
	3	240	200	24	1.97	9.05
	4	300	250	30	1.88	10.94

TABLE 8 - extended

Per Share Data			Rates			
Market Value $/Sh	Book Value $/Sh	Dividends = Earnings $/Sh	r %	k %	E/P %	M/B %
16.00	20.00	1.60	8	10	10	80
14.77	18.46	1.48	8	10	10	80
13.90	17.38	1.39	8	10	10	80
13.24	16.55	1.32	8	10	10	80
20.00	20.00	2.00	10	10	10	100
20.00	20.00	2.00	10	10	10	100
20.00	20.00	2.00	10	10	10	100
20.00	20.00	2.00	10	10	10	100
24.00	20.00	2.40	12	10	10	120
25.41	21.18	2.54	12	10	10	120
26.52	22.10	2.65	12	10	10	120
27.44	22.86	2.74	12	10	10	120

It seems difficult to relate Van Horne's first case to regulated utilities. Many certainly are experiencing growth of earnings, and virtually none pay out 100 percent of earnings as dividends. Since the first case is unrealistic, let us turn to the second case to see if it is more useful.

The second case involves "an expansion situation where the firm is able to invest in projects that provide an expected perpetual return of k on the equity financed portion,"[3] according to Van Horne. In this context, expansion is different from growth. Expansion is the reinvestment of some portion of earnings at a rate of return equal to the cost of equity capital, that is, at $r = k$. Growth is reinvestment at $r > k$.

As demonstrated earlier, the market/book ratio equals 1.00 when $r = k$. The circumstances wherein $E_1/P_o = k$ require that $M/B = 1.00$. One can confirm this conclusion by rearranging equation 2-3 to the following form:

$$k = \frac{D_1}{P_o} + g.$$

Substituting $D_1 = (1 - b)E$, and $g = br$ gives

$$k = \frac{(1 - b)E_1}{P_o} + br.$$

By substituting the stated condition, $r = k$, one arrives at

$$k = \frac{(1 - b)E_1}{P_o} + bk.$$

Rearranging,

$$k - bk = \frac{(1 - b)E_1}{P_o}.$$

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[3]Van Horne, pp. 115-116.

Or

$$(1 - b)k = (1 - b)\,\frac{E_1}{P_o}.$$

Therefore,

$$k = E_1/P_o.$$

The earnings-price ratio is apparently a correct surrogate for the cost of equity capital for the situation where $r = k$ and $M/B = 1.0$.

The latter case may have applications in utility regulation. If a firm's market/book ratio is, in fact, 1.0, then the E/P might correctly be used as k. Suppose an investor purchases a stock at book value and expects the company consistently to earn exactly its cost of capital. He could then expect the book value and market value to grow as a function of the rate of earnings retention and the E/P, since $r = k = E/P$, as indicated in the second example in Table 9. Contrast this with the other examples in the same table, where the allowed rate of return is less than the required rate, $r < k$, and where the allowed rate is greater than the required rate, $r > k$. One sees that E/P overstates k when $r < k$ and understates k where $r > k$. E/P is an appropriate measure of k only under the specific circumstances mentioned above.

TABLE 9

E/P AS A MEASURE OF k WITH EARNINGS EXPANSION

		Aggregate Data				
Example	Period	Market Value[a] $	Book Value $	Earnings $	Earnings Retained[b] $	Number Shares
$r < k$	1	70.59	100.00	8.00	3.20	5
	2	72.85	103.20	8.26	3.30	5
	3	75.18	106.50	8.52	3.41	5
	4	77.59	109.91	8.79	3.52	5
$r = k$	1	100.00	100.00	10.00	4.00	5
	2	104.00	104.00	10.40	4.16	5
	3	108.16	108.16	10.87	4.33	5
	4	112.49	112.49	11.25	4.50	5
$r > k$	1	150.00	100.00	12.00	4.80	5
	2	157.21	104.80	12.58	5.03	5
	3	164.75	109.83	13.18	5.27	5
	4	172.65	115.10	13.81	5.52	5

[a] $P = D/(k - g) = D/(k - br)$

[b] Retention rate = 40 percent

TABLE 9 - extended

Per Share Data				Rates				
	Market	Book						
Dividends $/Sh	Value[a] $/Sh	Value $/Sh	Earnings $/Sh	$\bar{k}$ %	r %	k %	E/P %	M/B %
0.96	14.12	20.00	1.60	--	8	10	11.33	71
0.99	14.57	20.64	1.65	10.2	8	10	11.33	71
1.02	15.04	21.30	1.70	10.2	8	10	11.33	71
1.06	15.52	21.98	1.76	10.2	8	10	11.33	71
1.20	20.00	20.00	2.00	--	10	10	10.00	100
1.25	20.80	20.80	2.80	10.2	10	10	10.00	100
1.30	21.63	21.63	2.16	10.2	10	10	10.00	100
1.35	22.50	22.50	2.25	10.2	10	10	10.00	100
1.44	30.00	20.00	2.40	--	12	10	8.00	150
1.51	31.44	20.96	2.52	9.8	12	10	8.00	150
1.58	32.95	21.97	2.64	9.8	12	10	8.00	150
1.66	34.53	23.02	2.76	9.8	12	10	8.00	150

APPENDIX D

DERIVATION OF THE M/B EQUATION WHEN STOCK IS SOLD

Definitions

B_o = original book value per share before sale of stock

B_{oa} = new book value per share after sale of stock

S = total number of original shares outstanding

SB_o = total book equity before sale of stock

s = growth rate of total book equity from sale of stock

sSB_o = total dollar increase in book equity from sale of stock

ΔS = number of shares that must be sold to raise funds in the amount of sSB_o

g_1 = growth in earnings per share from retention

g_2 = growth in earnings per share and book equity per share from sale of new stock

P_o = market price per share

Determination of the Value of g_2

First, determine the number of shares of new stock sold:

$$\Delta S = sSB_o/P_o.$$

Then, determine the new book value per share after the stock is sold:

$$B_{oa} = \frac{SB_o + \Delta SP_o}{S + \Delta S}.$$

Substituting for ΔS, we obtain

$$B_{oa} = \frac{SB_o + (sSB_o/P_o)P_o}{S + sSB_o/P_o}$$

$$= \frac{B_oP_o(1 + s)}{P_o + sB_o}.$$

Now we can determine the growth in book value, hence earnings, attributable to the change in book value per share:

$$g_2 = \frac{B_{oa}}{B_o} - 1.$$

Substituting for B_{oa}, we obtain

$$g_2 = \frac{P_o(1 + s)}{P_o + sB_o} - 1. \qquad \text{(D-1)}$$

In this derivation, we assume no flotation costs; hence, new shares net the firm their full price, P_o. This assumption is relaxed in the next appendix.

Development of the M/B Equation

The basic dividend growth model is

$$P_o = \frac{D_1}{k - g}.$$

$$= \frac{D_1}{k - g_1 - g_2}, \qquad \text{(D-2)}$$

when earnings growth occurs both from earnings retention and from sale of stock. D_1 is now paid from earnings, E_1, on both the original book value, B_o, and the increase in book value from sale of stock, B_og_2.

Therefore,

$$D_1 = (1 - b)E_1$$
$$= (1 - b)r(B_o + B_o g_2)$$
$$= r(1 - b)B_o(1 + g_2). \qquad \text{(D-3)}$$

Substituting equation (D-3) into (D-2) gives

$$P_o = \frac{r(1 - b)B_o(1 + g_2)}{k - g_1 - g_2}.$$

Dividing through by B_o gives

$$\frac{P_o}{B_o} = \frac{r(1 - b)(1 + g_2)}{k - g_1 - g_2}.$$

Substituting $x = r(1 - b)$ and $y = k - g_1 = k - br$ results in

$$\frac{P_o}{B_o} = \frac{x(1 + g_2)}{y - g_2}. \qquad \text{(D-4)}$$

Substituting equation (D-1) for g_2 and cancelling terms gives

$$\frac{P_o}{B_o} = \frac{x\left[1 + \frac{P_o(1 + s)}{P_o + sB_o}\right] - 1}{y - \left[\frac{P_o(1 + s)}{P_o + sB_o}\right] - 1}$$

$$= \frac{xP_o(1 + s)}{y(P_o + sB_o) - P_o(1 + s) + P_o + sB_o}$$

$$= \frac{xP_o(1 + s)}{yP_o + ysB_o - P_o s + sB_o},$$

Rearranging terms, then dividing through by P_oB_o, results in

$$yP_o^2 + ysB_oP_o - sP_o^2 + sB_oP_o = xB_oP_o + xB_oP_os$$

$$y \frac{P_o}{B_o} + ys - s \frac{P_o}{B_o} + s = x + xs$$

$$\frac{P_o}{B_o} (y - s) + s(y + 1) = x(1 + s)$$

$$\frac{P_o}{B_o} = \frac{x(1 + s) - s(1 + y)}{y - s}.$$

Finally, substitute for x and y to complete the derivation of text Equation 11:

$$M/B = \frac{P_o}{B_o} = \frac{r(1 - b)(1 + s) - s(1 + k - br)}{k - br - s}. \qquad (11)$$

APPENDIX E

DERIVATION OF THE M/B EQUATION WHEN FLOTATION COSTS ARE INCURRED

Definitions

B_o = original book value per share before sale of stock

B_{oa} = new book value after sale of stock

S = total number of original shares outstanding

SB_o = total book equity before sale of stock

s = growth rate of total book equity from sale of stock

sSB_o = total dollar increase in book equity from sale of stock
= amount of funds available after flotation costs

F = flotation costs expressed as a percentage of the total funds raised by sale of stock

$\frac{sSB_o}{1 - F}$ = amount of funds that must be raised through sale of stock in order to leave sSB_o available after flotation costs; i.e., gross funds raised before flotation costs.

ΔS = number of shares that must be sold to raise funds in the amount of $sSB_o/(1 - F)$

$$= \frac{sSB_o}{1 - F} \div P_o = \frac{sSB_o}{P_o(1 - F)}$$

g_1 = growth in earnings per share from retention

g_2 = growth in book equity per share resulting from sale of stock. This g_2 is, of course, different from the g_2 that would result in the absence of flotation costs

Determination of the Value of g_2

$$B_{oa} = \frac{SB_o + \Delta S P_o(1 - F)}{S + \Delta S}.$$

Substituting for ΔS, we obtain

$$B_{oa} = \frac{SB_o + \dfrac{sSB_o}{P_o(1 - F)}\; P_o(1 - F)}{S + \dfrac{sSB_o}{P_o(1 - F)}}$$

$$= \frac{SB_o + sSB_o}{\dfrac{SB_o(1 - F) + sSB_o}{P_o(1 - F)}}$$

$$= \frac{B_o P_o(1 + s)(1 - F)}{P_o(1 - F) + sB_o}.$$

But g_2 is defined as follows:

$$g_2 = B_{oa}/B_o - 1.$$

Substituting for B_{oa}, one obtains

$$g_2 = \frac{\dfrac{B_o P_o(1 + s)(1 - F)}{P_o(1 - F) + sB_o}}{B_o} - 1$$

$$= \frac{P_o(1 + s)(1 - F) - P_o(1 - F) - sB_o}{P_o(1 - F) + sB_o}$$

$$= \frac{sB_o(1 - F) - sB_o}{P_o(1 - F) + sB_o}.$$

Development of the M/B Equation

Substituting the new equation for g_2 into Equation (D-4) from Appendix D results in the following:

$$\frac{P_o}{B_o} = \frac{x(1 + g_2)}{y - g_2}$$

$$= \frac{x\left[1 + \dfrac{sP_o(1 - F) - sB_o}{P_o(1 - F) + sB_o}\right]}{y - \dfrac{sP_o(1 - F) - sB_o}{P_o(1 - F) + sB_o}}$$

$$= \frac{x\left[\dfrac{P_o(1 - F) + sB_o + sP_o(1 - F) - sB_o}{P_o(1 - F) + sB_o}\right]}{\dfrac{yP_o(1 - F) + ysB_o - sP_o(1 - F) + sB_o}{P_o(1 - F) + sB_o}}$$

$$= \frac{xP_o(1 - F)(1 + s)}{P_o(1 - F)(y - s) + sB_o(1 + y)}.$$

Rearranging terms, we obtain

$$P_o^2(1 - F)(y - s) + sB_oP_o(1 + y) = xB_oP_o(1 - F)(1 + s).$$

Dividing through by P_oB_o gives the following:

$$\frac{P_o}{B_o}(1 - F)(y - s) + s(1 + y) = x(1 - F)(1 + s)$$

$$M/B = \frac{P_o}{B_o} = \frac{x(1 - F)(1 + s) - s(1 + y)}{(1 - F)(y - s)}.$$

Substituting $x = r(1 - b)$ and $y = k - g_1 = k - br$ and rearranging terms results in Equation 14 in the text.

$$M/B = \frac{r(1 - b)(1 + s)(1 - F) - s(1 + k - br)}{(k - br - s)(1 - F)}. \qquad (14)$$

APPENDIX F

DIFFERENTIATION OF THE M/B MODEL WITH SALE OF STOCK AND FLOTATION COSTS

The differentiation of M/B follows.

$$M/B = \frac{r(1 - b)(1 + s)(1 - F) - s(1 + k - br)}{(k - br - s)(1 - F)}.$$

Substituting $s = G - br$ gives the following:

$$M/B = \frac{r(1 - b)(1 + G - br)(1 - F) - (G - br)(1 + k - br)}{(k - G)(1 - F)}.$$

Initially, treat b, G, F, and k as constants; therefore, the denominator is constant.

$$M/B = \left\{(1 - b)(1 - F)(r + Gr - br^2) - [G + Gk - Gbr - br - brk + b^2r^2]\right\}/(k - G)(1 - F)$$

$$= (r + Gr - br^2 - Fr - FGr + Fbr^2 - br - bGr + b^2r^2 + bFr + bFGr - b^2Fr^2 - G - Gk + bGr + br + bkr - b^2r^2)/(k - G)(1 - F)$$

$$= [(1 + G - F - FG + bF + bFG + bk)r + (-b + bF - b^2F)r^2 - G - Gk]/(k - G)(1 - F)$$

$$= \left\{[-b + bF(1 - b)]r^2 + [G(1 - F + bF) + (1 - F + bF) + bk] r - G(1 + k)\right\}/(k - G)(1 - F)$$

$$= \left\{-b[1 - F(1 - b)]r^2 + [G(1 - F(1 - b)) + (1 - F(1 - b)) + bk]r - G(1 + k)\right\}/(k - G)(1 - F)$$

$$= \left\{-b[1 - F(1 - b)]r^2 + [(1 + G)(1 - F(1 - b)) + bk]r \right.$$
$$\left. -G(1 + k)\right\}/(k - G)(1 - F).$$

Let $w = -b[1 - F(1 - b)]$
$x = [1 + g][1 - F(1 - b)] + bk$
$y = -G(1 + k)$
$z = (k - G)(1 - F)$.

Then,

$$M/B = \frac{wr^2 + xr + y}{z}$$

$$= \frac{w}{z} r^2 + \frac{x}{z} r + \frac{y}{z}$$

where $\frac{w}{z}$, $\frac{x}{z}$, and $\frac{y}{z}$ are constants, and $z > 0$.

Then,

$$\frac{\delta(M/B)}{\delta r} = 2 \frac{w}{z} r + \frac{x}{z}$$

and

$$\frac{\delta^2(M/B)}{\delta r^2} = 2 \frac{w}{z}.$$

Substituting for w, x and z gives

$$\frac{\delta(M/B)}{\delta r} = \frac{-2b[1 - F(1 - b)]}{(k - G)(1 - F)} r + \frac{[1 + G][1 - F(1 - b)] + bk}{(k - G)(1 - F)}$$

and

$$\frac{\delta(M/B)}{\delta r^2} = \frac{-2b[1 - F(1 - b)]}{(k - G)(1 - F)}.$$

One can maximize M/B where

$$\frac{\delta(M/B)}{\delta r} = 0$$

$$2 \frac{w}{z} r + \frac{x}{z} = 0$$

$$r = -\frac{x}{2w}.$$

By substitution,

$$r = \frac{[1 + G][1 - F(1 - b)] + bk}{2b[1 - F(1 - b)]}$$

$$= \frac{1 + G}{2b} + \frac{k}{2[1 - F(1 - b)]}.$$

Since $\frac{\delta^2(M/B)}{\delta r^2} < 0$ for relevant values, $0 \leq b \leq 1$, $0 \leq F \leq 1$, and $k > G > 0$, the maximum M/B value should occur above r.

APPENDIX G

COMPANIES IN THE SAMPLE OF ORIGINAL COST, NORMALIZED DEPRECIATION-TAX-SAVINGS ELECTRIC UTILITIES

1. Boston Edison Company
2. Central Louisiana Electric
3. Consumers Power Company
4. Detroit Edison Company
5. Florida Power and Light
6. Florida Power Corporation
7. Hawaiian Electric Company
8. Idaho Power Company
9. Interstate Power Company
10. Iowa-Illinois Gas and Electric
11. Iowa Power and Light
12. Iowa Public Service Company
13. Kansas Gas and Electric
14. Kentucky Utilities Company
15. Louisville Gas and Electric
16. Montana-Dakota Utilities
17. New England Electric System
18. New England Gas and Electric
19. Northern States Power
20. Sierra Pacific Power Company
21. Tampa Electric Company
22. Wisconsin Electric Power
23. Wisconsin Public Service

APPENDIX H

ACTUAL DATA, NORMALIZED VALUES, AND RESIDUALS FOR ACTUAL RATE OF RETURN, RETENTION RATE, AND TOTAL ASSET GROWTH FOR FLORIDA POWER CORPORATION DURING THE YEARS 1954 - 1972

Actual Rates of Return

Year	Actual Value	Normalized Value	Residual
1954	12.196	11.963	0.233
1955	12.101	12.078	0.023
1956	13.076	12.193	0.883
1957	12.794	12.307	0.487
1958	13.555	12.422	1.133
1959	11.926	12.537	-0.611
1960	11.825	12.651	-0.826
1961	11.872	12.766	-0.894
1962	13.043	12.881	0.162
1963	12.123	12.995	-0.872
1964	12.094	13.110	-1.016
1965	12.344	13.225	-0.881
1966	13.125	13.340	-0.215
1967	13.362	13.454	-0.092
1968	13.975	13.569	0.406
1969	15.169	13.684	1.485
1970	14.929	13.798	1.131
1971	13.661	13.913	-0.252
1972	13.744	14.028	-0.284

Retention Rates

Year	Actual Value	Normalized Value	Residual
1954	31.188	33.544	-2.356
1955	32.054	34.211	-2.157
1956	42.318	34.877	7.441
1957	38.793	35.544	3.249
1958	43.236	36.210	7.026
1959	36.441	36.877	-0.436
1960	37.112	37.543	-0.431

Retention Rates - continued

Year	Actual Value	Normalized Value	Residual
1961	34.399	38.210	-3.811
1962	38.193	38.877	-0.684
1963	35.648	39.543	-3.895
1964	35.678	40.210	-4.532
1965	35.540	40.876	-5.336
1966	38.574	41.543	-2.969
1967	39.267	42.209	-2.942
1968	41.886	42.876	-0.990
1969	47.087	43.542	3.545
1970	47.335	44.209	3.126
1971	45.657	44.876	0.781
1972	50.914	45.542	5.372

Total Asset Growth

Year	Actual Value	Normalized Value	Residual
1954	13.880	8.642	5.238
1955	10.260	8.864	1.396
1956	12.040	9.087	2.953
1957	4.640	9.309	-4.669
1958	12.930	9.532	3.398
1959	10.090	9.754	0.336
1960	10.630	9.976	0.654
1961	7.070	10.199	-3.129
1962	9.790	10.421	-0.631
1963	7.810	10.644	-2.834
1964	6.260	10.866	-4.606
1965	12.340	11.089	1.251
1966	7.540	11.311	-3.771
1967	5.790	11.533	-5.743
1968	10.070	11.756	-1.686
1969	8.830	11.978	-3.148
1970	11.440	12.201	-0.761
1971	20.780	12.423	8.357
1972	20.040	12.645	7.395

APPENDIX I

REGRESSION STATISTICS FOR 23 ORIGINAL-COST, NORMALIZED-DEPRECIATION ELECTRIC UTILITIES DURING THE PERIOD 1954 - 1972, USING TREND-NORMALIZED DATA FOR RATE OF RETURN, r, RETENTION RATE, b, AND GROWTH RATE, G, IN EQUATION FORM: $M/B = B_o + B_1 r + B_2 b + B_3 g + B_4 (D/A) + \varepsilon$

Year	Constant B_o	Rate of Return r	Retention Rate b	Growth Rate G	Debt Ratio D/A	Barton's $\overline{R^2}$
1954	0.4498 (1.0900)	0.1031 (4.375)	-0.0022 (-0.4929)	0.0158 (1.6030)	-0.0023 (-0.2692)	0.6573
1955	0.2516 (0.5674)	0.1025 (4.2040)	-0.0005 (-0.1194)	0.0286 (2.6560)	0.0005 (0.0626)	0.7065
1956	0.1965 (0.3956)	0.1007 (3.8650)	0.0028 (0.5439)	0.0454 (3.6930)	-0.0021 (-0.2286)	0.7236
1957	0.4895 (0.8313)	0.1004 (3.7230)	0.0081 (1.4530)	0.0628 (4.4500)	-0.0123 (-1.224)	0.7424
1958	-0.2173 (-0.2846)	0.1238 (3.5130)	0.0132 (1.7410)	0.0801 (4.0920)	-0.0075 (-0.6288)	0.7394
1959	-0.9618 (-1.1610)	0.1532 (3.5830)	0.0200 (2.1750)	0.0973 (3.8700)	-0.0043 (-0.3428)	0.7504
1960	-1.4620 (-1.4730)	0.1650 (3.1500)	0.0205 (1.8250)	0.1349 (4.2630)	-0.0026 (-0.1738)	0.7431
1961	-2.1730 (-1.8480)	0.1476 (2.454)	0.0228 (1.7210)	0.1816 (5.0350)	0.0094 (0.5313)	0.7579
1962	-2.2060 (-1.9210)	0.1548 (2.5040)	0.0205 (1.4770)	0.1645 (4.3590)	0.0130 (0.7470)	0.7289

Year	B_o	r	b	G	D/A	Barton's $\overline{R}^2$
1963	-2.4740 (-2.3580)	0.2044 (3.3140)	0.0132 (0.9648)	0.1437 (3.7220)	0.0130 (0.8400)	0.7162
1964	-3.2630 (-3.3710)	0.2663 (4.4050)	0.0065 (0.4891)	0.1535 (3.9850)	0.0181 (1.3560)	0.7614
1965	-3.3860 (-3.4490)	0.3104 (4.6530)	0.0045 (0.3157)	0.1294 (3.1380)	0.0153 (1.1310)	0.7312
1966	-3.6720 (-3.5860)	0.3006 (4.1910)	0.0082 (0.5458)	0.1102 (2.6460)	0.0178 (1.2520)	0.6908
1967	-3.9760 (-3.8790)	0.2664 (4.0320)	0.0146 (1.0340)	0.0863 (2.3630)	0.0236 (1.7290)	0.6813
1968	-3.7420 (-4.3520)	0.2197 (4.5140)	0.0178 (1.6600)	0.0588 (2.2860)	0.0286 (2.5780)	0.7288
1969	-3.5260 (-3.5010)	0.2132 (4.3580)	0.0211 (1.9100)	0.0283 (1.1510)	0.0256 (2.0060)	0.6623
1970	-3.0770 (-2.4670)	0.2314 (4.4100)	0.0240 (2.0620)	0.0052 (0.2066)	0.0139 (0.9019)	0.6133
1971	-2.0480 (-1.7500)	0.2225 (5.0720)	0.0175 (1.8340)	-0.0074 (-0.3642)	0.0043 (0.2933)	0.6346
1972	-1.2510 (-1.0180)	0.1754 (4.7910)	0.0125 (1.5430)	-0.0164 (-0.9823)	0.0032 (0.2018)	0.5836

Notes: T-values are shown in parentheses.
T is significant at 1.734 for 0.10 probability and 18 degrees of freedom.

Source: Data are from the Compustat Annual Utility Tape. The statistics are calculated by the Regression Analysis Program for Economists.

APPENDIX J

CORRELATION MATRICES FOR DEPENDENT AND INDEPENDENT VARIABLES FOR 23 ORIGINAL-COST, NORMALIZED DEPRECIATION ELECTRIC UTILITIES DURING THE PERIOD 1954 - 1972.

1954	Market/Book Ratio M/B	Ex Post Rate of Return r	Retention Rate b	Total Asset Growth Rate G	Debt/Total Asset Ratio D/A
M/B	1.0000				
r	0.8147	1.0000			
b	0.2306	0.3595	1.0000		
G	0.4854	0.3624	0.1419	1.0000	
D/A	0.5027	0.6674	0.3609	0.2099	1.0000
1955					
M/B	1.0000				
r	0.8104	1.0000			
b	0.2878	0.3619	1.0000		
G	0.5872	0.3681	0.1558	1.0000	
D/A	0.4878	0.6132	0.2142	0.1808	1.0000
1956					
M/B	1.0000				
r	0.7647	1.0000			
b	0.3544	0.3642	1.0000		
G	0.6776	0.3736	0.1728	1.0000	
D/A	0.4011	0.5608	0.1528	0.2012	1.0000
1957					
M/B	1.0000				
r	0.7059	1.0000			
b	0.4507	0.3662	1.0000		
G	0.7177	0.3787	0.1932	1.0000	
D/A	0.2407	0.4634	0.0800	0.2687	1.0000
1958					
M/B	1.0000				
r	0.7147	1.0000			
b	0.5039	0.3681	1.0000		
G	0.7053	0.3828	0.2178	1.0000	
D/A	0.1589	0.3368	-0.1012	0.1988	1.0000

1959	Market/Book Ratio M/B	Ex Post Rate of Return r	Retention Rate b	Total Asset Growth Rate G	Debt/Total Asset Ratio D/A
M/B	1.0000				
r	0.7237	1.0000			
b	0.5508	0.3695	1.0000		
G	0.6938	0.3851	0.2468	1.0000	
D/A	0.1561	0.2886	-0.1054	0.1975	1.0000
1960					
M/B	1.0000				
r	0.6913	1.0000			
b	0.5309	0.3705	1.0000		
G	0.7360	0.3844	0.2803	1.0000	
D/A	0.1556	0.2886	-0.1590	0.1814	1.0000
1961					
M/B	1.0000				
r	0.6468	1.0000			
b	0.5124	0.3709	1.0000		
G	0.7886	0.3792	0.3176	1.0000	
D/A	0.1179	0.2675	-0.3106	0.0613	1.0000
1962					
M/B	1.0000				
r	0.6589	1.0000			
b	0.5051	0.3705	1.0000		
G	0.7608	0.3677	0.3570	1.0000	
D/A	0.1541	0.2706	-0.3601	0.0644	1.0000
1963					
M/B	1.0000				
r	0.7145	1.0000			
b	0.4664	0.3691	1.0000		
G	0.7050	0.3486	0.3955	1.0000	
D/A	0.1987	0.2547	-0.3478	0.0321	1.0000
1964					
M/B	1.0000				
r	0.7570	1.0000			
b	0.4148	0.3667	1.0000		
G	0.6739	0.3215	0.4291	1.0000	
D/A	0.2417	0.2086	-0.3370	-0.0297	1.0000

1965	Market/Book Ratio M/B	Ex Post Rate of Return r	Retention Rate b	Total Asset Growth Rate G	Debt/Total Asset Ratio D/A
M/B	1.0000				
r	0.7797	1.0000			
b	0.4068	0.3630	1.0000		
G	0.5954	0.2877	0.4542	1.0000	
D/A	0.2778	0.2469	-0.2954	-0.0122	1.0000
1966					
M/B	1.0000				
r	0.7652	1.0000			
b	0.4173	0.3579	1.0000		
G	0.5433	0.2504	0.4687	1.0000	
D/A	0.2920	0.2709	-0.2972	-0.0510	1.0000
1967					
M/B	1.0000				
r	0.7516	1.0000			
b	0.4349	0.3515	1.0000		
G	0.5006	0.2133	0.4728	1.0000	
D/A	0.2672	0.2114	-0.3618	-0.1171	1.0000
1968					
M/B	1.0000				
r	0.7541	1.0000			
b	0.4447	0.3438	1.0000		
G	0.4721	0.1799	0.4682	1.0000	
D/A	0.2710	0.1300	-0.4181	-0.1218	1.0000
1969					
M/B	1.0000				
r	0.7521	1.0000			
b	0.4689	0.3349	1.0000		
G	0.3762	0.1520	0.4576	1.0000	
D/A	0.1557	0.0508	-0.4681	-0.1054	1.0000
1970					
M/B	1.0000				
r	0.7522	1.0000			
b	0.5289	0.3254	1.0000		
G	0.2707	0.1306	0.4434	1.0000	
D/A	-0.0534	-0.0416	-0.4430	-0.0558	1.0000

1971	Market/Book Ratio M/B	Ex Post Rate of Return r	Retention Rate b	Total Asset Growth Rate G	Debt/Total Asset Ratio D/A
M/B	1.0000				
r	0.7892	1.0000			
b	0.4926	0.3154	1.0000		
G	0.1619	0.1152	0.4273	1.0000	
D/A	-0.1345	-0.0783	-0.3824	0.0683	1.0000
1972					
M/B	1.0000				
r	0.7688	1.0000			
b	0.4178	0.3054	1.0000		
G	0.0318	0.1051	0.4106	1.0000	
D/A	-0.1931	-0.1281	-0.3742	0.1842	1.0000

APPENDIX K

MARKET/BOOK RATIOS CALCULATED FROM EQUATION (25) COMPARED TO ACTUAL VALUES DURING 1972

All Cases

Riskless Rate = Aaa Utility Bond Yield = 7.46%
Estimated Long-Term Growth Rate = 6.00%
Flotation Cost = 10.00%

Case 1

Risk Premium = 2.97%
Industry Average Required Rate of Return = 10.43%
Uncorrected R^2 = 0.6028
Barton's $\overline{R}^2$ = 0.5834

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.27	1.26	0.01
2	2.16	2.02	0.13
3	1.12	1.19	-0.06
4	1.07	1.14	-0.07
5	1.80	1.84	-0.04
6	1.90	2.16	-0.26
7	1.46	1.08	0.38
8	1.51	1.18	0.33
9	1.31	1.05	0.26
10	1.12	1.61	-0.49
11	1.21	1.39	-0.17
12	1.13	1.31	-0.18
13	1.20	1.35	-0.15
14	1.16	1.63	-0.47
15	1.79	2.05	-0.26
16	1.21	1.30	-0.09
17	1.20	0.91	0.29
18	1.19	1.15	0.04
19	1.43	1.65	-0.22
20	1.34	1.01	0.34
21	2.07	1.99	0.09
22	1.07	0.83	0.24
23	1.18	1.13	0.05

Case 2

Risk Premium = 3.08%
Industry Average Required Rate of Return = 10.54%
Uncorrected R^2 = 0.6022
Barton's $\overline{R}^2$ = 0.5828

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.27	1.25	0.03
2	2.16	2.14	0.02
3	1.12	1.16	-0.04
4	1.07	1.10	-0.03
5	1.80	2.02	-0.21
6	1.90	2.37	-0.47
7	1.46	1.04	0.43
8	1.51	1.16	0.34
9	1.31	1.02	0.29
10	1.12	1.66	-0.55
11	1.21	1.40	-0.19
12	1.13	1.31	-0.18
13	1.20	1.36	-0.16
14	1.16	1.71	-0.55
15	1.79	2.20	-0.41
16	1.21	1.29	-0.08
17	1.20	0.86	0.35
18	1.19	1.11	0.08
19	1.43	1.71	-0.28
20	1.34	0.94	0.40
21	2.07	2.10	-0.03
22	1.07	0.75	0.32
23	1.18	1.10	0.08

Case 3

Risk Premium = 3.14%
Industry Average Required Rate of Return = 10.60%
Uncorrected R^2 = 0.6053
Barton's $\overline{R}^2$ = 0.5859

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.27	1.22	0.05
2.	2.16	2.10	0.05
3	1.12	1.14	-0.02
4	1.07	1.07	0.00
5	1.80	1.95	-0.15
6	1.90	2.31	-0.41
7	1.46	1.01	0.45
8	1.51	1.15	0.35
9	1.31	1.01	0.30
10	1.12	1.63	-0.52
11	1.21	1.38	-0.17
12	1.13	1.28	-0.15
13	1.20	1.34	-0.14
14	1.16	1.67	-0.51
15	1.79	2.16	-0.37
16	1.21	1.28	-0.07
17	1.20	0.85	0.36
18	1.19	1.09	0.10
19	1.43	1.68	-0.25
20	1.34	0.92	0.42
21	2.07	2.06	0.01
22	1.07	0.74	0.33
23	1.18	1.07	0.10

Case 4

Risk Premium = 4.28%
Industry Average Required Rate of Return = 11.74%
Uncorrected R^2 = 0.6194
Barton's $\overline{R^2}$ = 0.6004

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.27	0.90	0.38
2	2.16	1.64	0.52
3	1.12	0.85	0.27
4	1.07	0.72	0.35
5	1.80	1.22	0.58
6	1.90	1.59	0.31
7	1.46	0.73	0.73
8	1.51	0.95	0.56
9	1.31	0.84	0.47
10	1.12	1.23	-0.11
11	1.21	1.11	0.10
12	1.13	0.93	0.20
13	1.20	1.02	0.18
14	1.16	1.13	0.03
15	1.79	1.59	0.20
16	1.21	1.03	0.18
17	1.20	0.67	0.53
18	1.19	0.77	0.42
19	1.43	1.25	0.18
20	1.34	0.65	0.69
21	2.07	1.59	0.48
22	1.07	0.57	0.49
23	1.18	0.78	0.40

Case 5

Risk Premium = 4.60%
Industry Average Required Rate of Return = 12.06%
Uncorrected R^2 = 0.6159
Barton's $\overline{R}^2$ = 0.5968

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.27	0.83	0.44
2	2.16	1.54	0.62
3	1.12	0.80	0.32
4	1.07	0.85	0.42
5	1.80	1.10	0.70
6	1.90	1.46	0.44
7	1.46	0.68	0.79
8	1.51	0.90	0.60
9	1.31	0.80	0.51
10	1.12	1.15	-0.03
11	1.21	1.06	0.16
12	1.13	0.87	0.27
13	1.20	0.95	0.25
14	1.16	1.04	0.12
15	1.79	1.48	0.31
16	1.21	0.98	0.23
17	1.20	0.64	0.57
18	1.19	0.71	0.48
19	1.43	1.17	0.26
20	1.34	0.60	0.74
21	2.07	1.49	0.58
22	1.07	0.54	0.53
23	1.18	0.73	0.45

APPENDIX L

MARKET/BOOK RATIOS CALCULATED FROM EQUATION (25)
COMPARED TO ACTUAL VALUES DURING 1970

All Cases

Riskless Rate = Aaa Utility Bond Yield = 8.31%
Estimated Long-Term Growth Rate = 6.00%
Flotation Cost = 10.00%

Case 1

Risk Premium = 2.97%
Industry Average Required Rate of Return = 11.28%
Uncorrected R^2 = 0.5268
Barton's $\overline{R}^2$ = 0.5057

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.28	0.93	0.35
2	2.56	1.58	0.98
3	1.35	1.01	0.35
4	1.14	0.88	0.25
5	2.06	1.48	0.58
6	2.54	1.61	0.92
7	1.64	0.79	0.85
8	1.55	0.97	0.58
9	1.28	0.94	0.33
10	1.29	1.29	0.00
11	1.37	1.09	0.29
12	1.18	1.10	0.08
13	1.30	1.30	0.00
14	1.38	1.35	0.02
15	1.80	1.73	0.07
16	1.17	1.12	0.06
17	1.14	0.73	0.41
18	1.20	0.90	0.30
19	1.36	1.32	0.04
20	1.72	0.90	0.82
21	2.48	1.61	0.87
22	1.06	0.69	0.37
23	1.19	0.89	0.30

Case 2

Risk Premium = 3.08%
Industry Average Required Rate of Return = 11.39%
Uncorrected R^2 = 0.5258
Barton's $\overline{R}^2$ = 0.5047

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.28	0.87	0.41
2	2.56	1.62	0.95
3	1.35	0.96	0.39
4	1.14	0.80	0.33
5	2.06	1.52	0.54
6	2.54	1.66	0.87
7	1.64	0.71	0.93
8	1.55	0.94	0.61
9	1.28	0.91	0.37
10	1.29	1.28	0.01
11	1.37	1.06	0.31
12	1.18	1.07	0.11
13	1.30	1.29	0.01
14	1.38	1.36	0.02
15	1.80	1.80	0.00
16	1.17	1.09	0.08
17	1.14	0.67	0.47
18	1.20	0.84	0.37
19	1.36	1.32	0.04
20	1.72	0.83	0.88
21	2.48	1.65	0.83
22	1.06	0.61	0.45
23	1.19	0.83	0.36

Case 3

Risk Premium = 3.14%
Industry Average Required Rate of Return = 11.45%
Uncorrected R^2 = 0.5253
Barton's $\overline{R}^2$ = 0.5041

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.28	0.85	0.42
2	2.56	1.60	0.97
3	1.35	0.95	0.41
4	1.14	0.79	0.35
5	2.06	1.48	0.58
6	2.54	1.64	0.90
7	1.64	0.69	0.94
8	1.55	0.93	0.62
9	1.28	0.90	0.38
10	1.29	1.27	0.02
11	1.37	1.05	0.32
12	1.18	1.06	0.13
13	1.30	1.27	0.02
14	1.38	1.33	0.04
15	1.80	1.77	0.03
16	1.17	1.08	0.09
17	1.14	0.66	0.48
18	1.20	0.82	0.38
19	1.36	1.30	0.06
20	1.72	0.82	0.90
21	2.48	1.63	0.85
22	1.06	0.60	0.46
23	1.19	0.82	0.37

Case 4

Risk Premium = 4.28%
Industry Average Required Rate of Return = 12.59%
Uncorrected R^2 = 0.5051
Barton's $\overline{R}^2$ = 0.4835

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.28	0.66	0.61
2	2.56	1.30	1.27
3	1.35	0.74	0.61
4	1.14	0.58	0.56
5	2.06	1.04	1.02
6	2.54	1.23	1.30
7	1.64	0.54	1.10
8	1.55	0.78	0.77
9	1.28	0.76	0.51
10	1.29	1.02	0.27
11	1.37	0.89	0.48
12	1.18	0.82	0.36
13	1.30	1.00	0.30
14	1.38	0.98	0.39
15	1.80	1.36	0.44
16	1.17	0.90	0.28
17	1.14	0.54	0.59
18	1.20	0.63	0.57
19	1.36	1.03	0.33
20	1.72	0.62	1.09
21	2.48	1.30	1.18
22	1.06	0.49	0.58
23	1.19	0.65	0.54

Case 5

Risk Premium = 4.60%
Industry Average Required Rate of Return = 12.91%
Uncorrected R^2 = 0.4979
Barton's $\overline{R}^2$ = 0.4761

Company Number	Actual M/B	Predicted M/B	Residual (Actual-Predicted)
1	1.28	0.62	0.65
2	2.56	1.23	1.33
3	1.35	0.69	0.66
4	1.14	0.54	0.60
5	2.06	0.96	1.10
6	2.54	1.15	1.38
7	1.64	0.50	1.13
8	1.55	0.74	0.81
9	1.28	0.73	0.55
10	1.29	0.96	0.32
11	1.37	0.85	0.52
12	1.18	0.77	0.41
13	1.30	0.94	0.36
14	1.38	0.92	0.46
15	1.80	1.28	0.52
16	1.17	0.88	0.32
17	1.14	0.52	0.62
18	1.20	0.59	0.61
19	1.36	0.97	0.38
20	1.72	0.58	1.13
21	2.48	1.23	1.25
22	1.06	0.46	0.60
23	1.19	0.61	0.58

APPENDIX M

CALCULATION OF INVESTORS' REQUIRED RATE OF RETURN FROM THE M/B EQUATION

$$M/B = \frac{r(1 - b)(1 + g - br)(1 - F) - (G - br)(1 + k - br)}{(k - G)(1 - F)}.$$

Substituting $x = r(1 - b)(1 + G - br)(1 - F)$ simplifies the above equation to the following:

$$M/B = \frac{x - (G - br)(1 + k - br)}{(k - G)(1 - F)}.$$

Dividing through by M/B results in

$$1 = \frac{x - (G - br)(1 + k - br)}{(k - G)(1 - F)(M/B)}.$$

Substituting $y = (1 - F)(M/B)$ gives

$$1 = \frac{x - (G - br)(1 + k - br)}{(k - G)y}.$$

Multiplying through by $(k - G)y$ results in

$$(k - G)y = x - (G - br)(1 + k - br)$$

$$ky - Gy = x - (G - br)(1 - br) - (G - br)k$$

$$ky + k(G - br) = x - (G - br)(1 - br) + Gy$$

$$k(y + G - br) = x - (G - br)(1 - br) + gy$$

$$k = \frac{x - (G - br)(1 - br) + Gy}{y + G - br}.$$

Substituting for x and y and rearranging terms results in the following equation for k:

$$k = \frac{r(1 - b)(1 + G - br)(1 - F) - (G - br)(1 - br) + G(1 - F)(M/B)}{(1 - F)(M/B) + G - br}$$

$$= \frac{r(1 + G - br - b - bG + b^2r)(1 - F) - (G - Gbr - br + b^2r^2) + G(1 - F)(M/B)}{(1 - F)(M/B) + G - br}$$

$$= \frac{[r + Gr - br^2 - br - Gbr + b^2r^2 - Fr - FGr + Fbr^2 + Fbr + FGbr - Fb^2r^2 + Gbr + br - b^2r^2 - G + G(1 - F)(M/B)]}{[(1 - F)(M/B) + G - br]}$$

$$= \frac{(bF - b^2F - b)r^2 + (1 + G - F - FG + bF + bFG)r - G + G(1 - F)(M/B)}{(1 - F)(M/B) + G - br}$$

$$= \frac{b[F(1 - b) - 1]r^2 + \{1 + G - F[G(1 - b) + (1 - b)]\}r - G + G(1 - F)(M/B)}{(1 - F)(M/B) + G - br}$$

$$= \frac{b[F(1 - b) - 1]r^2 + (1 + G)[1 - F(1 - b)]r + G[(1 - F)(M/B) - 1]}{(1 - F)(M/B) + G - br}$$

APPENDIX N

INFLATION PREMIUMS

This appendix derives a relationship between I_r and I_k that will allow the M/B to remain the same after inflation as before inflation.

Before inflation:

$$M/B = r_o(1 - b)/(k_o - br_o). \tag{N-1}$$

Let I_k = the inflation premium added to the investors' required rate of return and I_r = the inflation premium added to the allowed rate of return.

With inflation:

$$M/B = \frac{(r_o + I_r)(1 - b)}{(k_o + I_k) - b(r_o + I_r)}.$$

$$k_oM/B + I_kM/B - br_oM/B - I_rbM/B = r_o - br_o + I_r - bI_r$$

$$k_oM/B - br_oM/B - r_o + br_o + I_kM/B = I_r - bI_r + I_rbM/B$$

$$M/B(k_o + I_k) - r_o(1 - b + bM/B) = I_r(1 - b + bM/B)$$

$$I_r = \frac{M/B(k_o + I_k)}{1 - b + bM/B} - r_o. \tag{N-2}$$

But before any inflation, the M/B was given by Equation (N-1). Since this original M/B is to be maintained, one can substitute Equation (N-1) into Equation (N-2) and simplify to obtain Equation (23) in the text.

$$I_r = \frac{[r_o(1 - b)/(k_o - br_o)][k_o + I_k]}{1 - b + b[r_o(1 - b)/(k_o - br_o)]} - r_o$$

$$= \frac{[k_o r_o(1 - b) + I_k r_o(1 - b)]/[k_o - br_o]}{[k_o - br_o - bk_o + b^2 r_o + br_o(1 - b)]/[k_o - br_o]} - r_o$$

$$= \frac{k_o r_o(1 - b) + I_k r_o(1 - b)}{k_o - br_o - bk_o + b^2 r_o + br_o - b^2 r_o} - r_o$$

$$= \frac{k_o r_o(1 - b) + I_k r_o(1 - b)}{k_o(1 - b)} - r_o$$

$$= r_o + \frac{I_k r_o}{k_o} - r_o$$

$$= \frac{I_k r_o}{k_o}$$

$$\frac{I_r}{I_k} = \frac{r_o}{k_o}. \qquad (23)$$

Equation (23) must hold if a firm is to maintain its pre-inflation M/B.

APPENDIX O

SAMPLE CALCULATIONS FOR CURRENT-DOLLAR VALUE OF EQUITY FOR ALLEGHENY POWER SYSTEM

Year	B (Book Value)	ΔB (Change in Book Value)	CPI Ratio	ΔB x CPI	Σ(ΔB x CPI) (Current Dollar Value of Equity)
1953	104.1000	104.1000	1.5643	162.8436	162.8436
1954	113.1000	9.0000	1.5565	14.0085	176.8521
1955	122.4000	9.3000	1.5623	14.5294	191.3814
1956	132.0000	9.6000	1.5393	14.7773	206.1587
1957	155.0000	23.0000	1.4864	34.1872	240.3459
1958	164.2000	9.2000	1.4469	13.3115	253.6574
1959	156.0000	-8.2000	1.4353	-11.7695	241.8879
1960	173.0000	17.0000	1.4126	24.0142	265.9021
1961	177.2650	4.2650	1.3984	5.9642	271.8662
1962	186.4170	9.1520	1.3830	12.6572	284.5232
1963	195.5280	9.1110	1.3664	12.4493	296.9724
1964	203.0940	7.5660	1.3488	10.2050	307.1772
1965	230.3100	27.2160	1.3259	36.0857	343.2627
1966	239.6860	9.3760	1.2891	12.0866	355.3491
1967	250.4210	10.7350	1.2530	13.4510	368.8000
1968	261.1160	10.6950	1.2025	12.8607	381.6606
1969	308.2090	47.0930	1.1412	53.7425	435.4031
1970	358.0120	49.8030	1.0774	53.6578	489.0605
1971	419.3018	61.2898	1.0330	63.3124	552.3728
1972	442.9729	23.6711	1.0000	23.6711	576.0439

APPENDIX P

ILLUSTRATIONS OF ACCOUNTING METHODS WITH 10 PERCENT INFLATION AND NO OTHER TRANSACTIONS

Traditional Method Without Provision for Inflation

Balance Sheet (December 31, $ Millions)

	1973	1974
Monetary assets	$ 1.0	$ 1.0
Non-monetary assets	2.0	2.0
Total	$ 3.0	$ 3.0
Long-term liabilities	$ 2.0	$ 2.0
Capital stock	0.5	0.5
Retained earnings	0.5	0.5

Income Statement

(No transactions.)

Retained Earnings Account

(No transactions.)

APB Statement No. 3 Method

Balance Sheet (December 31 $ Millions)

	1973	1974
Monetary assets	$ 1.0	$ 1.0
Non-monetary assets	2.0	2.2
Total	$ 3.0	$ 3.2
Long-term liabilities	$ 2.0	$ 2.0
Capital stock	0.5	0.55
Retained earnings	0.5	0.65
Total	$ 3.0	$ 3.2

APB Statement No. 3 Method - continued

Income Statement - 1974

Loss on monetary assets	($ 0.1)
Gain on liabilities	0.2
Net Income	$ 0.1

Retained Earnings Account

Beginning balance (Restated in 1974 dollars)	$ 0.55
Net income	0.1
Ending Balance (December 31, 1974)	$ 0.65

Indiana Telephone Company Method

Balance Sheet (December 31, $ Millions)

	1973	1974
Monetary assets	$ 1.0	$ 1.0
Non-monetary assets	2.0	2.2
Total	$ 3.0	$ 3.2
Long-term liabilities	$ 2.0	$ 2.0
Capital stock	0.5	0.55
Retained earnings	0.5	0.45
Unrealized gain on liabilities	-0-	0.2
Total	$ 3.0	$ 3.2

Income Statement - 1974

Loss on monetary assets	$ 0.1
Net Loss	$ 0.1

Retained Earnings Account

Beginning balance (Restated in 1974 dollars)	$ 0.55
Net loss	(0.1)
Ending Balance (December 31, 1974)	$ 0.45

Inflation Reserve Method (Agrawal)

Balance Sheet (December 31, $ Millions)

	1973	1974
Monetary assets	$ 1.0	$ 1.0
Non-monetary assets	2.0	2.0
Total	$ 3.0	$ 3.0

Inflation Reserve Method (Agrawal) - continued

	1973	1974
Long-term liabilities	$ 2.0	$ 2.0
Capital stock	0.5	0.5
Retained earnings	0.5	0.45
Inflation reserve	-0-	0.05
Total	$ 3.0	$ 3.0

Income Statement - 1974

Loss from inflation (10% of contributed risk capital)	$ 0.05
Net Loss	$ 0.05

Retained Earnings Account

Beginning balance	$ 0.5
Net loss	(0.05)
Ending Balance	$ 0.45

Note: All cases assume 10 percent inflation during 1974. In order to isolate the effects of inflation-accounting procedures, it is assumed that no other transactions occur during the year.

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BIOGRAPHICAL SKETCH

Thomas Arthur Bankston was born in San Angelo, Texas, on April 21, 1942, the son of T. Herschel and Marie E. Bankston. He graduated from San Angelo Central High School in May 1960, and entered The University of Texas at Austin in September 1960. After receiving the degrees of Bachelor of Business Administration in June 1965, and Master of Business Administration in June 1966, he went to work for Phillips Petroleum Company in Bartlesville, Oklahoma, as a sales-production coordinator. In December 1968, he married Joan E. Miletto of Palatine, Illinois. He entered the Graduate School of the University of Florida at Gainesville in September 1969, where he was a student, teaching assistant, and instructor. In August 1974, he joined the faculty of Angelo State University in San Angelo, Texas.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Eugene F. Brigham, Chairman
Graduate Research Professor of Finance

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Sanford V. Berg
Assistant Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

H. Russell Fogler
Associate Professor of Management

This dissertation was submitted to the Graduate Faculty of the Department of Finance, Insurance, Real Estate and Urban Land Studies in the College of Business Administration and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Dean, Graduate School