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HAZARDOUS TERRAIN: THE USE OF FINANCIAL INDICATORS IN UTILITY REGULATION

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Abstract

The typical practice of public utility regulation involves an extensive audit of cost information to establish compensatory revenue requirements. Much of this effort could be avoided if regulators could rely on financial indicators of firm performance. A common index is the firm's market-to-book ratio, or Tobin's *q*. Tobin's *q* differs from commonly reported market-to-book ratios, which include only equity capital and are not corrected for the effects of inflation and arbitrary accounting rules. These adjustments have very large quantitative impacts. Over the period 1969-1988, the stockholder equity market-to-book ratio of 114 utilities averaged 1.03. The adjusted Tobin's *q* values for these utilities averaged only 0.43 and dropped as low as 0.25 in 1981. These results suggest caution in the use of market-to-book data for utility regulation.

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I. Introduction

Public utility regulation attempts to provide management with incentives to achieve efficient operations while limiting profits to a normal return on capital. The determination of a "normal" return has been an elusive goal. Early legal decisions focused on rates that provided a regulated firm with a normal return on its market value, but failed to appreciate the circular dependence of market value on the allowed return.[1] With the passage of time, the locus of regulatory oversight shifted to the determination of a fair rate of return on the cost of the assets that are employed, as exemplified in the *Hope Natural Gas* decision.[2] Although this eliminated the circularity that plagued the earlier approach to rate setting, the focus on return on assets provided little guidance to determine the magnitude of an appropriate rate of return.

Investment theory, as articulated by Tobin [1969] and Tobin and Brainard [1977], provides a connection between the market value of a firm and the determination of a fair rate of

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[1] *Smyth v. Ames* provides a classic illustration of the difficulties of setting rates based on market value. See the discussion in Kahn [1970], p.38.

[2] Federal Power Commission v. Hope Natural Gas (1944).

return. Tobin and Brainard [1977], following Keynes, argued that it is efficient for a firm to invest if, on the margin, the investment adds more to the market value of the firm than the investment costs. Tobin used the letter q to represent the ratio of market value to investment cost. Greenwald [1984] applied Tobin's q theory to the economic theory of public utility regulation and proved the correspondence between a return equal to a utility's cost of capital and a unitary value of q for the utility. According to Greenwald, if the objective is to assure a return that compensates a utility for its cost of capital, the regulator need only raise rates if q less than one, and lower them if q exceeds one. Setting rates based on the firm's q value relieves the regulator of the need to undertake an expensive and time-consuming accounting of the firm's cost of capital and other factors of production in order to establish compensatory rates.

If Tobin's q is to be used as an indicator of the financial health of a firm and as an instrument of regulatory policy, it is clearly important that measures of the firm's q be accurate and appropriate to their intended purpose. Financial reports are common sources of information relevant to the determination of Tobin's q. It is generally recognized that these measures are imperfect. The financial sources report the ratio of the market value of stockholder equity to the firm's book value of stockholder equity (the "market-to-book" ratio). The reported values are distorted by inflation and tax accounting (specifically depreciation) that affects the appropriate measure of the firm's book value. Moreover, the focus on stockholder equity provides an incomplete picture of the value of the firm, which also includes that market and book values of its debt.

This paper examines the divergence between commonly cited q values and the corrected measures for a sample of 114 privately owned firms in the United States providing electric services (sic 4911) or electric and gas services (sic 4931) for each calendar year from 1969 through 1988. We follow the analysis in Tobin and Brainard [1977] and Lindenberg and Ross

[1981], except that we focus on the regulated electric and gas utilities.[3] The differences between the stockholder equity market-to-book values (which is the number typically reported in financial sources) and the corrected q values computed in this study are striking. Over the period 1969-1988, the stockholder equity market-to-book ratio of the 114 utilities averaged 1.03. The adjusted q values for the 114 utilities averaged only 0.43 for this period, and dropped as low as 0.25 in 1981.

Most of the difference between the unadjusted stockholder equity market-to-book values and the adjusted q values can be explained by including debt in the market-to-book calculation and by adjusting the book value of plant for inflation. Including debt lowers the ratio from an average of 1.03 to 0.87 over the entire sample period, although most of the decrease occurs in the early years when equity capital earned a large premium relative to debt. Adjusting the book value of capital for inflation reduces the total market-to-book ratio from 0.87 down to 0.50 over the sample period. Changing the depreciation calculation from the straight-line method used for tax purposes to an exponential rate, which better approximates true economic depreciation, has a much smaller effect, lowering the average q value to 0.43.

The adjusted q values for the 114 electric and gas utilities in this study are much lower than the corresponding values for manufacturing industries. The adjusted Tobin's q is about 1.1 for manufacturing over the period 1969-87, more than twice the market-to-book value for our utility sample. Although some of the difference in the adjusted q values is simply the result of a low valuation of equity capital for regulated utilities, most of the difference can be explained by the inflation adjustment. The average age of installed capital over the sample period is about nine years for the utilities in the sample, compared to only about two years for manufacturing.

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[3] Hall (1993) employs a version of the model used in this paper to estimate the market valuation of intangible R&D assets.

This results in a much larger inflation adjustment on average for utility capital than for manufacturing.

A main conclusion of this analysis is that unadjusted market-to-book ratios are essentially useless as a barometer of the effectiveness of regulation. The differences between commonly available market-to-book measures and economically correct measures of financial performance are very large. Moreover, these differences are not stable over time. The adjustments necessary to correct the reported stockholder equity market-to-book ratio to an economic measure of financial performance varied over the sample time period from about 40 to 70 percent for the aggregate values of all the utilities in the sample. For individual utilities, the necessary adjustments could be even more variable. This means that an economically meaningful measure of utility financial performance would require an extensive and idiosyncratic analysis of the circumstances of each regulated utility. Although the use of financial indices as inputs into utility regulation may not be quite the Holy Grail of public utility regulation, much effort would required on the part of utility regulators before financial measures could be relied upon as reliable indicators of economic performance.

Section II describes the data for this study. The model used to calculate Tobin's q is described in Section III. This is a version of the SLEPIAN model introduced by Brainard, Shoven, and Weiss, and modified by Hall et. al. [1988]. This section explains the construction of Tobin's q, the basic features of the model, and the corrections that are made to convert financial data to a meaningful estimate of Tobin's q. Section IV describes the results for the utilities in the sample and Section V examines the robustness of the results to different assumptions. Section VI concludes.

II. The Data

The data needed to compute Tobin's q consist of statistics at the level of the individual firm and industry aggregates. All of the firm-level data, except for inventories, came from Standard and Poor's Compustat Service. The Compustat data were available for each firm in our 114-firm sample on an annual basis for most of the years in the study period, 1969-1988. These data include the acquisition book value of the firm's physical plant and other investments (for the denominator of q) and the market value and structure of the firm's assets (for the numerator). The book values of inventories and the inventory valuation methods were obtained from consolidated balance sheets in *Moody's Public Utility Manual.*

Aggregate-level data were needed for inflation adjustments and for the calculation of asset yields for market valuation. The yields on long term debt were approximated by the average yield on BAA public utility bonds in *Moody's Public Utility Manual.* These yields were inflation adjusted using the GNP deflator for fixed non-residential investment from the *Economic Report of the President.* Utility plant and equipment costs were deflated using the Handy-Whitman Index of Public Utility Construction Costs, published in the *Statistical Year Book of the Electric Utility Industry.* Two other aggregate data items were needed for 1969-88. These were a deflator for manufacturing inventories, computed from data in the *Economic Report of the President,*[4] and the preferred dividend rate for medium risk companies, taken from the *Survey of Current Business.*

Both the book and market values of the firm's debt depend on its term structure. This information was not available from *Compustat*, but instead had to be pieced together from annual reports. As an approximation, an initial structure of long-term debt was assumed that was the same for every utility in the sample. This initial structure was modeled after the actual debt

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[4] A deflator specifically for public utility inventories was not available.

structures of three of the large electric utilities in the sample (American Electric Power, Illinois Power, and Pacific Gas & Electric) under the assumption that all long-term debt has a maturity of thirty years.[5] These structures were averaged and smoothed using a three-year moving average. The debt structure for each utility in the sample was updated in each year of the study period by using *Compustat* data on the firm's total outstanding debt, as described in Section III below.

III. Calculation of Tobin's q

Tobin's q values were calculated using the SLEPIAN program introduced in Brainard, Shoven, and Weiss [1980] and subsequently modified by Hall et. al. [1988]. The program computes an annual Tobin's q for each firm and an aggregate q for all 114 firms for the period 1969-88.

The numerator of Tobin's q is the market value of the firm's total assets, which may be written as

$$N_t = STOCK_t + LTDEBT_t + STDEBT_t - ADJ_t. \quad (1)$$

$STOCK_t$ is the sum of the values of the firm's common and preferred stock in year t. Common stock is valued at the closing price at the end of the calendar year times the number of outstanding shares. The value of the firm's preferred stock is calculated by capitalizing the

[5] Some of the firms in the sample had missing data which necessitated calculation of their market-to-book ratios beginning in a year after 1969. For these firms, the initial debt structure was an average of the debt structures of American Electric Power, Illinois Power, and Pacific Gas & Electric corresponding to the first year for which complete data were available. For example, if a firm had complete data only for the years 1973-1988, the initial debt structure was the average of the debt structures of the three utilities for 1973.

firm's total payment of preferred dividends at a rate equal to the preferred dividend rate for medium-sized companies.

The market value of long-term debt is calculated from its book value as follows. All long-term debt is assumed to be issued for a period of 30 years. Debt issued in year t_0 is assumed to have a coupon rate equal to the composite average of yields on public utility bonds for that year, as reported in *Moody's Public Utility Manual.* The value in year t of long-term debt issued in year t_0, $P_t(t_0)$, is equal to the present value of the remaining coupon yield plus the present value of the bond's principal. The present value is calculated by discounting the coupon yield and the bond's principal at the rate equal to the composite average of yields on public utility bonds for year t. Specifically, in year t, the market value of a \$1 bond issued in year t_0 with a coupon rate r_0 is (for $t_0 \leq t \leq t_0 + 30$)

$$P_t(t_0) = \sum_{i=t}^{t_0+30} \frac{r_0}{(1+r_t)^{i-t}} + \frac{1}{(1+r_t)^{t_0+30-t}}. \tag{2}$$

Let $n_t(t_0)$ represent for year t the dollar amount of long-term bonds that were issued by the firm in year t_0. The total market value in year t of all of a firm's long-term debt is $LTDEBT_t = \sum_{t_0=t-30}^{t} n_t(t_0)\, P_t(t_0)$.

The assumed initial debt structure was used along with changes in the firm's book value of debt to estimate the total value of the firm's debt for each year in the sample period. For the first year in the sample period $n_t(t_0)$ was estimated using the assumed initial structure of long-term debt described in Section II (modelled after the average of three large utilities). For subsequent years, changes in the firm's book value of debt from one year to the next were used to improve the estimate of the firm's actual debt structure. If the firm's debt in year t minus its debt in year t-1 exceeded the amount that was assumed to become due, the difference was taken to be newly issued debt in year t with a thirty-year maturity. If the difference was less than assumed, the term structure was re-normalized so that the total amount of debt was equal to the firm's actual outstanding debt in year t. For each year, the market value of the firm's debt was calculated using the updated term structure and the valuation formula given by equation (2). The sensitivity of our results to the long-term debt initialization procedure is discussed in Section V.

Short-term debt is debt with a maturity of one year or less and has a market value equal to its book value. The final term in equation (1) is an adjustment factor, which is equal to net short term assets minus the book value of inventories. This is subtracted from the measure of the firm's market value because the short term assets are capitalized in the market value of the firm's equity, but excluded from our measure of the book value of the firm. They are subtracted from the measure of the firm's market value to avoided double counting.[6]

In the evaluation of Tobin's q, the relevant comparison is the market value of the firm's assets (the numerator) to its current replacement value (the denominator). The denominator of Tobin's q is

$$D_t = NPLANT_t + ADJINV_t + ADJTOT_t. \quad (3)$$

These are the total physical assets of the firm, which consist of its net plant ($NPLANT_t$), inventories ($ADJINV_t$), and investments in unconsolidated subsidiaries and intangibles plus other investments ($ADJTOT_t$). The firms' assets are usually reported at their historical costs less accounting depreciation. Converting this number to a replacement cost requires adjusting the acquisition costs for inflation and adjusting book depreciation to more closely approximate true economic depreciation.

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[6] See Hall et al (1988), p.12.

In computing net plant, the first step is to determine the average age of the firm's plant and equipment to facilitate the adjustment for inflation and depreciation. An initial estimate of the average age of the firm's assets is obtained by dividing the firm's reported accumulated depreciation by its depreciation reported for the current year. This is an accurate measure of the average life of the firm's assets if the firm follows the straight-line convention for depreciation and if all assets have the same useful life. In 1976, 97% of utility companies used straight-line depreciation.[7] Yearly fluctuations in depreciation methods and in the mix of asset lifetimes introduce variation in the calculated lifetimes, which are minimized by smoothing.[8]

Straight-line depreciation, the method commonly used by utilities, does not accurately reflect the economic aging of capital assets. Straight-line depreciation suggests that a machine gradually loses its usefulness during the entire course of its life. In most situations a more reasonable assumption is that a machine breaks down with greater likelihood and severity towards the end of its life, so that it is close to fully productive during much of its life and increasingly less useful towards the end. An exponential depreciation process better captures this conception of aging. We assume in our calculations that the amount of an asset that has depreciated after t years is $e^{.05t}$ times a constant. The constant is determined to ensure that the asset is fully depreciated at the end of its life.[9]

The second component of the denominator of Tobin's q is the value of the firm's inventories. This value is inflation adjusted using the deflator for manufacturing inventories

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[7] Federal Energy Regulatory Commission (1976), p. 1.

[8] The smoothing is accomplished by multiplying the calculated value of the average age, T, by a moving average of T normalized to its current value.

[9] The 5% exponent has its precedent in Tobin and Brainard (1977). The results of using 3% and 7% as alternatives are reported in Section V.

before they are added into the denominator of q. The inflation adjustment is only applied to LIFO inventories, since the use of LIFO by a firm implies that its inventory is valued at the price level for the year in which the inventory was taken on.[10] The third and final component of the denominator comprises the firm's reported book values of investment in unconsolidated subsidiaries, other investments not included in book plant, and intangibles. These assets are inflation adjusted using the GNP deflator for non-residential fixed investments.

In addition to computing the q values for all 114 firms in each year for which the necessary data are available, an aggregate q is calculated as the total over all firms of the numerators from the firms divided by the total over all firms of their denominators.

IV. Results

The results of our Tobin's q calculations are strikingly low. Very few of the firms achieved q values above one in any of the years examined in the study. Most of the firms achieved a high near 0.7 (usually in 1988) and a low near 0.3 (usually in 1981). The aggregate value of q for all of the sample firms averaged less than 0.5 over the period 1969-88. These results are shown in Figure 1. Also shown in the figure are the aggregate q values calculated on a similar basis for 2,705 Compustat-listed manufacturing firms for the years 1969-1987. The large differences in the aggregate q values reflect a significant divergence between the performance of the two sectors during the period studied.[11]

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[10] See Hall et al (1988), p. 13.

[11] The two columns in Table 2 are not strictly comparable because the manufacturing q values were computed with an earlier version of the SLEPIAN which used a slightly different method of depreciation accounting. Based on the effects of depreciation in our utility sample, it is unlikely that this would change the calculated q values by more than about fifteen percent.

As noted previously, the q values calculated in this study differ in their construction from the market-to-book values commonly reported in the financial community. The latter report the ratio of the market price of a firm's common stock to its book value per share and do not adjust for either inflation of for non-economic depreciation. The differences between the market-to-book values computed in this study and those reported by the financial community are very large. Goldman Sachs Investment Research provides market-to-book ratios for selected utilities for the years 1985 through 1988. The averages for those utilities that are included in both the Goldman Sachs and our samples are compared in Table 1. The first column shows the average of the market-to-book values for the utilities in the Goldman Sachs report computed using the SLEPIAN model, which includes adjustments for inflation and economic depreciation. The second column shows the average of the market-to-book values reported by Goldman Sachs. These are stockholder equity-only market-to-book values and are unadjusted for depreciation or inflation. As a bench mark, the fourth column in Table 1 shows the average of the stockholder equity-only market-to-book values of the utilities covered by Goldman-Sachs as computed by the SLEPIAN program, without adjusting for inflation and depreciation. These values are very close to those reported by Goldman Sachs. This allows us to conclude that divergence between the adjusted values calculated using the SLEPIAN program and the values reported in the financial community arise from our conceptual approach to measuring market-to-book values, and are not explained by errors in the input data.

TABLE 1

Average Market-to-Book Values for Electric Utilities:

Our Tobin's q v. Equity-Only Measures

YEAR	Adjusted Aggregate Tobin's *q*	Average Market-to-Book Equity Only, unadjusted for economic depreciation or inflation	
		Goldman Sachs*	SLEPIAN program
1985	0.48	1.19	1.22
1986	0.62	1.49	1.46
1987	0.58	1.23	1.15
1988	0.59	1.21	1.23
4-year Average (not weighted)	0.57	1.28	1.26

* Average of market-to-book values for individual firms reported in Goldman Sachs Investment Research (1988).

The factors that account for the differences in the market-to-book ratios computed in this study and those reported by Goldman Sachs (1988) can be identified more clearly be re-writing the expression for Tobin's q as follows:

$$Q \equiv \frac{M_E + M_D}{K} = [Q_E \frac{B_E}{K^{**}} + Q_D \frac{K^{**} - B_E}{K^{**}}] \times (\frac{K^{**}}{K^{*}}) \times (\frac{K^{*}}{K}) \tag{4}$$

where:

M_E = Market value of firm equity

M_D = Market value of firm debt

B_E = Book value of firm equity[12]

K^{**} = Book value of total firm capital stock

K^{*} = Book value of total firm capital stock, adjusted for inflation

K = Book value of total firm capital stock, converted to exponential depreciation and inflation-adjusted

Q_E = M_E/B_E , and

Q_D = $M_D/(K^{**}-B_E)$

Equation (4) breaks down Tobin's q into a number of component parts. The two terms on the right-hand-side of (4) show the effects of adjusting the book value of the firm's capital stock to account for exponential depreciation, (K^{**}/K^{*}), and for inflation, (K^{*}/K). The term in square brackets is the market-to-book ratio written as the weighted sum of an equity-only market-to-book, Q_E, and a debt-only market-to-book, Q_D. The weights for these values are the equity and debt shares, respectively, of the book value of capital stock.

Figure 2 illustrates the consequences of adjusting the reported market-to-book values to account for the factors identified in this study. With the exception of 1974, the highest line in Figure 2 is the equity-only q computed using the SLEPIAN program without adjusting for inflation or economic depreciation. This is essentially identical to the values reported by Goldman Sachs and is equal to the ratio $Q_E = M_E/B_E$ in the above notation. Including debt in market-to-book calculation results in an unadjusted total market-to-book ratio equal to $(M_E + M_D)/K^{**}$ in the above notation. This new ratio is lower than the unadjusted equity-only market-to-book ratio for all years except 1974. In all other years in the sample period, the market-to-book ratio for the firm's debt was lower than the market-to-book ratio for its

[12] This is also called the liquidation value of stockholder equity.

stockholder equity. Thus, omitting this component tended to overstate the value of the firm. Over the entire sample of 1969-1988, the average value of the unadjusted equity-only market-to-book ratio was about 1.03. Including debt reduced this average to about 0.86, a reduction of about fifteen percent. Most of the difference is in the first few years of the sample period, when the premium on equity capital was particularly large. After 1974, including debt lowers the market-to-book ratio by less than ten percent.

The next line in Figure 2 shows the effect of adjusting the firm's book value of assets to account for inflation. This new ratio is equal to $(M_E + M_D)/K^*$. The adjustment for inflation has a very large impact on the market-to-book ratio. After adjusting for inflation, the total market-to-book value of all the firms over the entire sample period drops to an average of 0.50. This is about 40% below the unadjusted market-to-book ratio when debt is included, and one-half of the unadjusted equity-only ratio. Further adjusting for economic depreciation to yield the Tobin's q ratio $(M_E + M_D)/K$ lowers the market-to-book value to an average of 0.43 for all of the firms over the sample period. This is about fifteen percent below the total market-to-book ratio with only the inflation adjustment.

The adjustments made in this analysis to the commonly reported equity-only market-to-book ratio are appropriate to an economic evaluation of the impacts of regulation over the sample period. An adjustment for inflation is essential to measure the present cost of replacing the firm's capital stock. This adjustment was relatively modest in the early part of the sample period, increasing the book value of the firm's capital by about 25 percent. In periods of rapid inflation, such as occurred during the late 1970s and early 1980s, the adjustment increased the book value of the utilities' capital stock by as much as 120 percent. This is a main reason for the extraordinarily small adjusted values for Tobin's q observed in the early 1980s.

The inflation adjustment is compounded by the change from straight-line to exponential depreciation. The exponential method assumes that capital depreciates more rapidly towards the end of its useful life, which is a better approximation to the true value of most assets than the uniform reduction in value implied by straight-line depreciation. The exponential method increases the average age of the firm's net plant and results in a larger inflation-adjusted capital stock (and hence a lower value for Tobin's q).

Finally, including debt in the market-to-book ratio is appropriate because the value for the firm includes its value to bondholders as well as to stockholders. In relative terms, the debt component of Tobin's q fell short of the equity component for every year except 1974. In absolute terms, the market value of long-term debt was small relative to its book value in most years because unanticipated inflation increased nominal bond yields and lowered bond prices as computed in equation (2). Nominal bond yields increased greatly between 1969, the initial year of this study, and at least 1981. As a consequence, all debt that was issued prior to 1969 and in the early years of the sample period plummeted in value and contributed to the decline in the adjusted values of Tobin's q observed in the period 1969-81.

The factors that go into adjusting equity-only market-to-book ratios to reflect an economically meaningful measure of Tobin's q help to explain the relatively poor performance of the utility sector compared to manufacturing, as indicated in Figure 1. The utility sector begins with a smaller equity-only market-to-book ratio for the sample period, reflecting the consequences of rate regulation. This is compounded by the adjustments for debt, inflation, and depreciation. The market-to-book ratio for debt is lower than the market-to-book ratio for equity over most of the sample period, and utilities tend to hold large amounts of long-term debt. Inflation has extracted a much larger toll on utilities than on manufacturing generally. The average age of installed utility capital stock in the sample is about nine years. This compares to an average age of installed capital of about two years for manufacturing. The greater average age implies a much larger inflation adjustment for utilities and is probably the largest single effect explaining the difference in the adjusted Tobin's q's for the two sectors. The inflation adjustment is increased further after substituting exponential for straight-line depreciation.

V. Robustness of the Results and Limitations of the Study

The calculations of Tobin's q in this paper are based on a number of assumptions. Some are central to the low values that we compute, while others may appear to be important on first examination, but turn out to be of little consequence. One key assumption is the omission of a correction for technical progress in the adjustment for the book value of capital. Lindenberg and Ross [1981] include an economy-wide estimate for technical progress, which may explain their much larger adjusted q values.[13] A correction for technical progress does not seem warranted given that the industry produces a homogeneous product and that capital costs should be adequately reflected in the Handy-Whitman Index of Public Utility Construction Costs.

Another assumption that appears crucial to this analysis is the approximation of the aggregate structure of utility debt based on averaging the actual debt structures for a few selected firms. Although this approach is unlikely to generate an accurate estimate of the debt structures of the other utilities in the sample, the results are almost independent of this assumption, as demonstrated below.

To test for robustness, Tobin's q calculations were performed using the SLEPIAN model varying only the aggregate debt structure. Three debt structure series were input as alternatives

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[13] Lindenberg and Ross [1981] estimate an average adjusted Tobin's q for eight firms in the "electric, gas, & sanitation services" industry equal to 0.84 for the years 1968-78. This compares to the estimates in this paper for 114 electric and gas utilities equal to 0.47 over approximately the same time period.

to our base structure (called BASE in what follows). The first, called FLAT, assumed that 1/30 of a utility's outstanding debt in each year had been issued in each of the previous 30 years. The second, called FALLING, assumed an exponentially decreasing portion of each utility's debt was issued in the thirty preceding years. The third, called MIDPEAK, was irregularly shaped and chosen because it offered a particularly significant departure from the BASE debt structure.

The aggregate Tobin's q values calculated using the alternative debt structures are shown in Table 2. These time series show virtually no departure from the series found for the base debt structure, displayed in the last column. Given that the alternatives span a wide range of possible structures, we conclude that the results of this analysis are not influenced to any significant extent by the assumed structure of long-term debt.

Intuitively, the robustness result may be understood as follows. The debt structure assumption applies only to the first year of the firm's debt, and updating then occurs on the basis of the firm's actual long-term debt series. For almost every firm, the first year of the debt (and Tobin's q calculation) is 1969. Therefore, the debt structure assumption merely specifies what portion of the firm's debt was issued in each of the years 1940-1969. Bond yields on debt from those years vary little, so the prices in each year following 1969 of bonds from 1940-1969 vary little across those years. Consequently the value of long-term debt is almost invariant to the chosen initial debt structure.

TABLE 2

Aggregate Tobin's q for Alternative Debt Structures

Year	FLAT	FALLING	MIDPEAK	BASE
1969	0.69	0.70	0.67	0.70
1970	0.63	0.65	0.62	0.64
1971	0.58	0.59	0.56	0.58
1972	0.54	0.55	0.53	0.54
1973	0.48	0.49	0.47	0.48
1974	0.39	0.40	0.38	0.39
1975	0.34	0.34	0.33	0.34
1976	0.36	0.36	0.35	0.36
1977	0.35	0.35	0.34	0.35
1978	0.32	0.32	0.31	0.32
1979	0.29	0.29	0.28	0.29
1980	0.26	0.26	0.26	0.26
1981	0.25	0.25	0.25	0.25
1982	0.27	0.27	0.27	0.27
1983	0.33	0.33	0.33	0.33
1984	0.37	0.38	0.38	0.37
1985	0.45	0.45	0.45	0.45
1986	0.57	0.58	0.57	0.57
1987	0.55	0.55	0.55	0.55
1988	0.57	0.57	0.57	0.57

Another assumption that could influence the conclusions of this study is the choice of a five percent rate for the exponential depreciation calculation. Table 3 shows the results of calculations assuming exponential depreciation at three and seven percent per year in addition to five percent. As could be expected, the larger the exponential rate, the smaller the values for the adjusted q. More extreme exponential depreciation leaves more asset value on the books, further inflating the denominator of Tobin's q. However, the calculated values do not differ greatly despite a wide range of exponential depreciation rates.

TABLE 3

Aggregate Tobin's q for Alternative Exponential Depreciation Rates

Year	3%	5%	7%
1969	0.74	0.70	0.68
1970	0.67	0.64	0.62
1971	0.61	0.58	0.56
1972	0.57	0.54	0.53
1973	0.50	0.49	0.47
1974	0.41	0.39	0.38
1975	0.36	0.34	0.33
1976	0.37	0.36	0.35
1977	0.37	0.35	0.34
1978	0.33	0.32	0.31
1979	0.30	0.29	0.28
1980	0.27	0.26	0.25
1981	0.26	0.25	0.24
1982	0.28	0.27	0.26
1983	0.34	0.33	0.32
1984	0.39	0.37	0.36
1985	0.47	0.45	0.43
1986	0.60	0.57	0.55
1987	0.58	0.55	0.53
1988	0.60	0.57	0.55

Finally, a potentially serious limitation of the current study is a failure to account for accelerated retirement of debt. We assumed that all debt retiring in a given year was issued 30 years earlier and, conversely, that no debt issues retire until reaching their 30-year maturity. Early redemption contradicts this assumption and could distort our Tobin's q estimates if it is an important phenomenon for our sample.

Table 4 shows the extent of early retirement of debt for a portion of our sample period for which the relevant data were available. The ratio of the number of issues retiring early to the number maturing rises above 10% only for a few years that follow a peak in bond yields; in most years of rising yields and immediately after peaks, when the downward trend of yields may not yet be assured, early retirement is not a significant phenomenon. Nevertheless, in some years, premature redemption of debt is significant. The periods of intense redemption reflect refinancing, where utilities replace long-term debt carrying high interest rates with new debt at lower current interest rates. Thus, they are shifting their debt load from bond issues whose prices are relatively high to lower-priced bonds, with the effect of reducing the market value of their total long-term debt below what is implied by our assumed debt structure. Therefore, accounting fully for early redemption of long-term debt should reduce the measured q values below the already very low values that we report in this study.

TABLE 4

Early Retirement of Debt Versus Maturing Debt, 1975-88

YEAR	# OF ISSUES REDEEMED	# OF ISSUES MATURING	#REDEEMED/ #MATURING	BOND YIELD
1975-76	4	98	.04	0.1096
1976-77	33	83	.40	0.0982
1977-78	14	116	.12	0.0906
1978-79	2	118	.02	0.0962
1979-80	3	103	.03	0.1096
1980-81	1	101	.01	0.1395
1981-82	N/A	N/A	N/A	0.1660
1982-83	1	126	.01	0.1645
1983-84	5	130	.04	0.1420
1984-85	9	106	.08	0.1453
1985-86	68	121	.56	0.1296
1986-87	138	179	.77	0.1000
1987-88	117	145	.81	0.1053

Source: *Moody's Public Utility Manual.*

VI. Conclusions

Traditional regulatory practice involves a complex process designed to uncover a utility's "true" cost of capital and to reward the utility no more or no less than it needs to attract desired levels of investment. Much of the costs of this regulatory process could be saved if regulators could rely on publicly available statistics on financial performance as an indicator of the appropriate level of prices. The "market-to-book" ratio has been held to be such an indicator and Greenwald [1984] has established the theoretical linkage between a market-to-book ratio equal to one and a compensatory allowed rate of return on invested capital.

Can regulators rely on published financial statistics, or is the search for such a measure the Holy Grail of regulation? This paper accepts the theoretical value of the market-to-book measure established by Greenwald [1984], but asks how that measure must be constructed to be empirically useful. We have argued that Tobin's q is the correct measure of the market-to-book value. Tobin's q differs from the measures most often quoted in financial sources in that it includes the returns to bondholders and preferred stockholders as well as to investors in common equity.

For much of the period covered in this study, utility bondholders suffered losses brought about by unanticipated inflation. Why should regulators be concerned about capital losses incurred by bondholders? If rates are sufficient to attract investment capital from the equity market, isn't that sufficient to determine a normal rate of return? The answer should be no, because it is unreasonable to set rates with the expectation that earnings will be subsidized by capital losses from long-term lenders. These losses are a disequilibrium phenomenon. Regulators cannot assume that the cost of long term debt can be held at non-compensatory levels. If regulators had to compensate bondholders for their losses over the sample period without changing the returns earned by stockholders, they would have had to increase utility rates, thereby adversely affecting consumers. Thus, the appropriate measure of financial performance in evaluating the rates that utilities must earn in equilibrium to attract investment should account for debtholders as well as for holders of equity capital. This argues for the total market-to-book measure, Tobin's q, used in this paper and not the equity-only market-to-book ratio that is commonly quoted in financial sources.

In addition to the conceptual issue of what belongs in the market-to-book measure, there is the practical difficulty of adjustments for inflation and accounting practices that do not reflect actual economic depreciation. The results in this paper show that these adjustments can have enormous and highly variable impacts on measures of financial performance. From 1969-88, the 114 utilities covered in this study achieved equity-only, unadjusted market-to-book values that averaged just over 1.0. This might lead to one to conclude that, on average, utilities earned normal rates of return on their capital over this time period. However, after including the financial consequences for bondholders and adjusting for inflation and depreciation, these firms had an average market-to-book value over this period of 0.43, or less than half the unadjusted value. At times the ratio dropped as low as 0.25, meaning that one dollar invested in these utilities earned a present value return of only 25 cents.

The adjustments to the equity-only market-to-book values are negative and large over this period. They are not uniform, however. The adjustments range from about 40 to more than 70 percent. Regulators would not be able to rely on publicly available data without making large adjustments. The nature and extent of these adjustments are not without controversy. Hence, as a practical matter, the use of market-to-book ratios as regulatory indices would not eliminate the burdensome process of utility rate reviews, but rather would be likely to shift the locus of controversy over a different set of variables and methodologies.

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Figure 1

Tobin's Q: Electric Utilities v. Manufacturing

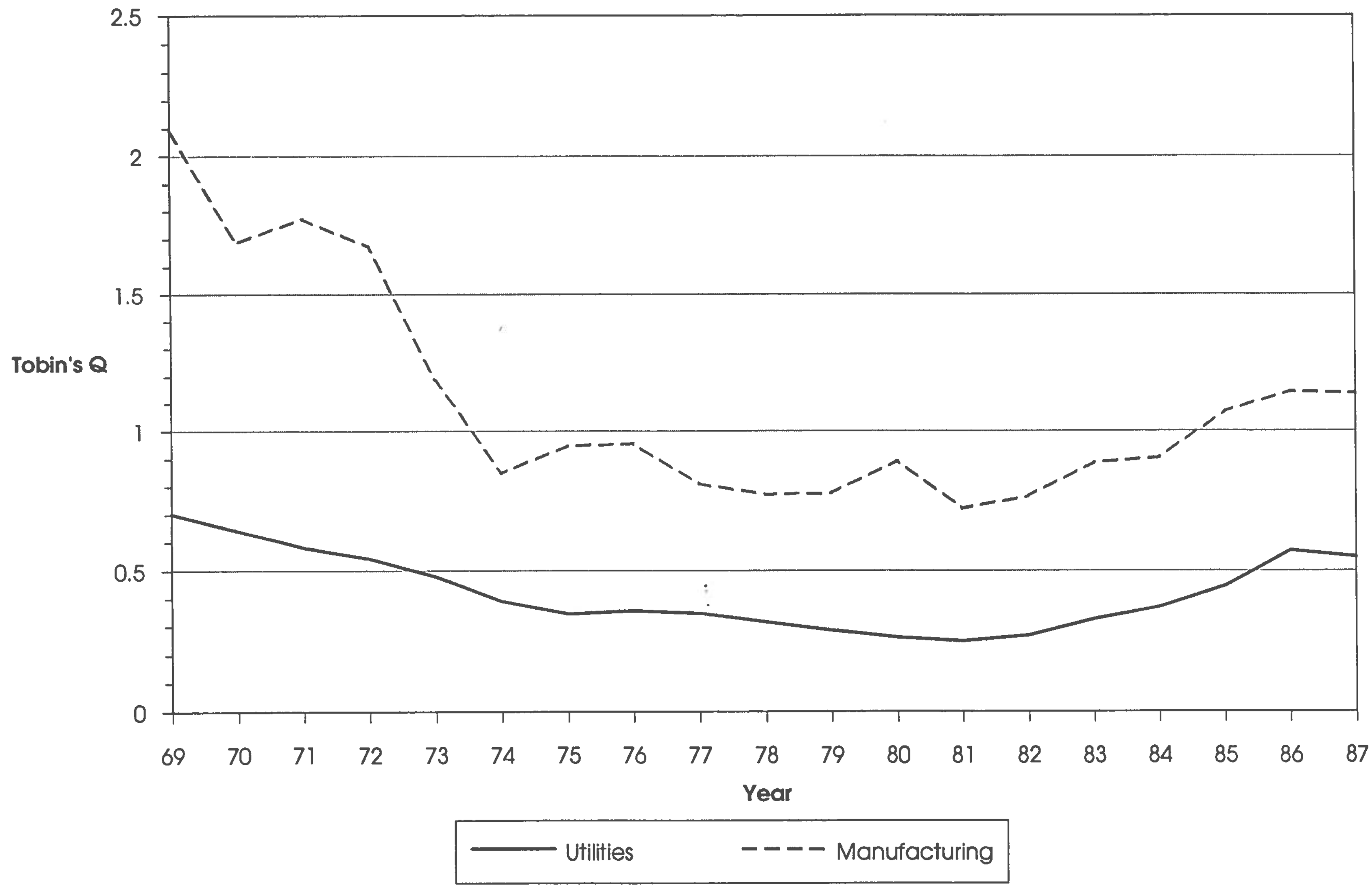

Figure 2

Effects of Adjustments on Tobin's Q: Utilities