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INFLATION RISK AND REGULATORY LAG

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I. Introduction

Rate of return regulation in principle suggests strong linkages betwen interest rates, utility return on book equity (ROE), and stock price/book equity ratios: ceteris paribus, changes in interest rates should be quickly transformed into changes in ROEs, and stock prices should tend toward book value. Absent lags in the process, it also suggests that utility investors are minimally exposed to the risks of unanticipated changes in interest rates, notably those associated with inflation. In this paper we examine the financial implications of electric utility regulation from 1971–1980. Over this period, which was characterized by inflation-related rises in interest rates, we find that the gap between allowed and earned ROEs, on the one hand, and interest rates, on the other hand, increased. Since this outcome is in contradiction of the conceptual model of regulation and investors' exposure to inflation risk, we test the hypothesis that investors respond to the reality of regulation by imposing risk premiums which are functionally related to interest rates. The basic idea is that an ROE shortfall leads to an expectation that regulation will respond in the future with a higher earnings level, but this "IOU" in the implicit social contract is risky. And the question addressed in this paper is whether the degree of riskiness is related to the level of interest rates. Using two valuation models we conclude that at least during the 1970s risk premiums were not related to the level of interest rates.

II. Rate of Return Regulation, Financial Implications and Evidence

Public utility rate of return regulation over the years has come to be guided in principle (if not always in fact) by two U.S. Supreme Court decisions in *Bluefield Waterworks Co. v. Public Utilities Commission*, 262 U.S. 679(1923), and *Federal Power Commission v. Hope Natural Gas Co.*, U.S. 591 (1944). In *Hope*, in particular, the Court stated:

> "... the investor interest has a legitimate concern with the financial integrity of the company whose rates are being regulated. From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on debt and dividends on the stock. By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That

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return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital.

There are several implications derivable from the *Hope* criteria, including:

a. In the language of capital asset pricing theory, regulation is implicitly charged with concern for the utility stock's total—not simply systematic—risk. (Whether regulation is perceived to be concerned in this fashion is of course a major source of investor risk perceptions.) This implication is not obviously congruent with any single or multi-period version of the capital asset pricing paradigm which forms the center of much contemporary finance theory.

b. Many scholars (Myers [10], Gordon [7], Carleton [2], Brennan and Schwartz [1], Thompson [14]) have noted that the application of a market-based cost of equity to a utility's book value equity will tend to produce convergence of the company's stock price toward its accounting, or book value, provided the company's total capitalization equals its asset rate base.

c. The conceptual linkage between cost of equity and ROE on the one hand, and between market and book values of equity, on the other, suggests some very strong and easily tested empirical hypotheses: First, if rate of return regulation performs (and is expected to perform) as conceptualized, utility market/book ratios should remain close to 1.0 over time. Second, assuming a direct (though not necessarily fixed) relationship between realized inflation rate, expected inflation rate, interest rate and earned ROE, there should be no systematic relationship between utility market/book ratios and the realized inflation rate. Third, assuming no systematic inverse relationships between changes in utility equity risk premiums and changes in interest rates, utility ROEs should be positively related to interest rates over time.

Table 1

Electric Utility and Capital Market Data, 1971–80

	Market/ Book	Earned ROE	Std. Dev. ROE	Allowed ROE	Rate of Change in CPI	Yield on 20-year U.S. Gov't Bonds
1971	1.398	.116	.022		.043	0.59
1972	1.329	.122	.021	.125	.033	.059
1973	0.968	.155	.023	.125	.062	.073
1974	0.664	.107	.022	.130	.110	.081
1975	0.897	.115	.020	.132	.091	.083
1976	1.028	.118	.016	.131	.058	.075
1977	0.993	.116	.022	.133	.065	.078
1978	0.858	.118	.021	.132	.077	.088
1979	0.771	.115	.020	.135	.113	.102
1980	0.727	.116	.024	.143	.135	.122

Source: Market/Book is the mean, for all electric utilities on the Compustat Tapes, of year-end closing stock prices + year-end book value per share. Earned ROE is the mean, for the same companies, of net income available for common equity + average of beginning and end of year book equity. Std. dev. ROE is computed from company ROEs. Allowed ROE is taken from U.S. Department of Energy, *Impacts of Financial Constraints on the Electric Utility Industry*, December, 1981, p. A-5. Rate of change in CPI is computed from the monthly average consumer price index for each year (Source: Federal Reserve Bank of St. Louis, Annual U.S. Economic Data).

It is unnecessary to specify these hypotheses more precisely because they can be rejected almost from a visual inspection of Table 1:

a. The average electric utility market/book ratio clearly fell on balance during the 1970s, from 1.398 at year-end 1971 to .727 by year-end 1980.

b. The decline in market/book ratios occurred while the inflation rate was rising. Simple regression of the average market/book ratio on the growth rate in the CPI produces a slope coefficient of −6.56, $|t|$ value of 5.66 and R^2 of .80.

c. The relationship between average ROE and the 20-year U.S. Government bond yield index is negative but insignificant.[1]

The picture that emerges unambiguously is that electric utility regulation during the 1970s did not function as has been hypothesized by finance scholars. ROE/interest rate differences were substantially longer, and market/book ratios substantially lower, toward the end of the decade when interest rates were almost double the level of the beginning of the decade. Since that period, and particularly its latter half, has been characterized as one of unanticipated increases in the expected rate of inflation and inflation uncertainty, rate of return regulation can also be characterized as having been unresponsive to inflation. The question we address in this paper is: How did investors respond, and in particular were their equity risk premiums related to the level of interest rates?

One possibility is that the cumulative experience of investors reflected in Table 1 led them to increase their risk premiums through the decade; i.e., they became more uncertain about future regulatory response to interest rate changes. This hypothesis, if correct, would generate a positive relationship between risk premiums and interest rate levels. Alternatively, investors have interpreted the risks inherent in the regulatory rate of return response mechanism as essentially the same under all interest rate environments. Finally, there is the possibility that Myron Gordon's and Paul Halpern's conjecture in the mid 1970's [8] is correct: even for stocks which provide an imperfect hedge against inflation uncertainty, the real (hence nominal) risk premium would fall with a rise in inflation uncertainty. This would lead to a negative risk premium/interest rate relationship (given a positive expected inflation/inflation uncertainty relationship).

III. Investor Responses to Regulation: The First Model

In an article in 1976 Carleton and Cooper [3] developed and estimated an equation for the discount function on nominal risk-free cash flows (equivalently, for the term structure of interest rates). This equation was of the form:

$$P_{0,j} = b_1 X_{1,j} + \cdots + b_n X_{n,j} + e_j \tag{1}$$

where

$P_{0,j}$ = price of security j at time 0;

[1] The same results obtain when we regress ROE's on lagged yields, and when we employ short-term interest rates as regressor variables. When a longer period of history is employed, 1961–80, significantly negative relationships between ROEs and interest rates are obtained. Attempts to explain cross-sectional differences in ROEs, year by year, as a function of current and lagged growth in utility plant, leverage ratio and allowance for funds during construction are also unsuccessful.

$X_{t,j}$ = payment (coupon and/or principal) at period t on security j;
e_j = disturbance term distributed as $N(0, \sigma^2)$.

The equation was estimated for a composite of U.S. Government and Federal Home Loan Bank Board issues for year end 1970, 1971, 1972 and 1973. The quarterly estimated discount factors $b_1, \cdots, b_n$ for all four sample dates displayed the hypothesized relationships $b_1 \geq b_2 \geq \cdots b_n \geq 0$, consistent with the existence of positive forward rates, and the regression residuals were on balance consistent with an absence of arbitrage opportunities.

As an application, Carleton-Cooper went on to suggest an equity valuation model of the form:

$$P_{0,j} = \textstyle\sum_{t=1}^{\infty} \alpha^t \hat{b}_t E(D_{t,j}) + u_j \tag{2}$$

where

$P_{0,j}$ = current stock price;
$\hat{b}_t$ = discount factor (reflecting the nominal risk-free rate) for year t cash flow estimated from Government securities or derived from such estimates;
$E(D_{t,j})$ = expected year t dividend for company j, employing a growth extrapolating model;
α^t = certainty-equivalent factor, where $0 < \alpha < 1$;
u_j = disturbance term.

This certainty equivalence, or risk premium structure, model was transformed into estimable form, and estimated for the electric utility industry at year-end 1970, 1971, 1972 and 1973, and produced remarkably stable (and intuitively plausible) values of $\hat{\alpha}$, .945 to .951. It is the first model we further develop and employ in this paper, under alternative assumptions as to how investors form $E(D_{t,j})$ expectations.

First, the formal and informal background. We assume:

a. Government bonds and electric utility common stocks vary only randomly from their certainty-equivalent present values. Arbitrage possibilities exist neither within nor between the two securities groups.

b. Unbiased estimates of the expected dividend growth function can be generated.

c. It further is appropriate (at least for the electric utility industry) to assume that the certainty equivalence function is of the form α^t, where $0 < \alpha < 1$. This implies that the spot rate k_t for reducing a period t risky expected cash flow, or dividend payment, to its present certainty equivalent value is:

$$(\alpha^t b_t)^{-1/t} - 1 = \frac{1 + R_t}{\alpha} - 1 = k_t$$

where R_t is the spot rate applicable to a dollar of nominal risk free cash flow in period t. This form implies that each period's expected growth factor, $1 + g$, is multiplied by investors at a rate of α, reflecting uncertainty as to its achievability. The compound effect is uncertainty increasing at a constant rate per unit of time, the same assumption required for a single risk-adjusted cost of equity capital for each future period when the term structure of interest rates is horizontal (Robichek-Myers [12]).

d. The discount function on nominal risk free cash flows can be "observed" (or at least estimated in a way which removes the effect of coupon bias from the conventional yield curve surrogate).

a. Next, the data and specific estimating model. The procedure used to estimate the present value coefficients of equation (1) is very similar to Carleton-Cooper. Carleton-Cooper regressed U.S. Government bond prices (means of bid and asked) against a payoff matrix of interest and principal payments to obtain present value coefficients. Due to liquidity and payment date differentials between Treasury coupon and Federal Home Loan Bank Board obligations, the FHLBB payoff matrix was adjusted to consistency with the Treasury payoff matrix. Our procedure is similar. First, the present value, or discount, function is constrained to lie along a polynomial:[2]

$$P_{s,i} = \sum_{t=1}^{T} C_i(s + t, s) \cdot \exp - \left(\sum_j x_{s,j} t^j\right) + e_{s,i} \tag{3}$$

where

i = bond subscript;
s = time period at which bond price is observed;
$P_{s,i}$ = bond price;
$C_i(s + t, s)$ = cash flow on bond i at $s + t$;
$x_{s,j}$ = jth polynomial coefficient at time s;
j = polynomial index;
$e_{s,i}$ = pricing disturbance of bond i at time s;
t = time to maturity in quarters.

The samples are for each of the last trading days of 1971 to 1980, and included U.S. Treasury notes with coupons greater than 1½ percent and maturities of six years or less. The purpose of these restrictions is to provide reliable estimates of the discount function over the interval 0 to 5 years. Based on prior work (Chambers, Carleton and Waldman [4]), a sixth degree polynomial function is fitted for equation 3, using a weighted non-linear least squares procedure which corrects for heteroskedasticity present in 5 of the sample years.

For the purposes of later interpretation, first and twentieth quarter present value coefficients derived from these polynomial estimates are presented in Table 2, transformed into annual rate of return equivalents. In other words, Table 2 describes the shortest and longest spot rates for term structures derived from equation 3 as applied to quarterly dividends.

b. Equation (2) places no restrictions on values of $E(D_{t,j})$, and yet it must be the case that in an informationally efficient capital market investors are aware of the presence of rate of return regulation as a constraining influence on future earnings and dividends growth paths. Prior work (Higgins [9] and Carleton-Cooper [3]) established the reasonableness of 4 years as investors' horizon for the estimation of non-normal earnings or dividends growth through the pressure

[2] See Chambers, Carleton and Waldman [4] for the formal development of this model.

Table 2

Estimated Spot Rates on U.S. Government Securities

	R_1	R_{20}
1971	.044	.059
72	.057	.063
73	.074	.069
74	.063	.076
75	.063	.076
76	.050	.064
77	.071	.078
78	.103	.090
79	.120	.105
80	.139	.128

(in the case of above-normal growth) or support (in the case of below-normal growth) of prospective regulation. As the discussion and analysis of Section II make clear, regulation at best can be described as responding with a lag to changes in capital market conditions. We employ 3, 4 and 5 years specification of non-normal growth horizons to reflect regulatory lag. Up to the horizon, each company's quarterly dividend is expected to grow as an extrapolation of its own history, computed as its own log line dividends per share growth rate over the prior 10 years. (All such regressions are adjusted for any first order correlation in residuals.) From the horizon year onward, however, it is assumed that excessive or deficient earnings will have been corrected, and that regulation is expected to produce normal earnings and dividend growth. Normal, or long-run expected growth, is estimated as the mean industry estimated dividends per share growth rate. In cross-sectional regressions based on equation (2), this means that some utilities have $E(D_{t,j})$ paths up to the horizon (3, 4 or 5 years) growing more rapidly than the industry mean, some growing more slowly, but all converging at the horizon because of the lagged prospective impact of regulation.

The data set includes all electric utilities on the Compustat Annual Utility Tape having complete records and fiscal years ending December 31, for years 1961–80. There were 97 usable data points in 1971, declining to 89 in 1980.

The final version of equation (2) for estimation (after some algebraic manipulation) is in quarterly cash flow form:

$$P_j = c + \textstyle\sum_{t=1}^{H-1} (A - B\cdot M)^{t/4}\cdot \hat{b}_t \cdot D_{0,j}\cdot (1 + \hat{g}_j)^{t/4} + (A\cdot B\cdot M)^{H/4} \cdot \hat{b}_4\cdot 4D_{0,j}(1 + \hat{g}_j)^{H/4}\cdot (1 + \bar{R})[1 + \bar{R} - (A - B\cdot M)(1 + \bar{g})]^{-1} + u_j \quad (4)$$

where

P_j = closing price of jth electric utility's common stock at the end of the year;

M = rating for utility's first mortgage bonds. If at year-end, either Moody's or Standard & Poor's rates bonds A or lower, $M = 1$, otherwise $M = 0$;

$A - B\cdot M$ = α, the certainty-equivalent parameter, $0 < \alpha < 1$. For utilities with higher rated bonds, $A = \alpha$, for lower-rated $A - B\cdot M = \alpha$;

c = constant;

$D_{0,j}$ = company j's dividend in fourth quarter of the year;

$t = 1, \ldots, H$, the quarter, up to horizon, H, during which a company's dividend grows at its own specific rate;

$1 + \hat{g}_j$ = estimated expected short-term dividend growth factor for company j;

$\hat{b}_t$ = polynomial-derived present value coefficient for quarter t, centered to end of period;

$\bar{R}$ = annual interest rate on Government securities, derived from $\hat{b}_H$ on the assumption that from period H onward the term structure is horizontal;

$\bar{g}$ = mean industry dividend growth rate for each year, i.e., $\frac{1}{n} \sum_j \hat{g}_j$.

u_j = disturbance term distributed as $N(0, \sigma^2)$.[3]

Equation (4) thus describes the price of a utility's common stock as the certainty equivalent present value of a quarterly stream of dividends to period H (growing at expected annual rate $\hat{g}_j$) and an annual stream beyond H (growing at an expected rate of $\bar{g}$). While we would not claim that bond ratings provide an ideal taxonomy for the relative risk of utility equities, it is used in this fashion by securities analysts, and its inclusion in equation 4 allows us to test for risk differences.

Equation (4) is estimated by a non-linear least squares procedure at the end of years 1971–80, employing horizons of 3, 4, and 5 years (H = 12, 16, 20). The results are summarized in Table 3.

Given the non-linearity of the equation and the limited sample sizes, we would interpret asymptotic t statistics as suggestive rather than definitive. The following appear to be reasonable summary points, however:

a. A coefficients are in general higher, for all three possible horizons, in the latter half of the decade than the first half. That is, risk premiums appear to be lower during the period of higher interest rates.

b. For a horizon of 3 years (H = 12), the $\hat{A}$ coefficient clearly rises each year from 1976 to 1980, the period of most rapidly rising realized (and by assumption, expected) inflation rates. On the other hand, for a horizon of 4 years, the $\hat{A}$ coefficients are mixed while for a 5-year horizon, they rise to 1977, then fall. Finally, because the model and estimation proceeding tends to provide very large R^2 values it would be difficult to use this statistic to determine whether 3, 4, or 5 years represents the best horizon estimate. Recall that the certainty equivalent coefficient for low-rated electives is estimated as $\hat{A} - \hat{B}$. For values of $\hat{B} > 0$, the certainty equivalent factor is lower, i.e., risk premium is higher, for lower-rated firms.

c. B coefficients are always greater than zero, suggesting that bond rating does at least approximately classify relative common stock risk.

d. The constant term is greater than zero in all but three regressions, and asymptotic t values are about 2 or greater from 1971–1977.

[3] Estimated residuals display no evidence of heteroskedasticity; essentially identical estimation results are generated with original and weighted variables.

Table 3

Asymptotic Regression Results for Equation 4
(Asymptotic Standard Errors in Parentheses)

		$H = 12$				$H = 16$				$H = 20$		
Year	Constant	A	B	Asym. R^2	Constant	A	B	Asym. R^2	Constant	A	B	Asym. R^2
1971	5.66	.9263	.0041		5.67	.9271	.0033	.98	5.77	.9286	.0028	.98
N = 96	(1.52)	(.0005)	(.0039)	.98	(1.48)	(.0051)	(.0033)		(1.43)	(.0050)	(.0033)	
1972	8.73	.9241	.0069	.97	8.58	.9252	.0057	.97	8.51	.9260	.0048	.97
N = 97	(1.95)	(.0100)	(.0062)		(1.91)	(.0092)	(.0060)		(1.87)	(.0090)	(.0057)	
1973	2.74	.9336	.0046	.96	2.85	.9330	.0042	.96	3.02	.9322	.0039	.96
N = 97	(1.11)	(.0057)	(.0030)		(1.10)	(.0057)	(.0030)		(1.09)	(.0057)	(.0031)	
1974	2.57	.9095	.0324	.99	2.53	.9118	.0315	.99	2.52	.9134	.0309	.99
N = 97	(1.14)	(0.106)	(0.100)		(1.12)	(.0095)	(.0095)		(1.10)	(0.101)	(.0092)	
1975	1.70	.9489	.0117	.99	1.81	.9502	.0116	.99	1.98	.9509	.0116	.99
N = 97	(.98)	(.0046)	(.0031)		(.97)	(.0046)	(.0031)		(.96)	.0047	.0032	
1976	1.36	.9487	.0064	.99	1.56	.9503	.0064	.99	1.85	.9514	.0066	.99
N = 97	(.95)	(.0034)	(.0019)		(.94)	(.0034)	(.0019)		(.94)	(.0035)	(.0020)	
1977	1.35	.9574	.0046	99	1.54	.9580	.0046	.99	1.83	.9575	.0047	.99
N = 95	(.78)	(.0032)	(.0016)		(.78)	(.0032)	(.0016)		(.79)	(.0033)	(.0017)	
1978	.23	.9598	.0038	.99	.45	.9567	.0037	.99	.77	.9543	.0038	.99
N = 96	(.59)	(.0029)	(.0014)		(.58)	(.0029)	(.0014)		(.58)	(.0030)	(.0015)	
1979	−.50	.9604	.0039	.99	.07	.9552	.0040	.99	.42	.9521	.0042	.99
N = 91	(.61)	(.0036)	(.0017)		(.59)	(.0036)	(.0018)		(.58)	(.0036)	(.0019)	
1980	−.27	.9609	.0034	.99	.40	.9567	.0038	.99	1.08	.9503	.0044	.99
N = 89	(.87)	(.0061)	(.0031)		(.84)	(.0063)	(.0033)		(.82)	(.0066)	(.0037)	

This last result is somewhat troublesome, and deserves further analysis. If the regression were completely well-specified and variables measured without error, we would expect an insignificant constant. Among the possibilities, $\bar{g}$ could be biased as an estimate of investors' normal long run growth expectations. While possible, experimentation with ranges of $\bar{g}$ higher and lower than the industry mean values resulted in A and B coefficients remaining substantially unchanged and the constant remaining greater than zero in virtually all years. Another possibility is in outliers. As in Carleton-Cooper, it was apparent that four companies in the first half of the decade have abnormally large residuals. (Further inspection revealed that these companies are located in two states with reputations for regulatory responsiveness to investor interests.) Deletion of these companies and re-estimation results in unchanged A and B coefficients and smaller constants in early years—but the constants remain positive in most years. Still a third possibility is specific kinds of errors in the $\hat{g}_j$ estimates. For example, we put no upper or lower bounds on the $\hat{g}_j$'s, yet it is likely that some of the lowest and highest for any given year are outside the bounds reasonable investors could expect, even within a short non-normal earnings horizon of 3, 4 or 5 years. Finally, omitted tax effects may be present in electric utility stock prices in such a way as to induce positive intercepts from 1971–77. Our interpretation is that the errors-in-variables problem, which is of course present in all expectational models, plus omitted tax effects, are the root cause of the non-zero constant for years 1971–77. Given the non-linear nature of equation (4), it is difficult to analyze the effect of this errors-in-variables problem on any of the estimated coefficients. Thus a *caveat* must be added to our final interpretations of our results.

Given this qualification, a final test in our first model of the hypothesis, that risk premiums in the 1970s were functionally related to interest rates, is possible. For Table 4 we have first computed as risk premium estimates, for each rating class and for each year, the reciprocal of estimated certainty equivalent parameters, $\hat{A}$ and $\hat{A} - \hat{B}$, across H (12, 16, 20). The averages across H of these reciprocals, less unity, presented in the table are estimates of the equity risk premiums for electric utility common stocks, 1971–80.

Three features of Table 4 are apparent: First, estimated risk premiums are noticeably higher for years 1971–73 than for years 1975–80. Second, 1974's premiums are noticeably higher than all other years'. (It was the year of Consolidated Edison's difficulties, high interest rates and OPEC.) Third, examination of the latter half of the decade, 1975–80, suggests a modest decline in risk premiums, followed by a rise. Regression of risk premiums on the 20th quarter interest rates, R_{20}, from Table 1, confirms what visual inspection reveals: a slope coefficient modestly negative at $-.09$ and a $|t|$ value of only 1.28 for the high rated companies, and $-.17$ and 1.34 for the lower rated companies. Regressions covering the entire 1971–80 period produce negative coefficients and slightly larger $|t|$ values. Similar results are obtained when risk premiums are regressed on the one quarter interest rates, R_1, from Table 1.

The evidence from our first model is that investors did not react to regulatory sluggishness during the 1970s by increasing their risk premiums as interest rates

Table 4

Estimated Electric Utility Risk Premiums

	High Rated Companies	Low Rated Companies
1971	.0784	.0823
72	.0809	.0878
73	.0719	.0768
74	.0970	.1364
75	.0526	.0657
76	.0525	.0597
77	.0442	.0493
78	.0450	.0491
79	.0461	.0506
80	.0461	.0503
Average	.0615	.0708

rose, they may in fact have reduced their risk premiums.[4] But our tests are weak ones and dependent on having correctly specified the expected dividend growth function.

IV. Investor Responses to Regulation: The Second Model

Our second model involves a different, though plausible, specification of investor perceptions about rate of return regulation which makes use of the implications of the market/book ratios given in Table 1. At any given time during the past decade most utilities were likely involved in rate case hearings attempting to raise their ROEs. For the indutry as a whole it may be valid to describe the ROEs investors were expecting over the future, at least on current book equity, as equal to average allowed ROEs. Despite procedural innovations which took place during the 1970s, the focus of regulation is normally on the ROE allowed to be earned over the following year or two on assets (hence book equity) measured currently or historically. If investors expect current book equity to earn the allowed ROE in the future, and future additions to earn the cost of equity capital, then:

$$\begin{aligned} P_0 &= \frac{E_1}{k} + \frac{PV}{k} \text{(future additions to assets, hence equity)} \\ &= \frac{\text{Allowed ROE} \cdot B_0}{k} + \frac{PV\text{(future additions)}}{k} \end{aligned} \tag{5}$$

where

P_0 = current price of the utility's stock;
E_1 = next year's earnings;
B_0 = current book value of utility's stock.

[4] This would be consistent with the conjecture in the mid 1970s by Myron Gordon and Paul Halpern [8].

If investors expected no rents to be earned on future construction outlays, $PV = 0$, and rearranging

or
$$k = \frac{\text{Allowed ROE}}{P_0/B_0} \tag{6}$$

This specification is straightforward. Employing the data in Table 1, it results in the k estimates of Table 5. The estimates present a somewhat different picture of investor risk premiums than in our first model. To facilitate the comparison, we derive both multiplicatively $((1 + \hat{k})/(1 + R) - 1)$ and additively $(\hat{k} - R)$ measured premiums for R_1 and R_{20}. Depending on how measured, electric utility risk premiums rose to 1974, subsequently fell to 1977–78, and were mixed, 1978–80. Simple regressions of these risk premium estimates on R_1 and R_{20} are given in Table 6. For only one of these can the null hypothesis of no relationship between risk premiums and interest rates be rejected. We conclude from our second model that electric utility risk premiums for the 1970s were not related to interest rates.

V. Concluding Comments

The relationship of utility rate of return regulation to capital market conditions under idealized conditions has been noted by many finance scholars: It produces a tendency of stock price to converge toward book value. Absent changes in equity risk premiums, it also results in a direct relationship between interest rates and utility ROEs. This implies that utility shareholders do not have to bear inflation risk as unanticipated changes in expected rates of inflation and/or inflation uncertainty result in interest rate changes. We have examined the record for the 1970s and demonstrated that electric utility regulation departed overwhelmingly from the idealized model and, in fact, this resulted in allowed and earned ROEs lagging behind increases in interest rates. We then tested the hypothesis that investors in the capital market, aware of the realities of regulation, imposed risk premiums in their return requirements which were functions

Table 5

Cost of Equity Estimates, $\hat{k}$, and Risk Premiums Based on Allowed ROE

	$\hat{k}$	$\frac{1+\hat{k}}{1+R_1} - 1$	$\frac{1+\hat{k}}{1+R_{20}} - 1$	$\hat{k} - R_1$	$\hat{k} - R_{20}$
1972	.094	.035	.029	.037	.031
1973	.129	.051	.056	.055	.060
1974	.196	.125	.112	.133	.120
1975	.147	.079	.066	.084	.071
1976	.127	.073	.059	.077	.063
1977	.134	.059	.052	.063	.056
1978	.154	.046	.059	.051	.064
1979	.175	.049	.063	.055	.070
1980	.197	.051	.061	.058	.069

Table 6

Relationship of Risk Premium Estimates to Interest Rates (Slope coefficient, $|t|$, and R^2)

Dependent Variable	Independent Variable R_1	R_{20}
$(1+\hat{k})/(1+R_1)-1$, 1972–80	−.33 (1.09) $R^2 = .14$	
$(1+\hat{k})/(1+R_1)-1$, 1975–80	−.32 (2.9) $R^2 = .68$	
$(1+\hat{k})/(1+R_{20})-1$, 1972–80		.12 (.30) $R^2 = .01$
$(1+\hat{k})/(1+R_{20})-1$, 1975–80		.05 (.45) $R^2 = .05$
$\hat{k}-R_1$, 1972–80	−.30 (.93) $R^2 = .11$	
$\hat{k}-R_1$, 1975–80	−.16 (1.12) $R^2 = .24$	
$\hat{k}-R_{20}$, 1972–80		.19 (.46) $R^2 = .03$
$\hat{k}-R_{20}$, 1975–80		.11 (1.03) $R^2 = .21$

of interest rate levels. Using two models which assume alternative expectations about the outcomes of rate of return regulation, we were unable to find a significant relationship between risk premiums and interest rates.

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DISCUSSION

GEORGE R. HALL*: The paper by professors John and Saunders addresses a fundamental dilemma inherent in the conventional system of public utility regulation. The primary objective of public utility regulation is to limit the revenue of the regulated firm to a sum that will cover prudent operating expenses and interest on debt plus a fair return to equity. The dilemma arises because pursuit of the objective of limiting the firm's profit to the amount that would be earned in competitive markets substantially lessens incentives to reduce cost that are present in competitive markets.

Conventional regulation relies primarily on two techniques to address this dilemma. The first is the prudent investment doctrine which allows regulators to disallow unreasonable expenses incurred by managers of jurisdictional firms. This doctrine is only an ultimate deterrent for extreme cases. It creates the danger of regulatory "Monday morning quarterbacking." At best it is a negative force; it does not provide a positive incentive.

The other conventional regulatory inducement to cost reduction is the filed-rate doctrine, or as it is more often called by economists, regulatory lag. Public utilities are permitted to charge only filed rates and these are only adjusted periodically and prospectively. Utility rates are fixed for some period of time and are not true cost-plus prices. During the period the fixed rates are in effect, any realized cost efficiencies benefit the firm. However, efficiencies are likely to be reflected in the rates set whenever new rates are filed and approved by regulators. Thus, we must seek new and positive regulatory incentives for efficiency. To this end the paper before us proposes more use of incentive contracting between utilities and their suppliers.

Professors John and Saunders assume a world in which the key unknown with respect to incentive contracts is the amount of investment required to realize a cost reduction. They also assume an asymmetry of information between utility managements and suppliers. Within the narrow confines of this problem I believe their conclusions follow. However, within the broader context within which

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