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Regulation, Regulatory Lag, and the Use of Futures Markets

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THIS STUDY EXPLORES THE feasibility of using futures markets to mitigate the eroding effects of regulatory lag on a public utility's revenue stream. By the very nature of the regulatory process, shareholders of public utilities are exposed to substantial risks due to unanticipated economic fluctuations, since the rates allowed by public utility commissions presumably reflect the anticipated costs of service, at least in forward test year jurisdictions. To the extent that the cash flow components which constitute a public utility's revenue requirements are not correctly anticipated, and that new information affecting utility costs and revenues becomes mirrored in futures prices, trading in futures markets can offset the unexpected changes in the costs of service.

Despite the deleterious effects of regulatory lag on a utility's earnings, no uniform policy exists to prevent the erosion of earnings due to unanticipated economic events and inevitable delays in processing applications for rate increases. Stopgap palliative measures have surfaced in some jurisdictions including emergency rate increases, bonded rate increases, adoption of transition loss allowances, automatic adjustment mechanisms such as fuel adjustment clauses, and adoption of a forward test year, but none offers the same potential for the efficient risk-bearing that futures markets offer. The use of futures markets to alleviate regulatory lag offers a potential for lowering regulatory risk thereby reducing investor return requirements and, hence, output prices borne by consumers.

The paper is organized as follows: Section I presents a brief overview of the regulatory process and discusses the effect regulatory lag has on the public utility's revenues. Section II develops strategies for hedging the expected revenue requirements against the effects of unanticipated price movements in several factor inputs. Specifically, risk control techniques are explored for three inflation sensitive components of revenue requirements: the cost of incremental debt, labor costs, and materials costs. As Section III shows, the use of futures markets by utilities themselves, or as part of the rate-setting process, has consequences for issues of social welfare. The use of futures markets in a regulated industry raises important questions of efficient risk-bearing, the allocation of gains and losses between firms and the public, and managerial incentives. Finally, Section IV provides a summary of the paper's issues and findings.

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I. Overview of the Regulatory Process

A. Rate of Return Regulation

The traditional regulatory-imposed constraint on profits is that the sum of after-tax profits and interest payments should equal the allowed rate of return times the rate base:[1]

$$(\text{EBIT} - I)(1 - t) + I = k_a(\text{RB}) \tag{1}$$

where EBIT = earnings before interest and taxes, I = interest payments, t = tax rate, k_a = weighted average cost of capital or allowed rate of return, and RB = rate base, i.e., net plant in service plus working capital allowance. Equation (1) is translated into a revenue requirement, hence into a set of output prices, by adding an allowance for operating expenses. In words, the expected revenue requirements should equal the costs of service which are the dollar sum of allowed operating expenses and overall rate of return:

$$E(\tilde{R}) = E(\tilde{O}) + Z + T + k_a(\text{RB}) \tag{2}$$

where $E(\tilde{R})$ = expected revenues, $E(\tilde{O})$ = expected operating expenses, Z = depreciation to be charged, and T = taxes. Furthermore, the allowed dollar return on the rate base, $k_a(\text{RB})$, can be broken down as follows:

$$k_a(\text{RB}) = k_d^e B^e + E(\tilde{k}_d^i)B^i + E(\tilde{k}_e)E \tag{3}$$

where k_d^e = embedded cost of debt, B^e = current debt outstanding at beginning of test period, $E(\tilde{k}_d^i)$ = expected cost of incremental debt, B^i = incremental debt to be issued during test period, $E(\tilde{k}_e)$ = expected cost of equity, and E = average equity outstanding during the test period. A public utility's product is priced at the start of each period t such that equation (2) will hold. Equation (2) is assumed to remain in effect indefinitely unless violated, thus triggering a formal request for a rate increase or decrease. Major events producing a discrepancy between the earned rate of return and the current cost of capital include changes in capital costs, operating expenses, or taxes, a change in capital structure, an expansion of the rate base, a deviation of actual from expected demand, delays in initiating new proceedings, or the persistence of regulatory lag.

B. Regulatory Lag

When the actual revenues earned are less than the costs of services as of time t_0, the utility files for a rate hearing to occur at a later date t_1. Finally, at t_2, an order is issued allowing the company to raise rates effective at t_3. Since the accounting cost data used in the hearing are based on expected cost figures (assuming a forward test year jurisdiction), the estimates become outdated if higher (lower) than anticipated inflation occurs after the time the new rates are in effect, thus providing lower (higher) revenues than specified in equation (2). If an unanticipated rise in costs occurs after t_3 the utility will presumably initiate another formal request, at time t_0', for a hearing to occur at t_1'. At t_2' a new order

[1] For a concise overview of rate of return regulation, see Myers [22] and Robichek [25].

is issued allowing the company to raise rates effective at t_3'. During the period t_3 to t_3', the utility is exposed to unexpected increases in its costs of service which cannot be incorporated into the price of its product and thus passed on to the ratepayers. The utility's shareholders will continually bear these losses as the above cycle repeats itself. This chronic and systematic erosion in utility's revenues due to unanticipated inflation is referred to as regulatory lag.[2]

Futures markets offer shareholders of public utilities a medium for alleviating the adversities of regulatory lag. It is widely accepted that futures prices embody predictions about future interest rates, relative prices, and inflation. Thus, to the extent that shareholders absorb losses due to unexpected inflation, it is possible that these losses can be offset with an appropriate position in the futures market.

II. Strategies for Hedging Regulatory Lag

To illustrate the hedging of regulatory lag, this section examines three separate components of the costs of service.[3] First, a public utility's profitability is extremely sensitive to unexpected changes in the cost of new debt, given its high degree of capital intensity and frequent debt flotation. Second, labor is an important component of the cost stream as well, and unexpected increases in labor costs will affect profitability. Third, utilities also must make projections regarding the cost of physical inputs, which is analyzed here for materials, such as copper.

For each of these factor inputs, an underlying cause of earnings variation is unanticipated inflation. In a forward test year jurisdiction, allowed rates for the next regulatory period should reflect anticipated inflation. When inflationary expectations are not realized, regulatory lag has an effect on the wealth of the utility's shareholders. Therefore, the hedging goal is to make the utility's income, during the regulatory period, invariant with respect to unanticipated inflation, and hence, regulatory lag.

Consequently, it appears that one could simply initiate a simple hedge against unanticipated inflation, and thereby secure the desired result. Since the relative inflation rates experienced in different economic sectors vary to an unanticipated extent, an aggregate approach is not likely to be effective. Also, the disaggregated approach to be followed here, allows for the differing susceptibility of different factors of production to regulatory lag. Consistent with the dis-aggregated approach, we assume that each component is to be hedged separately.

Since the only cost components allowed to vary from expectations are incremental debt, labor, and materials, a perfect hedge is achieved when the following conditions hold:

$$F_{B^i} = [k_d^i B^i - E(\tilde{k}_d^i B^i)] \tag{4a}$$

$$F_L = [L - E(\tilde{L})] \tag{4b}$$

$$F_M = [M - E(\tilde{M})] \tag{4c}$$

[2] Elton and Gruber [9] analyze the financial effects of regulatory lag in more detail.

[3] For simplicity, we assume that the only components of operating expenses are labor and materials costs.

where $k_d^i B^i$ = actual debt sevice cost of incremental debt in regulatory period, L = actual cost of labor in regulatory period, M = actual cost of material acquired in regulatory period, and F_{B^i}, F_L, and F_M = profits or losses on new debt, labor and materials hedges, respectively.

When conditions (4a–c) hold, total revenues equal total expenses as shown by equation (5):

$$F_{B^i} + F_L + F_M + R = k_d^i B^i + L + M + Z + T + k_d^e B^e + k_e E \tag{5}$$

Hedges for new debt, labor, and materials are now analyzed in turn.

A. Regulatory Lag and New Debt Issues

At t_2 new rates are set, consistent with some anticipated estimate of the cost of debt capital for the regulatory horizon. No new level of rates can be attained until t_3', the date new rates will take effect from the next rate hearing. Consequently, the utility is at risk with respect to new debt capital costs from time t_3 until time t_3'. Higher than anticipated costs that are incurred in servicing its debt over this period will be at the expense of the utility's shareholders alone.

To analyze this problem, and the appropriate response by the utility, we assume the following: (1) underwriting costs are estimated accurately, (2) the implied cost of debt, consistent with the revised rate at time t_2, equals the market's anticipation as revealed by an analysis of the term structure, (3) only one bond flotation, with known par value B^i is planned between t_2 and t_3, with one annual coupon payment equal to $k_d^i B^i$,[4] where k_d^i is the annual coupon rate and yield to maturity on the bond, and (4) the new rates going into effect at t_3' will cover the actual future cost (k_d^i) of the bond that was issued between t_2 and t_3.

Against this background, the risk position of the utility, with respect to the cost of debt capital, is apparent. Bonds issued prior to time t_2 have a known cost, ($k_d^e B^e$), and rates currently in existence at t_2 will reflect those costs. The real risk of the utility will be on bonds to be issued after t_2 at some uncertain rate. The danger is that the new rates (granted at t_2) may not be consistent with the actual bond rate (k_d^i). If k_d^i is higher than that which was anticipated as of time t_2 (i.e., $k_d^i > E_2(\tilde{k}_d^i)$), the utility will pay more in interest costs than the rates cover. This will mean an unanticipated loss to the shareholders. By the same token, if bonds are issed at an unexpectedly low rate, the utility's shareholders will enjoy a windfall gain. Note that this risk exposure lasts only from t_2 to t_3'. By assumption (4), the new rates going into effect at t_3' will cover the actual debt cost (k_d^i), whereas the rates granted at t_2 cover only the expected cost of new debt ($E_2(\tilde{k}_d^i)$). To hedge against the regulatory lag inherent in this process, the utility seeks to trade futures contracts so that it will experience neither windfall gains nor losses.

For the new debt to be issued, the utility expects it will pay $E_2(\tilde{k}_d^i)B^i$ between t_2 and t_3'. The amount it will actually have to pay will be $k_d^i B^i$. Consistent with equation (4a), the hedging goal of the utility is to assume a position in the futures

[4] This assumption affects the simplicity of expositions only. The model may be generalized to multiple issues with multiple coupons.

market such that over the life of the hedge:

$$[E_2(\tilde{k}_d^i) - \tilde{k}_d^i]B^i + (\Delta\tilde{P}_j)N = 0 \tag{6}$$

where P_j = the value of futures instrument j, and N = the number of futures contracts traded. To achieve this result, the utility must trade such that:

$$\frac{d[E_2(\tilde{k}_d^i) - k_d^i]B^i}{dR_d^i} + \left[\frac{dP_j}{dR_j} \cdot \frac{dR_j}{dR_d^i}\right]N = 0 \tag{7}$$

where $R_d^i = 1 + k_d^i$, and $R_j = 1 +$ the yield on the instrument underlying futures contract j. The value of the futures contract j, P_j, is given by equation (8):[5]

$$P_j = \sum_{t=1}^{J} \frac{C_{jt}}{(R_j)^t} - \sum_{t=1}^{J} \frac{C_{jt}}{(R_j^*)^t} \tag{8}$$

where C_{jt} = the cash flow of the asset underlying futures contract j at time t, time being measured from the maturity of the futures contract, $R_j^* = 1 +$ the implied yield on the instrument underlying futures contract j at the time it is written, and J = time to maturity of the asset underlying futures contract j.

The purchaser of a futures contract agrees to pay the futures price, FP_j, at the maturity of the contract, in exchange for the series of cash flows, C_{jt}. Consequently,

$$\mathrm{FP}_j = \sum_{t=1}^{J} \frac{C_{jt}}{(R_j^*)^t} \tag{9}$$

At the time of entering the futures contract, $R_j = R_j^*$, and thus $P_j = 0$, implying that the futures contract initially has zero value. Later during the life of the futures contract, it may be that $R_j \neq R_j^*$ and thus $P_j \neq 0$.

Taking the derivatives in equation (7) and multiplying the numerator and denominator in the second term by FP_j gives:

$$-B^i - \frac{D_j\mathrm{FP}_j}{R_j} \cdot \frac{dR_j}{dR_d^i} \cdot N = 0 \tag{10}$$

where D_j = Macaulay's duration of the instrument underlying the futures contract j.[6]

Therefore, solving for N gives:

$$N = -\frac{R_jB^i}{\mathrm{FP}_jD_j \cdot \dfrac{dR_j}{dR_d^i}} \tag{11}$$

[5] In this analysis, the differences between forward and futures contracts are ignored. For arguments justifying and explaining this view see Kolb [16] and Kolb and Gay [19]. Some authors have pointed out theoretical differences between forward and futures contracts, such as Cox, Ingersoll, and Ross [6], Richard and Sundaresan [24], and Jarrow and Oldfield [14]. Empirically, these differences have been found to be negligible by Cornell and Reinganum [5] and French [10].

[6] Equation (10) is expressed in terms of duration for the sake of notational compactness and to emphasize the dependence of the hedge ratio on the elasticity of the futures price with respect to a change in the discount rate. Although the equation uses Macaulay's duration, the model can accept other duration measures.

Note that a hedging strategy in accordance with equation (11) will not hedge the entire risk associated with the bond flotation but just the first coupon payment, $k_d^i B^i$. In order to hedge the interest rate risk of the entire issue, the appropriate number of future contracts to trade would be:[7]

$$N = -\frac{R_j B^i D_i}{R_d^i \mathrm{FP}_j D_j \cdot \dfrac{dR_j}{dR_d^i}} \tag{12}$$

where D_i = the duration of instrument i.[8]

The utility, however, is hedging only against the regulatory lag. In fact, it has no incentive to hedge the entire interest rate risk. Following the next rate order, the new rates will reflect the embedded cost of debt, which will then include this issue. At that time the ratepayers will, in effect, assume responsibility for this bond issue. From this fact it is clear the ratepayers bear the major risk of the bond issue. The utility's shareholders face only the portion of risk due to regulatory lag, and will hedge only that part. Whether such a strategy for risk bearing is optimal is another question addressed later in the paper.

B. Labor Costs

Effective hedging of any good or service via the futures market requires a close correlation in the price movements between a particular futures contract and the good or service that is to be hedged. Labor costs, in society as a whole, move closely with the inflation rate. Such costs must be closely correlated with inflation since labor is such a pervasive factor input.

This raises the possibility that unexpected increases in labor costs, during the period of regulatory lag (t_3 to t_3'), could be hedged in the futures market. If unexpected increases in labor costs were sufficiently correlated with unanticipated inflation, a firm could hedge against regulatory lag in labor costs by hedging in the interest rate futures market.

However, the correlation between unexpected labor costs faced by utilities and unanticipated inflation is likely to be low on the whole. To the extent that utility labor costs depend upon union contract negotiations, the unexpected increases in such wage contracts are likely to depend upon factors other than the extent of unanticipated inflation. Competitive labor market conditions, the utility's financial position, and the political climate within the union will all influence the outcome of the wage negotiations. For non-unionized employees, the unexpected changes in wages are much more likely to be tied to unanticipated inflation.

In order to illustrate the potential for hedging the regulatory lag of labor costs, the analysis assumes that a utility faces some component of its labor costs that is sensitive to inflation, and that the utility seeks to hedge the regulatory lag

[7] Kolb and Chiang [17, 18] derive equation (12) for hedging a complete issue.

[8] The dR_j/dR_d^i terms in equations (11) and (12) may be estimated empirically using regression techniques based on historical data. This idea has long been extant in agricultural futures hedging (see Stein [28]). The same model has recently been extended to financial futures hedging (see Ederington [7] and Franckle [8]), although their regression model is usually expressed in price change form. Often it is realistic to assume that $dR_j/dR_d^i = 1$. Even with such a simplifying assumption, high hedging effectiveness may be expected (see Gay, Kolb, and Chiang [11]).

associated with that portion of its labor costs. Interest rate futures prices reflect market expectations regarding the inflation that will occur over the life of the deliverable asset, and adjustments in these prices occur as the delivery date approaches. Wage agreements, by contrast, reflect both the inflation that occurred since the last wage settlement as well as expectations of future inflation. Since futures prices reflect only the inflationary expectations for the period covering the deliverable asset's life, a hedge cannot be instituted that will cover the originally unanticipated inflation that has occurred since the last wage agreement, nor can the currently anticipated inflation be hedged. Only the unanticipated inflation can be hedged, since any anticipated inflation will already be reflected in the futures prices. This point is reflected specifically in the more formal analysis that follows.

To simplify the hedging problem, and to allow a clearer analysis of the problem of regulatory lag, assume: (1) At t_2 the utility wishes to initiate a hedge of the unanticipated labor expense to be incurred between t_3 and t_3'; (2) The utility correctly forecasts determinants of wages except for unanticipated inflation; and (3) Short term inflation expectations (i.e., between t_2 and t_3, and between t_3 and t_3') are correct. Under these assumptions, the condition for a perfect hedge follows from equation (4b):

$$\frac{d[E_2(\tilde{L}_{3,3'}) - L_{3,3'}]}{dI_3} + \frac{dP_j}{dI_3} \cdot N = 0 \tag{13}$$

where $E_2(\tilde{L}_{3,3'})$ = the expectation formed at t_2 of $L_{3,3'}$, $L_{3,3'}$ = cost of labor between t_3 and t_3', and $I_3 = 1 +$ the error in the t_2 expectation of the inflation rate between t_3 and t_3'. Since by assumption (2), the only error in wage forecasts concerns inflation, it follows that:

$$L_{3,3'} = I_3 E_2(\tilde{L}_{3,3'}) \tag{14}$$

Likewise, F_L, the profit or loss on the futures position must be equal to the value of the futures contract, P_j, as given by equation (8). Substituting equations (8) and (14) into equation (13) and taking the derivatives gives:

$$-E_2(\tilde{L}_{3,3'}) - \textstyle\sum_{t=1}^{J} \frac{tC_{jt}}{(R_j)^{t+1}} \cdot \frac{dR_j}{dI_3} \cdot N = 0 \tag{15}$$

Making the necessary substitutions to express equation (15) in terms of duration, as was done in equation (10), and solving for N gives the hedge position:

$$N = -\frac{R_j \tilde{E}_2(L_{3,3'})}{\mathrm{FP}_j D_j \; dR_j/dI_3} \tag{16}$$

Equation (16) gives the number of futures contracts to trade to hedge the costs of labor that are expected to fall between time 3 and time 3′. All of the terms in equation (16) can be known at t_2 when the hedge is initiated, except for the dR_j/dI_3 term. This final term cannot be known at t_2, since it involves I_3, an error in expectations at t_2. However, since the hedge is to be terminated at t_3, R_j should embody at that time the current inflationary expectations, and dR_j/dI_3 will equal 1 if futures prices fully reflect inflationary expectations for short horizons.

This strategy hedges only the unanticipated change in labor costs from t_3 to t_3',the period of the utility's exposure to regulatory lag. As was the case with the debt issuance, this strategy leaves the ratepayers to bear the risk of unexpectedly higher labor costs beyond t_3. As a practical matter, one would be likely to hedge labor costs with a strip of short term debt instruments (e.g., T-bill futures) with deliverable instruments covering the same period from t_3 to t_3'. This procedure will likely result in a closer correspondence between futures price movements and unanticipated labor costs.

C. Materials Costs

Public utilities also face the risk of regulatory lag in the acquisition of material inputs such as copper, poles, and automobiles. If prices of such goods rise unexpectedly, utility shareholders suffer a loss due to regulatory lag. The utility may hedge these risks by transacting in the futures market, committing itself to the future purchase of these materials at the currently expected price. For some goods, such as copper, a direct hedge is possible. For other goods, whose prices are tied to inflation, a strategy similar to that shown for hedging wages may be employed. To hedge against regulatory lag, only those purchases to be made before the next rate revision need be hedged, again leaving the consumer to bear the risk of subsequent purchases.

In each case, debt flotation, labor, and materials, a strategy has been shown for allowing the utility to alleviate the risk of regulatory lag. In each case, the ratepayer is left bearing the brunt of the risk, since most risk lies beyond the purview of regulatory lag. Such a situation may be sub-optimal as a matter of utility company incentive, regulatory policy, and efficient risk-bearing. These issues are addressed in the next section.

III. Policy Implications

A. Risk Effects

The previous sections have ignored the potential impact that hedging may have on the utility's cost of capital. By protecting the shareholders from the adversities of regulatory lag, the hedging of the firm's various operating inputs and debt costs may reduce the volatility of its operating and earnings income. Considerable research (see for example Modigliani and Miller [21], Hamada [12], Rubinstein [27], Myers [23], Bowman [4], and Kim [15]) has established the linkage between operating or business risk and equity risk premia. The theoretical efforts have been able to establish a direct relationship only by making some restrictive assumptions. Following the development of Bowman, for illustrative purposes, the relationship between systematic risk, β_i, and operating risk, $\sigma(X_i)$, can be expressed as:

$$\beta_i = \frac{S_M}{S_i} \cdot \frac{\sigma(X_i)}{\sigma(X_M)} \cdot \rho(X_i, X_M) \tag{17}$$

where S_M = the market value of the market portfolio of equity securities, S_i =

the market value of the equity of firm i, X_i = operating earnings of firm i, and X_M = operating earnings of the market portfolio. From equation (13), the effect of a reduction in operating risk on the utility's cost of equity will depend on what changes occur in $\rho(X_i, X_M)$. The functional relationship between $\rho(X_i, X_M)$ and $\sigma(X_i)$ needs to be defined before the impact on systematic risk can be determined. A similar conclusion is reached by Rubinstein [27] who separates the effects of the risk-free rate of return, operating risk, and financial risk on the expected rate of return to equity.

Empirical work by Beaver, Kettler, and Scholes [3] and Rosenberg and McKibben [26] finds earnings volatility to be strongly related to beta. Lev and Kunitsky [20] hypothesize that if the operational efficiency of a firm is enhanced by smoothing its input and output streams, then the firm's risk as perceived by investors should be reduced. Their empirical evidence finds that the extent of smoothness of sales, production, capital expenditures, dividends, and earning series is significantly correlated with both the overall and systematic common stock risk measures.

In summary, it appears that firm hedging of operating cash flows may indeed serve to reduce the firm's cost of equity capital, which may also reduce its future debt costs, thereby reducing the overall cost of capital. It would seem then that the chief beneficiary of this reduction will be the consumer, as the utility's revenue requirements and thus its output prices will be reduced.

B. The Sharing of Gains and Losses and Agency Issues

Under current regulatory practice, new rates take effect at t_3, at which time the ratepayer is insulated from any change in costs until new rates are instituted at t_3', (with the exception of provisions such as automatic fuel adjustment clauses). The shareholder is left to absorb any losses arising from an unexpected rise in costs and to reap any gains from an unanticipated reduction in the costs of service.[9] But since the utility can also protect its shareholders from unexpected cost changes through hedging transactions in the appropriate futures market, the regulatory process should recognize that all gains and losses in the futures market will be transmitted to the shareholder.

Utilities will hedge only those cash flows occurring during the regulatory lag period, as they lack any incentive to do otherwise. The hedging model developed in the previous section assumed that only the unexpected changes in costs occurring during the period t_3' to t_3 were hedged. Since such cost changes will become imbedded in the revenue stream at t_3', no managerial incentive exists to hedge costs beyond the regulatory lag period. For example, if yields on newly issued debt were to rise unexpectedly following the initial rate order, the unforeseen change in debt cost is initially absorbed by the shareholders until the new rates take effect. The shareholder absorbs the rise in cost in the short run, the ratepayer thereafter. Utility managers have no incentive to expend resources to hedge costs beyond the regulatory lag period.

[9] It must also be noted that the dominant model of hedging is that of insurance buying. If that model is correct, the hedging program may well induce a drop in returns as well as risk.

Three principal constituencies in society are available to bear the risk associated with the production of utilities: utility shareholders, ratepayers, and risk bearers in the futures market. Within the current regulatory environment, the largest component of that risk is borne by ratepayers since costs are passed on to the users of the utility's services. Even if utilities began to hedge on behalf of their stockholders, they would not hedge any cash flows beyond t_3. Ratepayers would continue to bear the greatest risk, although they may not be society's most efficient risk bearers.

Since the output of utilities is consumed by everyone, we may take the group of ratepayers as representative of society as a whole. If so, the question becomes whether society as a whole should bear the risk associated with utility production. This risk may be borne more efficiently by futures market participants. If so, regulators may wish to encourage utilities to hedge on behalf of both shareholders (cash flows before t'_3) and ratepayers (cash flows after t_3). Broadly speaking, utility regulation should strive to insure that utilities are operated in the public interest. Careful study of the issues involved may lead regulators to insist that utilities hedge on behalf of the ratepayers.

Even if the rationale for hedging advanced here is accepted, it may be argued that utilities should not be forced to hedge for the ratepayers. In perfect frictionless markets, whether the utility, the shareholder, or the consumer conduct the hedging is a matter of indifference. In practical terms, owing to the scale differences in the relative number and size of the futures contracts involved in corporate versus individual hedging, the terms of hedging are likely to be more favorable for the utility. The fractional number of contracts which would be required for each shareholder to hedge his proportional stake in the firm is cumbersome and prohibitive. Further, the utility takes actions to affect the size and timing of its operating cash flows and therefore has superior information.

The various costs incurred in conducting the hedging program, such as monitoring costs, and the working capital necessary to satisfy margin requirements, can either be considered as routine costs of providing service and thus borne by ratepayers, or disallowed from the revenue requirement computation and thus absorbed by shareholders. Alternatively, in keeping with the fairness doctrine which is firmly anchored in regulatory philosophy, the method of apportioning costs between ratepayers and investors should reflect the relative benefits conferred. As discussed earlier, there is no incentive for the utility to hedge cash flows occurring beyond the regulatory period as far as the shareholders are concerned. Also, the benefits of any additional hedging beyond the regulatory period will accrue to the ratepayers in the form of a lower present value of revenue requirements. Thus, the difference between the number of contracts required for a single period hedge and the number of contracts required to implement a hedge extending beyond could provide the basis for a fair distribution of the costs of hedging between investors and ratepayers. For example, the number of contracts required to hedge the costs of a debt issue's first coupon is given by equation (11). A similar expression can be derived for hedging the entire bond issue as given in equation (12). The cost of the additional number of contracts required to hedge the entire issue, as opposed to only the first coupon, for the strict benefit of ratepayers should be absorbed by ratepayers.

C. Fuel Adjustment Clauses

Most regulatory bodies for electrical utilities permit some version of an immediate or rapid pass-through of changes in fuel costs to the consumer of the electrical service. This practice has the effect of insulating the utility from any risk associated with fluctuating fuel costs. However, this benefit is achieved only by shifting the entire risk of fuel price changes to the consumer.[10]

Additionally, the present regulatory scheme for dealing with risky fuel prices may have other deleterious effects. In a recent analysis, Isaac [13] develops several models of utilities operating under such fuel adjustment clauses. Under certain model specifications, utilities can be shown to prefer more fuel-intensive technologies than would be socially optimal. In general, Isaac concludes that such clauses may preserve the financial integrity of utilities, but at the cost of encouraging inefficient input choices.

Consequently, it seems clear that the current use of FACs benefits utilities, but stimulates inefficient input choice and puts the entire burden of fuel price risk on consumers. These considerations raise the question of whether the present system of fuel cost risk bearing is desirable from a social point of view. Merely because utilities use fuel as an input and utility customers consume fuel, it does not follow that either constituency should bear the price risk for society.

Another possibility is to eliminate the FAC and allow utilities to hedge the price risk associated with their fuel needs in the futures market. By doing so, the utilities would be able to transfer the unwanted fuel price risk to other parties. Since one may think of the futures market as embodying a market for risk bearing services, it may well be the case that futures market participants can bear the risk at a cheaper price than either the utilities or the public at large. The insitution of such a practice might also help to reduce the present inefficiencies in input selection noted by Isaac.

Such a scheme is, at the present, merely visionary. Currently, futures markets in energy are poorly developed, with contracts in heating oil, propane, and gasoline. However, energy futures are expected to grow in importance over the coming years, and they may develop to the point of being useful for the purpose described here.

D. Futures and the Regulatory Environment

So far, it has been tacitly assumed that futures might be used by regulated utilities under the current regulatory framework. However, it is possible that the use of futures would have two effects on the regulatory process. First, the use of futures could threaten the ability of regulators to use regulatory lag as a tool. Second, futures could be productively incorporated into the regulatory process itself.

Some academicians, notably Myers [22], suggest that regulatory lag provides public utilities with an incentive to produce more efficiently. Others argue that

[10] From an analytical point of view, the present FACs treat fuel costs as though they were cash flows occurring after t_3. That is, the costs are free from regulatory lag and their riskiness is borne by ratepayers alone.

regulatory lag retards progress and efficiency.[11] For present purposes, the use of futures will allow utilities to escape some of the effects of regulatory lag. Such a result necessarily changes the current regulatory milieu. If regulatory lag is viewed as beneficial, regulators may take some action to re-institute regulatory lag. If regulatory lag is, in fact, harmful to economic efficiency, then the use of futures by regulated industries could confer a net benefit to society.

It is also possible that futures could enter the regulatory process itself. Presumably, the rates allowed by regulatory bodies reflect to some degree the risk borne by utilities in factor markets. Such risks are difficult to quantify and to incorporate into the rate structure. One way of gauging the proper price for such risk bearing is provided by the futures market. The benefit to society of bearing a "hedgable" risk cannot exceed the cost of hedging that risk in the futures market. The compensation to shareholders for bearing the risk associated with new debt, for example, should not exceed the cost of hedging that risk in the futures market.[12]

Such a framework might be useful in the regulatory process. With sufficient development of the hedging tools, and a careful assessment of hedging costs a new regulatory framework might emerge. Rates could be set to cover operating costs and to provide an adequate return equal to the risk-free rate plus the cost of hedging eligible risks, and to include a premium for bearing risks that cannot be hedged. Even if feasible, the adoption of such a new regulatory outlook is distant. However, this alternative framework could provide regulators with a new way of thinking about their decisions and could corroborate the results of current analytical techniques used in the rate setting process.

IV. Summary and Conclusion

This study has analyzed the use of futures markets by public utilities to hedge the regulatory lag inherent in incremental debt, labor, and materials costs. The development of the hedging model raises important issues regarding the effects of hedging on the utility's cost of capital, the managerial incentives for hedging, the proper bearers of risk in society, and the allocation of the benefits from hedging between shareholders and ratepayers. Finally, the prospect of hedging by utilities to avoid regulatory lag challenges regulators to respond to the issues developed here.

Strong incentives for hedging by utilities exist, and it is quite likely that important benefits for society are possible. Yet the current institutional structure, almost certainly, will not result in a socially optimal outcome. Under the present regulatory environment, utilities will probably not engage in the socially optimal amount of hedging, risks associated with the production of utilities will probably

[11] While Myers argues that regulatory lag be used consciously as an incentive to reduce costs, others (see Wein [30], Bailey [1], and Baron and Taggard [2]) argue that regulatory lag discriminates against efficient firms, deters product innovation, and impairs efficient resource allocation.

[12] The idea of using futures or forward markets to estimate the cost of risk bearing is also found in discussions of international capital budgeting (see Stonehill and Nathanson [29]). The required additional rate of return for bearing foreign exchange risk in an international project should be just sufficient to cover the cost of hedging that risk away in the foreign exchange market.

not be borne by the most efficient bearers, and the allocation of benefits from hedging will probably not be efficient. Taken together these difficulties pose a new set of problems for regulators and for students of the public utility industry.

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