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# Fragile Commitments And The Regulatory Process

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Richard Zeckhauser††

*Once a regulated utility has made an irreversible capital investment, that investment becomes vulnerable to appropriation by a regulator. This Article explores the incentives and strategies of the investor, the consumer, and the regulator—before and after capital investments are sunk—within a game-based model of regulation. A regulator, even one whose allegiance lies wholly with consumers, will find it advantageous to commit to repaying investor capital. A consumer gains when regulatory commitment to repaying capital is made less fragile. Commitment often does not take the form of a promise or contract. Historically, the most important force for keeping regulators faithful has been the continuing need for future investment. New methods for making commitments more sturdy include adopting technologies that result in small repeated investments, greater use of market transactions, and regulator involvement in the firm's planning decisions.*

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Introduction

Should utility regulators be flexible? Should they reserve the right to change their minds? Should they try to avoid “tying the hands of future regulators”? These questions are closely related to another question: Which regulator better serves the consumer—the consumer advocate, or the guardian of the utility’s financial integrity? We will show that the two goals underlying these questions, regulatory commitment and consumer protection, are not necessarily in conflict. Quite the contrary, consumers are best served by regulators who can faithfully protect the utility’s investors. In practice, the commitment of many regulatory bodies is fragile; it can break easily under pressure. Where commitments are fragile, consumers lose rather than gain.

We conceive of the regulation of public utilities as a game involving investors, consumers, and the regulator. Game theory explores the interactions when a small number of rational economic actors, who may have differing preferences and information, each seeks to maximize his own payoff.<sup>1</sup> In our

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1. Since political economist Thomas Schelling defined bargaining power as the “power to bind oneself,” game theoretic models have been used to examine the role of commitment in a range of areas, including the regulation of monopolies. THOMAS C. SCHELLING, *THE STRATEGY OF CONFLICT* 22 (1960). Many recent game theoretic models of utility regulation have emphasized the inefficiencies that result when the regulator knows less about cost or demand than does the firm and also is unable to make commitments. Bruce Greenwald describes the commitment problem as one of “dynamic consistency,” and he argues that

game, the firm tries to achieve the highest return on its investment; and consumers seek to maximize the benefits of utility service payments to the firm. The objectives of the regulator in this game are less clear. In general, regulation is intended to maximize either consumer or societal benefits.<sup>2</sup> We find that the results of this game depend greatly on whether the regulator can, before the firm has made an irreversible investment in the enterprise, commit to compensate the firm for that investment.

We assume that the regulator and the firm are equally informed about demand and costs, not because we believe this reflects reality but rather to isolate the effect of commitment in the regulatory relationships. We assume that, as is virtually always the case in the real world, the regulator has discretion over the firm's compensation. She<sup>3</sup> wants the firm to make investments in the enterprise that will benefit consumers. Once an investment is made, however, the regulator's interests may lie in maximizing consumers' surplus, which means reducing the firm's compensation. Anticipating such a move, the firm may refuse to invest in the first place. This scenario exemplifies the dilemma of a public official whose immediate responsiveness may not serve the long-term public interest.<sup>4</sup>

Part I outlines the source and consequences of fragile commitments for consumers and regulators. In Part II, we develop a game model in which the regulator's ability to commit affects the payoffs accruing to consumers. In the real world, of course, utility investment has occurred despite fragile commitments, and in Part III we discuss how regulators can be responsive to public pressure yet still induce investment. Part IV identifies existing and potential mechanisms for better commitment.

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regulators rightly are restricted to criteria of minimal "fairness" which would require by law that past regulatory promises be honored. Bruce Greenwald, *Rate Base Selection and the Structure of Regulation*, 15 RAND J. ECON. 85 (1984). David Baron and David Besanko develop a game model in which the self-interested utility firm and the regulator will reach a limited form of commitment, if the regulator is obligated to respect basic property rights of firms. David Baron & David Besanko, *Commitment and Fairness in a Dynamic Regulatory Relationship*, 54 REV. ECON. STUD. 413 (1987). David Sappington shows that if the regulator cannot commit to let the firm reap the benefits of its efficiency and innovation, the regulator may use bureaucratic procedure and delay to allow the firm to keep cost savings longer. David Sappington, *Commitment to Regulatory Bureaucracy*, 2 INFO. ECON. & POL. 243 (1986). In these and other models, the firm can use its information advantage to reap economic rents. Such rents are inefficient because they require that the firm restrict output (implying higher costs) to avoid revealing its private information. The regulator could increase benefits to consumers by credibly promising not to use revealed or acquired private information against the firm. This literature is surveyed in David Sappington et al., *Information and Regulation*, in PUBLIC REGULATION: NEW PERSPECTIVES ON INSTITUTIONS AND POLICIES 3-44 (1987) and DAVID BESANKO & DAVID SAPPINGTON, DESIGNING REGULATORY POLICY WITH LIMITED INFORMATION (1987).

2. Societal benefits are the sum of benefits reaped by consumers and investors.

3. Or "he," of course. For the sake of clarity, we refer to the regulator throughout the Article as a woman.

4. Dani Rodrik & Richard Zeckhauser, *The Dilemma of Government Responsiveness*, 7 J. POL'Y ANALYSIS & MGMT. 601 (1988).

## I. The Problem of Fragile Commitments

### A. *The Potential for Appropriation*

Because public utility systems require very large and long-lived investments, commitment is an especially important issue for utilities and regulators. Utilities require billions of dollars in capital; once utility plants are built they cannot be directed to another use without losing much of their value. The irreversible nature of utility investment creates an appropriable quasi-rent.<sup>5</sup> In other words, the difference between the cost of building a utility plant and the money that the firm could recover if the plant were scrapped is vulnerable to appropriation by consumers. Once the firm builds the plant, consumers can enjoy its benefits even if they do not pay for it.

Appropriation will occur, for instance, if a regulatory commission allows a firm to charge only enough to cover the variable costs of a new plant.<sup>6</sup> Unless the plant can be uprooted and moved to another jurisdiction, the firm has little choice but to accept whatever amount the regulator offers. The cost of building the plant has been appropriated for the benefit of consumers. Appropriable quasi-rents are substantial in traditional utility industries, because they are capital-intensive. Moreover, investments come in large lumps, and once in place a plant is highly idiosyncratic as to location and function.

In recent years regulators frequently have ruled that utility managers made "imprudent decisions" and therefore have excluded some investments, particularly investments in nuclear power plants, from the firms' rate bases.<sup>7</sup> The value of outright disallowances of nuclear plant investments by state utility commissions in the 1970s and 1980s has been substantial.<sup>8</sup>

The value of explicit disallowances does not capture the full effect of adverse regulatory decisions in the 1970s and 1980s. Regulators have considerable discretion in determining the rate of return to which a utility is entitled, and even when regulators have not specifically excluded a new plant from rates, they often have mandated lower profit levels. Even a small reduc-

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5. Benjamin Klein et al., *Vertical Integration, Appropriable Rents, and the Competitive Contracting Process*, 21 J.L. & ECON. 298 (1981).

6. Variable costs are those costs, such as fuel, wages, and supplies, that vary with the output of the plant and that are not incurred if the plant produces no output.

7. Rate base is the firm's investment in utility plant and other assets required to provide service. Regulators calculate the return to which the firm is entitled by multiplying an authorized rate of return by the rate base amount. See A. Lawrence Kolbe & William B. Tye, *The Duquesne Opinion: How Much "Hope" is There for Investors in Regulated Firms?* 8 YALE J. ON REG. 113 (1991).

8. The value of nuclear-related disallowances during the 1970s and 1980s was estimated in 1987 to be \$2-3 billion; the figure was expected to rise to approximately \$5-6 billion as then unfinished plants underwent regulatory review. ENERGY INFO. ADMIN., U.S. DEPT. OF ENERGY, COMMERCIAL NUCLEAR POWER 1987: PROSPECTS FOR THE U.S. AND THE WORLD 32 (1987). At \$6 billion, the disallowances would represent about 6% of the value of utility investment in nuclear plants between 1974 and 1987.

tion in the rate of return on investment can be quite expensive, since it applies both to existing and new plants. From 1974 to 1987, the incremental annual real return on new utility investments averaged less than 2%.<sup>9</sup>

At the time that the firm commits to an investment in fixed plant, regulators typically have made no specific commitment about the rates they will grant when the plant reaches completion. More importantly, even when a commitment is made, a regulator's promise of rates is much less costly to reverse than a firm's investment of capital. Constitutional guarantees of due process and equal protection of the law protect firms from outright, literal expropriation without compensation. However, the regulator can rule that the firm's profits are unreasonably high or, perhaps more easily, that its expenditures have been imprudent. Statutes typically provide the firm with an "opportunity to earn" a "fair and reasonable" return on its "prudent" investment, and the courts have given regulatory bodies considerable discretion, based on their expertise, in setting the rates of regulated firms.

#### B. *The Lure of Appropriation*

Because of the physical and economic characteristics of utility plants, the commitment of the firm to provide plant and services is virtually irreversible. By contrast, even if a given regulator wishes to promise to reward that investment, her commitment is fragile compared with the strength of the firm's commitment.<sup>10</sup> The fragility of regulatory commitments makes it more difficult and expensive to attract capital. A rational firm anticipates its vulnerability and will not sink its capital unless it believes that the regulator will keep her commitments.

A natural monopoly firm has high fixed costs relative to marginal costs. As a result, average cost declines as output increases and is above marginal cost at any level of output. This cost structure invites appropriation of sunk capital by regulators interested in furthering the societal good (which is the sum of producer benefits and consumer surplus). Recovery of sunk investment requires that the price be set above marginal cost, thus creating efficiency losses for society.<sup>11</sup> Setting prices to cover only marginal costs would impose a loss on

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9. Calculated by the authors from ENERGY INFO. ADMIN., U.S. DEPT. OF ENERGY, FINANCIAL STATISTICS OF SELECTED ELECTRIC UTILITIES 1982, Tables 3 and 12 (1984) and ENERGY INFO. ADMIN., U.S. DEPT. OF ENERGY, FINANCIAL STATISTICS OF SELECTED ELECTRIC UTILITIES 1987, Tables 10 and 12 (1989). The rate of return on new investment was calculated by dividing the annual increase in utility operating income by the annual increase in net utility plant.

10. The fragility of a commitment must be measured in relative terms. One party becomes vulnerable to appropriation whenever its commitment is stronger than the other party's. This is true whether, on an absolute scale, both parties' commitments are weak or strong.

11. Economic theory generally holds that societal benefits are greatest when price is equal to marginal cost. At any price above marginal cost, the demand for the good is reduced. Since consumers would have

the firm, but the loss would be more than offset by an increase in consumer benefits, a tempting prospect even for the "fair" regulator who gives equal weight to the interests of consumers and the firm.

Changes in the makeup of utility regulatory commissions suggest that regulators have become more inclined to respond to public pressure. Today regulators are more likely to be former legislators, political staff, or civic activists than in the early 1970s, when more regulators came from business, career government service, and private law practice. In 1988, 22% of state regulators came from politically active backgrounds, compared with 49% in 1973.<sup>12</sup> Over this period, the proportion of politically active regulators fell on fifteen state commissions and rose on twenty-seven. The proportion of regulators who were attorneys, accountants, economists, engineers, or business people declined from 67% in 1973 to 58% in 1988.<sup>13</sup>

Our concern is not that regulators have become more pro-consumer, though this appears to have happened. Rather, the problem arises when expectations change or regulators become weak-kneed, responding to political or public pressure to abrogate promises. Because regulation ultimately is a political process, consumers can control utility rates. Through their regulators, consumers have the power to collect quasi-rents by not paying the firm for its sunk investment. At times, such as when rate increases become noticeable and objectionable, consumers will exert pressure on regulators to collect these quasi-rents, making commitments, explicit or implicit, by past or present regulators, fragile.

## II. Regulation with Fragile Commitments

The effect of the regulator's fragile commitment is best illustrated by examining the regulatory process as a game played within a basic framework

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consumed these goods at a price equal to marginal cost, it follows that their marginal value to consumers is greater than their marginal cost. The reduction in demand resulting from prices above marginal cost therefore cause a net loss of societal benefits.

12. Federal regulators had similar close ties with industry in the 1970s. Ross Eckert examined the backgrounds of persons who had served on federal regulatory commissions and found a strong tendency through the mid-1970s for ex-regulators to work for regulated industries. Of the 142 people who had served on a federal commission through 1977 and did not retire or die in office, 72 took jobs in the regulated industry. Ross D. Eckert, *The Life Cycle of Regulatory Commissioners*, 24 J.L. & ECON. 113, 116-17 (1981).

13. Calculated by the authors from NAT'L ASS'N OF REGULATORY UTIL. COMM'RS., PROCEEDINGS: REGULATORY SYMPOSIUM (Paul Rogers, ed. 1974, 1989), which contains a brief biography of the professional backgrounds of state utility commissioners. For this analysis, a "politically active" regulator was defined as one who described herself as a civic, political, or consumer activist or had been an elected official (governor, legislator, mayor, etc.); a member of an elected official's staff; an official in a political party; or a lobbyist. The number of attorneys, accountants, economists, engineers, and business people was reported in the 1989 edition. Both changes in proportion reported in the text are significant at the 99% confidence level.

determined by the economy, the law, and the nature of utility services.<sup>14</sup> Three representative players participate in the game: the firm, the consumer, and the regulator. The players move in turn and base their actions on the other players' anticipated responses. The game model allows us to consider how consumers and the firm will be affected if the regulator gives more weight to the interests of either group, and how the ability of a regulator to commit affects consumers' benefits.

## A. *The Players*

### 1. *The Firm*

The utility firm raises funds in the capital market, where information and transaction costs are relatively low. Because information costs are low and an investor cannot be compelled to provide money to a firm, he does not accept anticipated but uncompensated risks of loss. Since the firm's stock is traded on the market, a single investor can hold a very small fraction of the total capital invested in the firm. Therefore he will be effectively risk neutral.<sup>15</sup> Due to low transaction costs, the market is liquid and the supply of funds very elastic at the market rate of interest. Thus the firm raises funds in a very competitive capital market.

The firm is forward-looking in that it attempts to anticipate the moves of consumers and the regulator and makes investment decisions accordingly. Let  $p$  be price,  $Q$  quantity,<sup>16</sup> and  $C(Q)$  the cost of producing  $Q$  units. The payoff to the firm,  $F$ , depends on the regulated price; its profits are  $F(p) = pQ - C(Q)$ .<sup>17</sup>

### 2. *Consumer*

The consumer has two functions in this game. Initially, he selects the regulator who will set rates after the firm has invested. Later, he makes a consumption decision based on the rate set by the regulator. The consumer may act in a forward-looking manner when he, acting collectively with other consumers, selects a regulator, but his consumption decisions are not strategic.

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14. Like any model, ours uses a simplified picture to explicate reality. The first simplifications are that all investors are alike, the firm perfectly represents their interests, and that all consumers are alike.

15. We recognize that utility managers may be averse to risks that would affect their compensation or tenure and that, because of the agency problem, they may act contrary to the interests of investors. However, we ignore this independent problem.

16. We suppress the argument of  $Q(p)$  where there will be no confusion.

17. We assume that the firm operates with increasing returns to scale, so that marginal cost is everywhere less than average cost. In general we use the simplest case of scale economies, where the firm incurs a fixed cost plus a constant marginal cost.



Each consumer chooses the quantity that equates personal marginal benefit with price. When the consumer lifts the telephone receiver or flips the light switch, he considers only the cost to him and not any societal costs arising from any divergence of price from marginal cost. This implies that whenever price differs from marginal cost, the consumer's consumption choice will create deadweight losses.

The payoff to the consumer is consumer surplus. These are the benefits,  $B(p)$ , that consumers get from buying at a price below their reservation price. For example, a consumer who would pay \$10 for a product but is charged \$4 reaps a consumer surplus of \$6. Assuming away income effects, consumer surplus is the area under the demand curve and above price:

$$B(p) = \int_p^{\infty} Q(p)' dp - pQ. \quad (1)$$

While the consumer may respond strategically in his choice of a regulator, we also consider the possibility that he acts naively in his choice of regulator or the pressure that he places on regulators. For example, the consumer might select a regulator who perfectly reflects the consumer's interests. As we shall see, however, the consumer's best strategy in many circumstances is to choose a regulator who is not a reflection of himself. A consumer also can make a naive response by pressuring the regulator for actions that produce immediate benefits, even if they may impose greater costs in the long run. The cost of information contributes to such naive responses; consumers may determine more easily the benefits of breaking commitments than they may determine the often indirect costs that will follow. Spillovers compound the problem; the consequences of broken commitments will be paid by other consumers, including consumers in other political jurisdictions and future consumers.

### 3. Regulator

In the utility game the regulator plays the role of referee.<sup>18</sup> She sets the rates that a firm may charge its consumers, making this decision after the firm has invested its capital. We assume the regulator can take the investment as given and set rates according to any criteria. The resulting price may be above,

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18. Rates are regulated by commissions consisting of a small number of individuals. We abstract from any dynamics that may arise from this multi-member decision-making process and treat the regulator as a single individual.

below, or equal to cost.<sup>19</sup> Once the regulator sets the price, consumers react naively by consuming utility services on the basis of that price, demanding the quantity  $Q(p)$ .

We initially consider three types of regulator:

- a. *Pro-consumer*, whose objective is to maximize consumer surplus,  $B(p)$ ;
- b. *Efficiency-seeking*, whose objective is to maximize societal benefits,  $S(p)$ . Societal benefits are the sum of benefits going to the consumer and the firm:

$$S(p) = B(p) + F(p) = B(p) + [pQ - C(Q)]. \quad (2)$$

- c. *Pro-industry*, whose objective is to maximize the firm's profits,  $pQ - C(Q)$ .

Later, we consider cases in which the regulator's preferences are some linear weighted combination of consumer and firm welfare.<sup>20</sup>

## B. Steps in the Game

The game consists of a series of moves by each player. The consumer chooses a regulator; the firm builds a plant; nature presents a state of the world; a regulator sets rates; and consumers consume on the basis of those rates. To simplify, we assume that most decisions are binary. We limit the uncertainty produced by nature to a single chance node for marginal cost between the time of investment and rate setting.

Figure 1 sets out the basic game, its assumptions, and its payoffs.<sup>21</sup> The payoffs were derived using a simple, linear demand function  $Q=100-p$ ,<sup>22</sup> and a cost function  $C=700+10Q$ , in which marginal cost is constant at 10. Average cost,  $AC=700/Q+10$ , is greater than marginal cost at any quantity produced. These functions are illustrated in Figure 2. The specific size of the payoffs is not important, except that the sum of consumer and firm benefits (societal benefits) is greatest when price equals marginal cost. The game consists of four steps:

19. In reality the regulator may not have such wide discretion in setting rates; custom or law may prohibit outright expropriation, and economics dictates that she set price high enough to cover variable costs. The important point, from the perspective of investors, is that the regulator has considerable discretion in setting rates; she may constrain investors to a return below their opportunity costs and may even deny investors recovery of their investments.

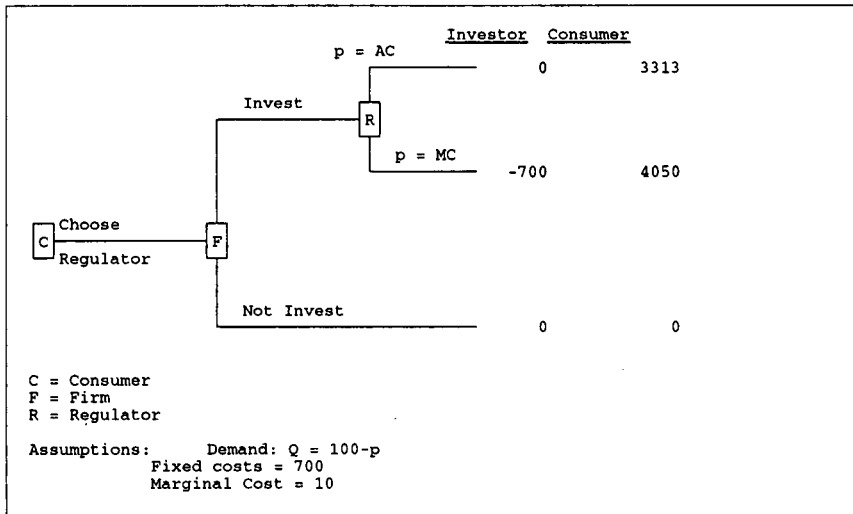
20. See *infra* text accompanying notes 34-35.

21. A similar game tree has been used by others in discussing the problems of negotiating a contract for an irreversible investment. See HOWARD RAIFFA, *THE ART AND SCIENCE OF NEGOTIATION* (1982); David A. Lax & James K. Sebenius, *Insecure Contracts and Resource Development*, 29 PUB. POL'Y 417 (1981) (game theory applied to Third World resource development).

22. The use of a linear demand curve keeps the example simple and does not affect the conclusions reached here.

Figure 1

REGULATORY GAME WITH NO UNCERTAINTY



(1) The consumer chooses a regulator, who has complete discretion in setting prices and whose tenure will last for the life of the firm's capital.<sup>23</sup> The regulator's objective or preferences are common knowledge.<sup>24</sup>

(2) The firm decides whether and how much capital to sink into the firm. Capital is invested in utility plant, which in the case of an electric utility might be a large generating station, small-scale cogeneration facilities, energy conservation measures, or other plant. In any case, we assume that the investment is socially beneficial and that, once made, the investment cannot be directed to another use.<sup>25</sup> The firm can cease operations at any time if price is negative or below variable cost, but it cannot recoup any sunk investment. For simplicity, we treat the investment decision as an all-or-nothing proposition, but the same insights would apply if the firm were deciding how much to invest rather than whether to invest at all. For example, a firm might have two possible ways of providing service. With a capital-intensive technology, a substantial capital

23. In reality, regulators are chosen either directly by voters or appointed by an elected governor or legislature. Regulators typically serve multi-year terms of office, rather than serving at the pleasure of the governor, but their terms are considerably shorter than the life of many capital investments.

24. If the regulator or her preferences may change, or if preferences are unknown, the fragile commitments problem will be exacerbated.

25. By assuming that the investment is socially beneficial, we abstract from the important questions of the need for additional capital investment by the utility and the type of investment that maximizes societal benefits. As we stated in the Introduction, the regulator and the firm are assumed to share a common knowledge of demand and cost and would, therefore, agree on the appropriate technology.

investment is required, but operating costs are low.<sup>26</sup> An alternative technology would involve higher operating costs and total production cost, but would require lower capital investment.<sup>27</sup>

(3) The state of nature is revealed to the firm and the regulator. At this point, demand and cost information is common knowledge. We look first at the case where costs and demand are certain and then consider the results when the firm must make its investment decision before the uncertainty is resolved.

(4) The regulator determines a price at which the service will be sold. Consumer demand, which cannot be committed, determines the quantity.

To understand the factors affecting each player's move, we must consider, as does the strategic player, the moves that will follow. The way to look forward in such dynamic optimization models is to start at the end and then fold back to the beginning.

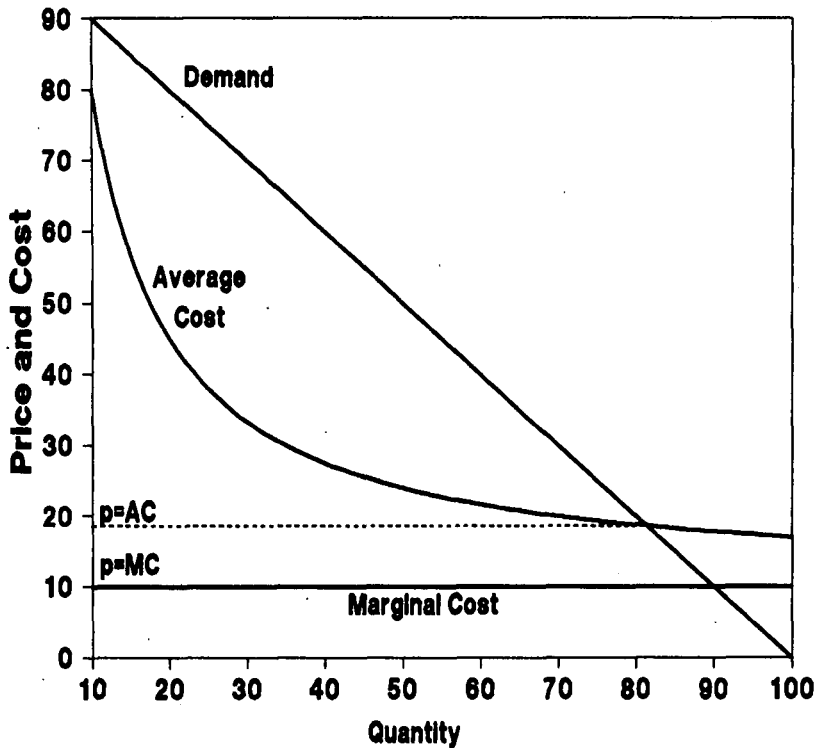
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26. Examples in the electric industry include conservation programs and nuclear plants.

27. Examples in the electric industry include oil- and gas-fired combustion turbines.

Figure 2

DEMAND AND COST FUNCTIONS



C. *The Game with Commitment*

We first consider what the regulator would do if she could commit, before investment is sunk, to a particular pricing rule, such as setting price equal to marginal cost. While the regulator moves last in this game by setting price, she must commit to a pricing rule before investment is sunk. She anticipates the reaction of the firm to this pricing rule.

1. *Investment.* The regulator is constrained in her choice of prices by the need to induce investment. The firm will invest only if the regulator commits

not to set prices such that the firm incurs losses. If price is set to cover only marginal costs, for example, the firm will incur a loss equal to its fixed costs. We refer to the requirement that the firm not suffer loss as the *participation constraint*:

$$pQ - C(Q) \geq 0. \quad (3)$$

If the regulator does not commit to this constraint (or cannot plausibly be expected to meet it absent a commitment), the firm will not supply capital.

2. *Rate Setting.* The regulator's problem is to choose a price that maximizes her objective, whether it is consumer surplus or societal benefits (which include the profits of the firm).<sup>28</sup> Either consumer surplus or societal benefits are maximized by setting price equal to marginal cost, which is assumed to be below average cost. While ex post a pro-consumer or efficiency-seeking regulator would prefer to ignore the firm's sunk costs and set price at marginal cost, she will have already committed to a price that allows the firm to recover its costs. Thus, either a pro-consumer or an efficiency-seeking regulator will set price equal to average cost. The pro-industry regulator would set price at the profit-maximizing level.

3. *Regulator Selection.* With commitment, the consumer has great discretion in his choice of a regulator. A pro-consumer regulator, who places no value on the welfare of the firm, will make the same choice as an efficiency-seeking regulator. If the regulator can commit to a pricing rule before investment is sunk, then the bias of the regulator toward consumer or firm has little relevance. Any regulator chosen by consumers, even one who placed no value on firm welfare, would commit to allow recovery of the firm's capital.

#### D. The Game Without Commitment

If the regulator cannot bind herself to a price or pricing rule before the investment decision is made, her preferences, virtually irrelevant with commitment, become central. In this variant of the game, the firm knows the bias of the regulator before it decides whether to invest, but it does not know the specific prices she will choose. If the regulator cannot commit, we find con-

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28. If the regulator's objective is  $R(p)$ , subject to the investor participation constraint, the Lagrangian is:

$$L = R(p) + \theta[Y(p) - C(Q)]$$

where  $\theta$  is the Lagrangian multiplier.

sumers' benefits are greater with a pro-industry regulator—whose bias in effect creates commitment—than with one who reflects consumer interests.<sup>29</sup>

1. *Investment.* Though the regulator has made no commitment about price, the firm can anticipate the regulator's action. If the regulator is pro-consumer or efficiency-seeking, price will be set too low to recover the investment. Only if a pro-industry regulator is selected will investment occur.

2. *Rate Setting.* Since the investment decision has already been made, the regulator's choice of price is unconstrained by any need to induce firm participation. The efficiency-seeking and pro-consumer regulators would ignore the firm's sunk investment and set price equal to marginal cost.<sup>30</sup> The pro-industry regulator would choose the price that maximizes profits.

3. *Regulator Selection.* The consumer must select a pro-industry regulator for investment to occur. Since we have assumed that the benefits of the investment exceed its costs, consumers are better off choosing the pro-industry regulator and paying the monopoly price rather than entirely foregoing the investment. The consumer receives greater benefits by choosing the regulator who, even after capital is irreversibly committed, will choose to compensate the firm for sunk capital rather than achieve greater societal benefits through marginal cost pricing.

Without commitment, the regulator who best advances consumer interests is a pro-industry regulator. By selecting a regulator who will prefer to repay firm capital, the consumer can induce beneficial investment that would otherwise not occur. The consumer's naive response—selecting a regulator who reflects his own interests—will result in no investment.

#### E. *The Game with Uncertainty*

We next consider the results of the utility game when both the consumer and the firm must make their choices under uncertainty. Nature changes after the investment has been made. Demand may change, costs may rise, or new

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29. Michael O'Hare & David Mundel, *When to Pay for Sunk Benefits*, in WHAT ROLE FOR GOVERNMENT 255, 255-61 (Richard J. Zeckhauser & Derek Leebaert eds., 1983) examine an analogous situation where discretion is costly. They consider whether a new government program should reward actions taken before the program was implemented. The usual argument is that this is an unnecessary use of the government's resources because the benefits of those actions can be had with no subsidy. O'Hare and Mundel argue that failing to pay for sunk benefits creates a precedent for all programs that discourages individual initiative when there is a possibility of future subsidies.

30. The pro-consumer regulator would prefer to set prices even lower, but if she does the firm will shut down. If marginal cost is increasing, the pro-consumer regulator could set price at average variable cost without causing shutdown.

technologies may develop. As a simplification, we assume that only a single node of uncertainty is present and that only the marginal cost is uncertain.<sup>31</sup>

We first develop the efficient pricing rule for a firm operating a natural monopoly under uncertainty. The problem is to allocate the firm's fixed costs over possible states of nature in a way that minimizes the deadweight losses of pricing above marginal cost. We then compare the allocations achieved by regulation, with and without commitment.

Figure 3 illustrates the utility game with uncertainty. Demand and fixed costs are as in Figure 1. To simplify exposition, only marginal cost is uncertain. There is an equal chance that marginal cost is 10 or 40. The qualitative nature of our results is unchanged if demand also varies across states of nature. The payoffs are such that as price increases, consumer benefits decrease and firm profits increase; societal benefits are greatest when price equals marginal cost.

1. *The Efficient Outcome: State-of-Nature Ramsey Pricing*

In the efficient outcome, expected consumer surplus is maximized, subject to the constraint that the firm be provided enough compensation to induce investment. Expected consumer benefits are:

$$\sum_{i=1}^n \pi_i B(p_i) \tag{4}$$

where  $i$  is a state of nature and  $\pi_i$  is the probability of state  $i$  occurring. The participation constraint requires that the firm's expected compensation over all states not be less than its expected costs over all states:

$$\sum_{i=1}^n \pi_i [p_i Q_i - C_i(Q_i)] \geq 0. \tag{5}$$

We assume demand and cost in each state are independent of demand and cost in other states.

Marginal cost pricing would achieve efficient consumption, given that the plant is built, but it would not provide the firm with sufficient compensation to invest. Average cost is the minimum required to recover fixed costs, and it exceeds marginal cost at any level of output, so the firm could not recoup fixed costs under marginal cost pricing. Therefore, the regulator must allow prices in excess of marginal cost, accepting some consumption inefficiency as the

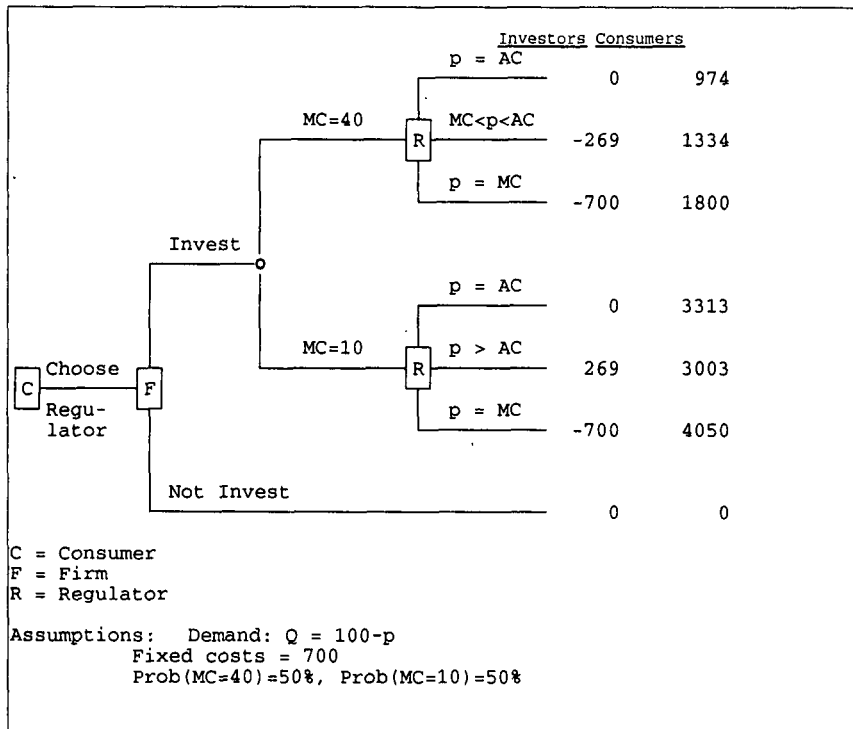
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31. In reality, nature is constantly changing and there are more sources of uncertainty than can be dealt with in a contract or other explicit agreement. The diversity of ways in which uncertainty can manifest itself increases the regulator's opportunity to appropriate sunk investments.



Figure 3

REGULATORY GAME WITH UNCERTAINTY



means to secure investment. The challenge is to find, among the set of prices sufficient to induce investment, the one that minimizes the loss of efficiency.

This is the classic problem in constrained maximization. Its solution, known as Ramsey pricing,<sup>32</sup> begins with the observation that setting price above marginal cost produces the greatest efficiency loss when demand is elastic, that is, when consumers will significantly shift their consumption in response to a shift in price. With perfectly inelastic demand, consumption does not vary with price, and there is no efficiency loss when price varies from marginal cost. Therefore, the lower the elasticity of demand, the further Ramsey pricing sets price above marginal cost. This is known as the inverse-elasticity rule, and it takes the form:

where  $MC_i$  is the marginal cost in state  $i$ ,  $\epsilon_i$  is the price elasticity of demand in that state, and  $p_i$  is the optimal price under Ramsey pricing. The value of

32. Frank P. Ramsey, *A Contribution to the Theory of Taxation*, 37 *ECON. J.* 47 (1927).

$$\frac{p_i - MC_i}{p_i} = \frac{1}{\theta} - 1, \quad (6)$$

$\theta$  will increase as fixed costs increase.<sup>33</sup>

The Ramsey pricing rule is usually employed to set prices in markets within a single state of nature, such as the residential and business utility service markets within a single year. We have applied the concept more broadly to pricing across states of nature. Future cost or demand is unknown, and any one of a set of possible states may occur. In this context, Ramsey pricing operates across the different possible states, minimizing the loss of consumption efficiency.

When the future is uncertain, societal benefits are maximized by allocating fixed costs over the range of possible states of nature using the Ramsey inverse-elasticity rule. With state-of-nature Ramsey pricing, the firm recovers its costs over all possible states of nature, but in any given state actual costs may be more or less than actual revenues. If the elasticity of demand is the same in all states, the percentage markup of price to cover fixed costs is the same in all states.

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33. The Lagrangian for the regulator's constrained maximization problem is:

$$L = \sum_{i=1}^n \pi_i B(p_i) + \theta \left\{ \sum_{i=1}^n \pi_i [p_i Q_i - C_i(Q_i)] \right\}.$$

For any  $p_i$ , the first-order condition is:

$$\frac{\partial L}{\partial p_i} = -\pi_i Q_i + \theta \pi_i [Q_i + p_i Q_i' - \frac{dC_i}{dQ_i} Q_i'] = 0,$$

where  $Q_i' = dQ_i/dp_i$ ; thus

$$p_i - \frac{dC_i}{dQ_i} = \frac{Q_i}{Q_i'} \left( \frac{1}{\theta} - 1 \right).$$

Since the price elasticity of demand,  $\epsilon_i = Q_i' p_i / Q_i$ , and marginal cost,  $MC_i = dC_i/dQ_i$ ,

$$\frac{p_i - MC_i}{p_i} = \frac{1}{\theta} - 1,$$

which is the Ramsey pricing rule. For a much more complete derivation of Ramsey pricing, see STEPHEN J. BROWN & DAVID S. SIBLEY, *THE THEORY OF PUBLIC UTILITY PRICING* 194-95 (1986).

## 2. *Uncertainty With Commitment*

As in the certainty case, if the regulator is not pro-industry and cannot commit, the firm anticipates a marginal cost pricing strategy and withholds investment. If the regulator can commit, to what should she commit?

One strategy, *actual cost recovery*, repays the firm for its actual costs in each state of nature. In each state, prices are set to cover the costs in that state. Actual cost recovery or historical cost pricing is essentially the rule most utility regulators would say they follow; rates are set to recover the firm's actual expenses and investment.

Another strategy, *expected cost recovery*, repays the firm on an expected value basis over all possible states of nature; in any given state, prices may turn out to be set above, below, or equal to costs. Since the firm is risk-neutral, a commitment to expected cost recovery is sufficient to induce investment.

If the regulator commits to actual cost recovery, she is constrained to non-negative profit in each state:

$$p_i Q_i - C_i(Q_i) \geq 0 \quad \text{for all } i. \quad (7)$$

The markup of price over marginal cost varies over states. When marginal cost and price are high, the utility produces a small output and requires a large per-unit markup to recover fixed costs. When marginal cost is low, the utility requires a smaller markup of price over cost because fixed costs are spread over a greater output. Actual cost recovery does not maximize economic efficiency because it results in variations of price from marginal cost that violate the Ramsey pricing rule.

By contrast, the efficient outcome results if the regulator commits to expected cost recovery. A regulator subject to this constraint will engage in state-of-nature Ramsey pricing (equation 6) because this rule produces the largest expected benefit without violating the firm's participation constraint. Table 1 shows the consequences for actual cost recovery and state-of-nature Ramsey pricing regulation for the numerical example presented in Figure 3. The theoretical ideal would be achieved by paying the fixed costs of the firm through lump-sum charges and then employing marginal cost pricing. The deadweight loss incurred in raising prices to meet fixed costs for actual cost recovery is 12% of the fixed costs. The performance measure of state-of-nature Ramsey pricing is the amount by which it can reduce the loss. In the example shown, it eliminates 30.6% of the loss. Moreover, all gains from the more efficient pricing rule accrue to consumers, since under either rule the firm's expected profits are zero. However, a commitment to expected cost recovery may be harder to specify and verify. Specification is difficult because we cannot

Table 1

## ACTUAL COST RECOVERY VERSUS STATE-OF-NATURE RAMSEY PRICING

	Actual Cost Recovery	State-of-Nature Ramsey Pricing
Prices:		
MC=40	55.9	48.3
MC=10	18.6	22.5
Profits:		
MC=40	0.0	-269.2
MC=10	0.0	269.2
Expected Value	0.0	0.0
Consumer Surplus:		
MC=40	974.3	1334.4
MC=10	3313.0	3002.6
Expected Value	2143.6	2168.5
Deadweight Loss	81.4	56.5
% DWL Eliminated	0.0%	30.6%
Assumptions: $Q = 100-p$ Fixed costs = 700 Prob(MC=40) = 50%, Prob(MC=10) = 50%		

enumerate all possible states and assess their probabilities. Verification is difficult because low actual profits may be the result of either a broken commitment or a state of nature in which a negative return is expected.

A commitment to actual cost recovery will induce investment but results in an inefficient allocation of revenues over states of nature. If the regulator commits to expected cost recovery, she would employ state-of-nature Ramsey pricing and the efficient outcome would result.

### 3. Uncertainty Without Commitment

As in the certainty case, investment will occur only if a commitment can be made or if the consumer selects a regulator who is pro-industry. Earlier, we considered only regulators who were efficiency-seeking or extremely pro-consumer or pro-industry, tilted completely to one side or the other. What happens when the regulator has an intermediate bias? Here we introduce a regulator whose objective is to maximize some combination of consumer surplus and profits:

$$R(p) = B(p) + k[pQ - C(Q)] \quad (8)$$

where  $k$  is a measure of the bias toward firm profits.<sup>34</sup> If  $0 < k < 1$ , the regulator is pro-consumer but still places some value on firm profits. If  $1 < k < \infty$ , the regulator is pro-industry but places some value on consumer surplus.

Before investment is made and uncertainty is resolved, the consumer picks a regulator, whose  $k$  is common knowledge. The regulator then sets a price that, given  $k$  and the state of nature, maximizes  $R(p)$ . The regulator, acting after investment has been sunk and in the absence of any commitment, will use state-of-nature Ramsey pricing and set prices to minimize the efficiency losses that result from giving the firm some amount over marginal cost. The specific amount that she wishes to give the firm is determined by  $k$  and may be more or less than the sunk investment.<sup>35</sup>

Thus, the consumer must select a regulator who, given her  $k$ , will prefer to compensate the firm for its sunk cost. The firm, knowing  $k$  and the distribution of possible states, will then be induced to invest. The existence of declining average cost requires that  $k > 1$ , since at  $p = AC$  marginal consumer benefits are greater than marginal profits. The consumer can induce investment and achieve efficient pricing by selecting a regulator who values both consumer and firm interests, but nonetheless is tilted toward the firm. Such a regulator will achieve greater consumer and societal benefits than one who commits to compensate the firm exactly for actual costs in each state of nature.

### III. Political Heat and Responsive Regulation

In the game developed in Part II, investment occurs only if the regulator or the consumer can make a commitment to compensate the firm. Either the regulator must commit to recovery of expected costs, even if her ex post preferences are to price at marginal cost, or the consumer must commit to a pro-industry regulator who cannot be removed from office for the duration of the investment.

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34. We assume that  $k$  is a constant. However, it is possible that the regulator would give more relative weight to investor profits in some circumstances, such as when profits are low, so that  $k$  would be a function of consumer surplus and/or profits.

35. To maximize  $R(p)$ , the regulator's decision rule in any state  $i$  will be to set:

$$\frac{dR_i}{dp_i} = -Q_i + k[Q_i + p_i Q'_i - \frac{dC_i}{dQ_i} Q'_i] = 0,$$

This is state-of-nature Ramsey pricing, developed above in equation (7).

### A. Political Heat

In the game developed earlier, we assumed that political forces or public opinion do not affect the regulator. She set rates based solely on her native bias ( $k$ ) and was deaf to any arguments that societal or consumer interests are better served by not compensating the firm for capital. In other words, we have assumed that the consumer can commit to letting the regulator set rates according to her own preferences.

This assumption reflects the practice of states to strengthen the weak knees of regulators by insulating them from the immediate preferences of voters. State legislatures once set utility rates, but in the modern world this task has been delegated to a rate-setting agency, typically independent of the governor and the legislature. The use of long terms of office, multi-member commissions, and overlapping terms reduces the susceptibility of regulators' commitments to the public will of the moment. The insulation of regulators from political pressure tends to make it easier for them to shift the risk of utility investments to consumers.<sup>36</sup>

Nonetheless, regulators remain vulnerable to public or political pressure. In many states, regulators are elected. Even in states where the regulators are appointed, elected officials can continue to influence them through control of the agency budget, designation of the commission chairman, and passage of legislation that affects the regulatory agency. The public also can pressure regulators with simple tools such as letters to the editor and telephone calls to the regulators.

Therefore, even if consumers have selected a pro-industry regulator, they may subject her to political pressure or *heat*, once she begins to set rates. Even

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36. Sam Peltzman suggests that one function of regulation is to dampen the effect of cost and demand fluctuations on profits, reducing producer risk. Sam Peltzman, *Toward a More General Theory of Regulation*, 19 J.L. & ECON. 211, 230 (1976). Seth Norton examines the stock market returns of electric utilities in states with strong regulatory powers and in states with weak or no regulation. He finds that  $\beta$ , or systematic risk, of strongly regulated utilities is lower than that of unregulated utilities and that the difference is significant at the .95 confidence level. Norton's estimates of  $\beta$ , based on the period 1951-75, are:

Regulatory Status	Mean $\beta$ Estimate	Standard Error	N
Unregulated	.70	(.05)	29
Weakly regulated	.64	(.06)	15
Strongly regulated	.58	(.03)	48
Total Sample	.63	(.02)	92

Seth W. Norton, *Regulation and Systematic Risk: The Case of Electric Utilities*, 28 J.L. & ECON. 671, 677 (1985).

though she would prefer to set rates that compensate the firm, the regulator may yield to this heat by setting rates that do not allow recovery of sunk capital.

Figure 4 illustrates the situation where consumer heat depends on the absolute level of rate increases as well as the underlying cost justification. Assuming that prices initially equal average costs, efficient price changes lie along the diagonal line where, in the constant elasticity case, the change in price equals some constant "a" times the change in cost:  $\Delta P = a\Delta C$ . The curves  $I_j$  are iso-heat functions. As functions of actual cost changes, they define the upper bound on rate changes for a given level of exogenous consumer pressure (heat) on regulators.  $I_1$  defines the feasible rate increases given a low level of consumer activism, and  $I_3$  is the limit with a high level of consumer activism. The iso-heat curves reflect three aspects of consumer pressure on regulators:

- (1) When cost changes are small, regulators are relatively free to change rates when costs change, regardless of the exogenous political climate.
- (2) Large rate increases are difficult to implement, even if they are fully justified by cost increases and consumer activism is relatively low.
- (3) Consumers exert little political pressure on regulators to lower rates further when costs decrease.

#### B. *Responsive Rates*

If consumers apply strong, constant political heat, the outcome is the same as when the consumer selects a non-committing, pro-consumer regulator: no investment occurs. However, the iso-heat functions suggest that consumer pressure is not constant. Consumers may complain mightily about large rate increases, regardless of whether the increase is justified by cost increases. Yet consumers may offer little dissent if rates remain constant, even if a rate decrease is in order. Given the variable response of consumers, a regulator might compensate the firm for his capital through responsive rates. In setting responsive rates, the regulator bends to the will of the public when costs are high but makes it up to the firm during other periods. Whatever her preferences, she acts like a pro-consumer regulator in high-cost periods and a pro-industry regulator in low-cost periods.

Figure 4

ISO-HEAT CURVES AND THE CONSTRAINTS ON REGULATORS

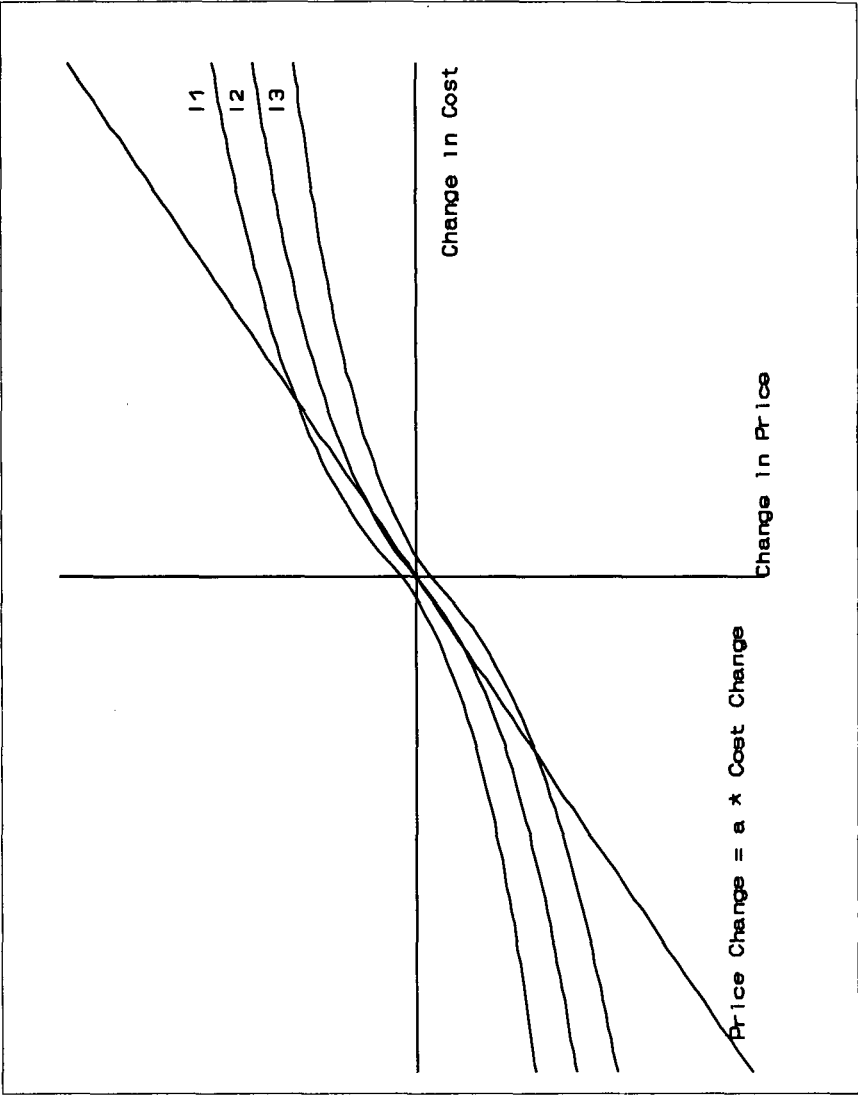




Table 2

COMPARISON OF RESPONSIVE RATES AND RAMSEY PRICING

	Responsive Case A: $P_H=MC$	Responsive Case B: Constant Price	Case C: State-of- Nature Ramsey Pricing
Prices:			
MC = 40	40.0	37.8	61.5
MC = 10	32.9	37.8	15.4
Profits:			
MC = 40	-700.0	-820.6	96.4
MC = 10	700.0	820.6	-96.4
Expected Value	0.0	0.0	0.0
Consumer Surplus:			
MC = 40	1085.2	1203.1	146.3
MC = 10	1485.6	1203.1	2905.6
Expected Value	1285.4	1203.1	1525.9
Deadweight Loss	365.8	448.1	125.2
% DWL Eliminated	18.4%	0.0%	72.0%
Assumptions:			
Demand: $Q = 1000 \times p^{-0.8}$			
Fixed costs = 700			
Prob(MC=40)=50%, Prob(MC=10)=50%			

Table 2 illustrates two examples of responsive rates. The example employs a constant elasticity demand curve,  $Q=1000p^{-0.8}$ .<sup>37</sup> Expected consumer surplus is measured up to a price of 200.<sup>38</sup> As before, the equally likely states of nature are distinguished solely by their marginal costs. In Case A, we assume that in the high-cost period the regulator covers only marginal costs, allocating all fixed costs to the low-cost period. Case B requires that rates be the same across all periods. Rates in the high-cost period may not even cover marginal

37. A constant elasticity demand curve is used to isolate the effect of changes in cost across states of nature. With a linear demand curve, demand elasticity varies and the illustration loses its transparency.

38. The losses would not change if we used a higher price.

costs. Case C is not an example of responsive regulation; rather, it shows what would happen under the efficient outcome of state-of-nature Ramsey pricing.

While efficient rates would have the same markup in all periods with the same elasticity, responsiveness to political heat tends to hold down prices in the high-cost period and raise them in the low-cost period. The deadweight loss from responsive rates increases as elasticity of demand at low prices becomes greater relative to its elasticity at high prices. Conversely, responsive rates entail less efficiency loss if demand is relatively more elastic at high prices.

With either form of responsive rates, the loss in expected consumer surplus from the optimum is considerably greater than it is with Ramsey pricing. Note from Table 2 however, that the minimum level of consumer surplus with either is higher than with Ramsey pricing. This is a symptom of responding to political heat, since consumers are likely to exert more pressure on the regulators as consumer surplus diminishes.<sup>39</sup>

Regulators in some cases can substitute responsive regulation for a commitment to price efficiently in every state of the world. Consumer pressure prevents regulators from raising rates enough to cover increased costs in full, so they also do not lower rates to reflect full cost decreases. Responsive regulation is not efficient, but it can substitute for commitment by the regulator or the consumer.

### C. *Examples*

Under responsive regulation, the regulator may not be able to award adequate rate increases during periods of high or rising costs, but because of consumers' relative indifference to rate decreases, she can compensate the firm for those losses by granting above-cost rates when costs remain steady or decline.<sup>40</sup> Commentators often note the tendency of regulators to repress price increases, but one can also find examples of regulators allowing utilities to keep the higher profits resulting from cost decreases.

In the natural gas industry, for example, from 1984 to 1987, the wholesale or "city gate" price paid by local gas distribution utilities fell from \$3.95 per thousand cubic foot to \$2.87, a decrease of \$1.08. Yet the prices charged residential consumers and approved by state regulators decreased by \$0.58.

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39. With constant demand elasticity, an ex post profit constraint is superior to responsive rates, but this is not always so. If demand is relatively elastic at high costs, then the small markup under responsive rates is similar to the Ramsey pricing result.

40. Responsive regulation might even benefit the firm. If consumers place more weight on the prospect of a loss (rate increase) than on the prospect of a gain (rate decrease), the iso-heat curves in Figure 3 would not be symmetrical around the origin; more consumer heat is applied to avoid cost increases than to capture cost decreases of the same magnitude. The consumers' aversion to loss may enable the firm to capture virtually all cost decreases simply by accepting a portion of cost increases.

Utilities were allowed to keep about half the decrease in wholesale costs, or about \$4.9 billion over three years. Using regression analysis of gas prices in forty-eight states, we found that about 63% of the change in city gate price was passed through to residential consumers.<sup>41</sup>

Regulation of electricity profits also appears to be less onerous during times of relatively stable costs. From 1976 to 1980, when residential electricity rates increased at an average annual rate of 11.5%, the real rate of return on new utility plant was -3.4%. From 1982 to 1987, the average annual increase in residential costs was 3.9%, and the real return on new utility investment was 6.0%.<sup>42</sup>

The Brewer and Mann study of market returns on electric utility common equity also provides evidence of a political response in regulation.<sup>43</sup> It compared the returns and risk of firms operating in states where regulators are elected with those where regulators are appointed by the governor. During 1970-79, a period of large cost increases, firms regulated by appointed commissioners experienced higher returns and lower risks. During 1980-84, a period of moderate cost increases, these firms experienced lower returns and higher risks.<sup>44</sup>

The pricing of long distance and local service by American Telephone & Telegraph Co. (AT&T) presents perhaps the longest-running example of responsive rates. Beginning in the 1940s, AT&T and state and federal regulators gradually increased the share of local telephone costs that was paid through long distance charges. This practice, made possible by the continuing decline in long distance costs, reduced the need for state regulators to increase local

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41. Calculated by the authors from U.S. DEPT. OF ENERGY, ENERGY INFORMATION ADMINISTRATION, NATURAL GAS ANNUAL 1987, Tables 17 and 18 (1988). In 105 of 144 observations (48 states over three years), the change in city gate prices exceeded the change in retail prices. An ordinary least squares regression of change in city gate price on change in retail price yielded this relationship (t-statistics in parentheses):

$$\Delta \text{RESIDENTIAL} = 0.00675 + 0.629 \times \Delta \text{CITYGATE}$$

(0.177) (4.10)

$$R^2 = .255 \quad F = 48.6$$

(Our null hypothesis would be that  $\Delta \text{RESIDENTIAL} = 0 + 1 \times \Delta \text{CITYGATE}$ . Thus the t test is for  $\text{CITYGATE} = 1$ .)

42. Calculated from ENERGY INFO. ADMIN., *supra* note 9. The rate of return on new investment was calculated by dividing the annual increase in utility operating income by the annual increase in net utility plant.

43. H.L. Brewer & Patrick C. Mann, *Regulator Selection and Financial Performance for Public Utilities: Selection Method and the Returns Experienced by Common Equity Owners*, 11 ENERGY ECON. 39 (1989).

44. The additional return earned by firms under appointed regulators was 3.9% per year in 1970-79. Firms under elected regulators earned an extra 2.6% per year in 1980-84. In both periods, the difference in means was not significant at the 5% level.

rates as costs increased. The Federal Communications Commission, which controlled interstate long distance rates, did not have to approve rate increases. Rather, it approved rate decreases that were smaller than the underlying decrease in long distance costs. Consumers did not object to this result, even though AT&T consistently earned more overall profits than regulators had authorized.<sup>45</sup>

Even the basic accounting method for utility investments facilitates responsive regulation. Regulators typically base rates on the historical cost of utility plant, less prescribed depreciation. This method tends to dampen the swings in utility rates caused by changing costs. If costs increase, rates rise for the higher cost of new plant but not for the higher opportunity cost of existing plant. Similarly, if costs decrease, ratepayers continue to pay higher rates for the existing plant. Rates would be more efficient, and total benefits would be greater, if regulators set rates based on the current value of utility plant.<sup>46</sup> However, this approach would entail larger rate increases and larger utility capital gains when costs increased, and regulators would have difficulty making such a commitment. Instead, historical cost pricing allows regulators to be responsive, avoiding some large rate increases by foregoing some rate decreases.

#### IV. Mechanisms for Commitment

We have paid little attention thus far to the ways in which regulators make commitments to repaying the firm's capital. In this part, we examine specific mechanisms, both old and new, to establish commitment. Perhaps the most important factor in the past has been consumers' continuing need for future utility services. As long as utilities continually require additional capital, the consumer has much to lose if the regulator fails to repay existing investment. Since this relationship depends on sure and steady growth, commitment may falter when demand slips or excess capacity is built. Given current slacking growth in electricity demand, we also examine some new mechanisms that are emerging to guarantee commitment.

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45. JAMES W. SICHTER, PROFITS, POLITICS, AND CAPITAL FORMATION: THE ECONOMICS OF THE TRADITIONAL TELEPHONE INDUSTRY 48 (1987) describes the result this way: "Thus, the telephone industry has, despite the potential for regulatory mischief in jurisdictional cost allocations, enjoyed the not insignificant comfort of being able to assume that the totality of the costs it incurs in the provision of telephone services will, indeed, be recognized and reflected in its rates . . ." See also PETER TEMIN, THE FALL OF THE BELL SYSTEM 19-27 (1987) (reviews the role of jurisdictional cost allocations in AT&T profitability).

46. Using historical cost instead of opportunity cost in setting prices leads to an efficiency loss in consumption. For example, one reason for the excess capacity in the electric industry in the 1980s was that electricity prices, which were based on the relatively low historical cost of existing plants, induced demand that would not have existed if prices had reflected current costs.

### A. *Hostages*

A regulator strengthens her promise to set compensatory rates if renegeing upon that promise would lead in a clear and direct way to greater consumer costs. This can happen if there are hostages,<sup>47</sup> that is, consumer assets that will be forfeited if the commitment is not kept. If consumers have a growing demand for utility services that will require capital investments, their future demand can serve as a hostage to present commitments.

As long as consumers need utility services in the future and the firm can withhold those services, the game developed above becomes a closed loop, with future needs perpetually serving as the hostage that prevents present expropriation. After consumers make consumption decisions, the next step is for the firm to make another round of capital investment. The need for future investment funds binds regulators to good behavior in the present. The reputation of the regulator for past good behavior becomes a form of capital owned by consumers, at least as long as that regulator is in office. The regulator still can break the commitment and expropriate sunk capital, but the cost is the stream of future benefits that new capital would have provided. This argument is often used to explain why sovereign nations usually repay their international debts and also why heavily indebted nations, who do not foresee the possibility of obtaining substantial new loans, decide not to repay.

The economy, however, may not consistently provide a steady stream of demand for new capital. Future demand can serve as a hostage only if the stream of future transactions is long and regular. If a final investment can be foreseen, or even if a sustained period without investment is possible, then the closed loop game unravels back to its no-commitment, single-play form.

This suggests that the ability of regulators to make firm commitments varies widely and depends on the specific situation and prospects of the industry and the firm, as well as on the personality of the regulator, the procedures of regulation, and the activism of the electorate. Indeed, the situation faced by many electric utilities in the 1970s and 1980s was particularly un conducive to strong regulatory commitment. The cost of new power plants was high, relative both to the cost of existing plants and to the anticipated cost of new plants. Moreover, many utilities overestimated the growth in demand for power, and the resulting excess capacity eliminated the need for new construction for several years. Consumers complained about rate increases, and utilities did not need to attract additional capital for several years. By contrast, in the telecom-

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47. Oliver E. Williamson, *Credible Commitments: Using Hostages to Support Exchange*, 73 AM. ECON. REV. 519 (1983).

munications industry, where costs were declining and demand was growing, the regulatory commitment seemed secure.

### B. *New Mechanisms*

Regulators interested in strengthening commitment can find many potential approaches, though none are without cost. Perhaps the most obvious approach would be to make the commitment in the form of a contract. However, such a contract would have to account for a vast number of contingencies, many unforeseeable. In addition, the contract would be difficult and expensive to enforce. Making all plants mobile, so that the firm could move out if the regulator broke her commitment, would prohibitively increase the cost of the plants. Giving the utility the taxing power of the state would ensure full recovery of investment, but eliminate the utility's incentive to minimize costs. Requiring that ratepayers invest in the plant would eliminate the potential gains from appropriation, but consumers would lose the benefits of diversified investment. Regulators best serve the interests of ratepayers by finding the mechanism that provides commitment at the least cost.

New mechanisms are emerging that may enable regulators to shore up their fragile commitments to the firm. For example, one study recommends a greater reliance on regulatory scrutiny before any investment is sunk.<sup>48</sup> Another study suggests additional measures, either explicit or implicit, to provide the utility with a fair return over the life of new capital investment.<sup>49</sup> However, there are other developments in the industry, not usually discussed as commitment mechanisms, which may ultimately be more effective in strengthening regulators' commitments. It is noteworthy that none of these alternative mechanisms re-establishes commitment by paying for past obligations. They allow regulators to commit without directly addressing the question of whether past regulatory decisions were proper. In a sense, this resembles a government that requires new capital but has defaulted on an existing debt. Repaying the old debt would be expensive to its citizens and probably would not fully restore its reputation, so it instead offers some new form of security.

#### 1. *New Technology*

Electric utilities now make investments in smaller increments than in the past, in part because new technology has reduced the minimum efficient scale

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48. JOSEPH P. KALT ET AL., RE-ESTABLISHING THE REGULATORY BARGAIN IN THE ELECTRIC UTILITY INDUSTRY 101 (1987).

49. Hung-po Chao et al., *Investing Under Regulatory Uncertainty: What to Do When the Rules Change*, 9 ENERGY SYS. & POL'Y 385, 395 (1986).

of electric power generation. Moreover, planners have recognized that small-scale plants reduce the cost of planning mistakes and that this reduction in risk is valuable,<sup>50</sup> particularly if regulators will judge mistakes with hindsight.

Building several small plants, rather than one mammoth plant, also makes it easier for regulators to uphold their commitments. Until the past decade, the trend was toward increasingly large coal and then nuclear plants. Utilities hoped to lower unit costs through scale economies, but one effect was to increase the potential gains from appropriation by consumers. The lure of appropriation is greater when the asset is a \$1 billion nuclear plant than when it is a \$50 million combustion turbine. Moreover, with large plants, the interval between construction projects is longer, so that the penalty for appropriation (higher future capital costs) has a lower present value. Finally, building large plants tends to produce sharp changes in rates, which is likely to cause ratepayers to turn up the heat on the regulators.

Small scale investments, such as conservation, combustion turbines, and new coal technologies, are economically competitive with larger plants. By building small and building often, the utility can increase the costs that an unfaithful regulator imposes on consumers.

## 2. *Purchased Power and Competitive Bidding*

Many utilities are increasing their purchases from independent power producers. In part, this trend has been driven by federal requirements intended to reduce the monopsony power of utilities that control electrical transmission. Utilities must buy power from qualifying facilities at rates approved by regulators. Thus, utilities now buy power on the basis of a commission-approved estimate of future costs—while a utility-built plant is priced based on cost less ex post disallowances. In some cases, regulatory commissions approve individually purchased power contracts while simultaneously declining to consider pre-approval of utility construction projects. Once contracts with these independent producers have been approved, the firm can expect that the regulator will not later find those payments to be imprudent.

A few states are going a step further by requiring utilities to solicit bids for power supplies. In such states, the utilities sign supply contracts with the winning bidders or build their own supplies if their costs are below the bids. These competitive bidding programs generally advance the time at which the commission makes its commitment, since in the absence of an auction, purchased power contracts usually are approved by regulators after they have been

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50. See e.g., NORTHWEST POWER PLANNING COUNCIL, 1986 NORTHWEST CONSERVATION AND ELECTRIC POWER PLAN 3-1 (1986) (planning agency concludes that small plant size increases flexibility to adapt to uncertainties in energy demand and costs).

negotiated and the power plant has been built. In a bidding system, the regulator establishes the bidding mechanism and approves the auction results before any contract has been signed or any money has been sunk in new plants. This early involvement further reduces the ability of regulators to claim later that the purchase was imprudent.<sup>51</sup>

### 3. *Least-Cost Planning*

Efforts by some states to increase the role of regulators in utility planning also may strengthen regulators' commitments. It is becoming commonplace for the regulator to intervene in the utility's planning process and require that it prepare least-cost plans for the future. The regulators may specify the resource options to be considered, the analytic framework to be used, and the process to be used for seeking independent advice and public input. Regulators require utilities to submit updated plans every two or three years.

Because regulators are so closely involved in the process, they may be more comfortable with the idea of pre-approving the resources identified in the plan. Least-cost planning can be thought of as an *ex ante* prudence review. Like an *ex post* review, it creates an incentive for utility managers to make good decisions. However, since investors have not yet sunk their capital, regulators do not have the incentive to make opportunistic disallowances. In *ex post* reviews, the test of prudence usually is whether the utility acted wisely at the time the decision was made, using the information available at that time. Regulators attempt to reconstruct what the utility knew or should have known at the time of the decision. With least-cost planning, the regulator makes this judgment at the time of the decision. Even if the regulators do not formally approve plans, their participation and periodic review of the planning process make it hard for them to say later that a decision was imprudent.<sup>52</sup>

### Conclusion

Consumers will benefit from mechanisms or institutions that enable regulators to uphold their commitments more faithfully. Because the regulator's promise to set fair rates is fragile in comparison with the strong commitment represented by the firm's investment in capital assets, the cost of attracting

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51. Both competitive bidding and the greater reliance on purchased power have been accompanied by greater involvement by federal regulators because wholesale power transactions are subject to federal regulation. This trend may also enhance the strength of a regulator's commitments: at a national level the growth of new capacity is more regular and federal regulators must be concerned that their actions in one jurisdiction will affect their reputation in all other jurisdictions.

52. E. HIRST, *REGULATORY RESPONSIBILITY FOR UTILITY INTEGRATED RESOURCE PLANNING* 5 (1988).



capital rises, desirable investments are foregone, and consumers are forced to bear risk that could be borne better by the firm.

In some cases, however, a strong regulatory commitment does not benefit consumers. Weak commitment or no commitment at all incurs no costs when the utility's actions do not involve an irreversible investment and thus will create no appropriable quasi-rent. In other words, if the utility is not risking capital, then consumers gain nothing from the regulatory commitment to a particular action. Indeed, such commitment would make the consumer vulnerable to ex post exploitation by the utility. Since only some circumstances call for commitment, consumers may be best served by a pro-consumer regulator who is able and willing to make commitments when needed.

Making the regulator's commitment less fragile may exacerbate the moral hazard problem that arises from the principal-agent relationship between the regulator and firm. Regulators often have been reluctant to foreclose future options—to tie the hands of future regulators—because to do so could allow the utility to exploit its advantage of superior information. Advance approval often would be based primarily on information controlled by the firm, and once the regulator has agreed to charge consumers for a new plant, the firm no longer has an incentive to minimize its costs.<sup>53</sup> To the extent that commitment is costly, we should not be surprised to find that the efficient outcome involves less than perfect commitment.

We view the consumer's perspective on utility regulation as one of constrained maximization. The objective is to maximize consumer surplus, subject to the constraint that compensation to the firm be sufficient to attract investment. In a declining average cost industry, this problem requires that rates, set after investment is sunk, implicitly give more weight to firm welfare than to consumer surplus. This requires either a pro-industry regulator or a pro-consumer regulator who can commit not to act on her ex post preferences. With uncertain future costs or demand, state-of-nature Ramsey pricing will yield an outcome superior to compensating the firm on the basis of historical cost. If appropriate commitment and monitoring mechanisms are available, it will be possible to maximize expected consumer benefits while compensating the firm on an expected value basis. Political pressures, especially pressure to hold down rates when cost increases are great, may limit the ability of regulators to employ such schemes.

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53. An example of the tradeoff between commitment and incentives is found in the debate over whether to pay the utility for plants before they are in operation (construction work in progress, or CWIP). Paying CWIP can improve the regulator's commitment by establishing a precedent that the utility will be compensated for its investment. The disadvantage is that there may no longer be an effective check on bad decisions by the firm, thus reducing its incentive to be efficient.

A range of mechanisms—smaller scale plants, regulator involvement in planning, greater use of bidding and purchased power, and more explicit contracts—may allow regulators to make firmer commitments without making themselves vulnerable to opportunistic behavior by the firm. A promising aspect of many of these strategies is a reliance on the use of market forces, rather than regulatory determination, to fix the firm's compensation. Markets provide an independent source of information that escapes the inherent conflict of interest found in the regulator's judgment. A regulatory commitment to a price based on a "fair, just and reasonable" profit on the utility's "prudent" investment leaves a great deal of room for opportunistic interpretation. A commitment to compensation based on a market price revealed by independent bidders may be quite strong.

