Determining the Rules of the Game: Regulatory Regime Adoption in the U.S. Telecommunications Industry

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Abstract

I investigate variations in the type of regulation used to govern intrastate telecommunications across states. I find: 1) States with larger markets, higher labor costs, or a higher fraction of the population in metropolitan areas are more likely to adopt an alternative to traditional rate of return regulation, most likely reflecting higher perceived benefits from providing incentives for efficient operation. 2) Alternative forms of regulation become more likely as experience with them increases or when regulatory budgets have been higher historically, likely reflecting better information regarding cost, demand, and the implementation of new regulatory methods. 3) Earnings sharing is more likely relative to price caps in states where rate filings under traditional regulation were more frequent or when the number of registered lobbyists per state legislator is higher. This is consistent with the idea that earnings sharing may be more desirable relative to price caps when negotiation or lobbying costs are high because it partially aligns the interests of opposing groups.

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1. Introduction

Rapid change has become commonplace in the telecommunications industry. Evolving technologies and products made interstate long distance competition feasible, leading to the divestiture of the Bell System on January 1, 1984. Similarly, the development of wireless and other modern technologies has continually reduced the spectrum of operations that might reasonably be regarded as natural monopolies. One interesting facet of the evolution of the telecommunications industry since divestiture is the use by many states of nontraditional regimes to regulate the intrastate operations of telecommunications firms. The first alternative regimes to appear were simple rate case moratoria where prices were simply frozen for a specified (usually short) period of time. Next, more sophisticated plans known as earnings sharing regulation (ESR) that called for some sharing of earnings between the firm and consumers began to appear and eventually became widespread. Finally, fairly sophisticated forms of price cap regulation (PCR) with rules determining future price reductions (X-factors) and specified procedures for deciding how to handle extreme contingencies beyond the firm's control (Z-factors) appeared. By 1996 more states used some form of PCR to regulate their dominant telecommunications firms than any other type of plan.[1] In this paper, I develop a simple theoretical model of regulatory regime selection and use it to inform an empirical investigation of regulatory regime adoption in the U.S. telecommunications industry. I find that regime adoption patterns can be explained fairly well using the basic theoretical differences in the incentive properties of regulatory alternatives and a simple theory of the political economy of regulation.

Exploring the reasons that states implement different types of plans to regulate intrastate telecommunications is an important task for several reasons. Understanding why states have done as they have up to this point may help to predict their future actions. For example,

assuming competition continues to develop, what might future patterns of deregulation look like? Determining whether the observed pattern of regime change has been simply a prelude to deregulation or embodies deeper intrinsic characteristics might produce lessons that apply to regulation of in other industries, for example electricity. Further, the study of regulatory regime adoption patterns in the telecommunications industry provides fertile ground for exploring various strands of economic theory outside the realm of public utility regulation, particularly within the area of constitutional political economy. For instance, how are the rules of the game shaped by the political and economic concerns of the polity to be governed by those rules?

A great deal of attention has been given to the theoretical properties of traditional rate of return regulation and alternative regulatory structures.[2] In addition, several empirical studies have focused on the effect of regulatory structure on the performance of telecommunications firms.[3] Donald and Sappington (1995 and 1997) investigate the empirical determinants of state decisions regarding the implementation of alternative regulatory regimes in the telecommunications industry.[4]

This paper builds on the work of Donald and Sappington (1995 and 1997) in several important respects. First, they classify all regulatory plans as either rate of return or incentive regulation. However, important differences exist between ESR and PCR, the two major alternatives to traditional rate of return regulation. I separate ESR and PCR. I find that doing so produces important new insights. Second, and due in part to the difference in plan classification, I model regime selection differently. Specifically, I account more explicitly for political factors, the role of uncertainty, and the potential for unplanned for contingencies.

The following are among my key findings. First, higher costs of making the transition to an alternative regime (as reflected empirically by cumulative experience with alternative regimes,

regulatory budgets, union strength, and party control) or more uncertainty (as reflected by lower regulatory budgets or more frequent rate filings historically) make adopting an alternative regime less likely. Second, higher perceived benefits from improving incentives for efficient operation, (as reflected by larger markets or higher labor costs) lead to a higher likelihood that an alternative to traditional rate of return regulation (RORR) will be adopted. Third ESR is more likely relative to PCR when more rate cases were filed in the past (reflecting a greater incidence of unforeseen contingencies) or when there are more registered lobbyists per legislator (reflecting more groups competing for influence and placing demands on the time of regulators and the firm). This may reflect the theoretical ability of ESR to economize on hearings due to unforeseen contingencies (Z-factors) and reduce the adverse effects of uncertainty relative to PCR.

The remainder of the paper is organized in the following manner. Section 2 develops a theoretical model to guide the empirical analysis of regime selection. Section 3 formulates the empirical model and tests the theory set out in section 2. Section 4 concludes and considers possible avenues for future research.

2. A Simple Model of Regulatory Regime Adoption

Regulatory regime adoption is affected by a wide variety of economic and political factors. The perceived efficiency gains from switching to a new form of regulation, as well as the perceived cost of making the transition to a new regime, are important economic considerations. Since the efficiency gains may flow largely from cost reducing effort that is hard to observe and quantify, moral hazard must also be considered.[5] Since alternative plans may not affect all groups symmetrically, the relative political strength of the regulated firm and consumers is also

important. No regulatory plan provides fully for all possible contingencies. When contingencies that have not been planned for arise, their impact may differ depending upon which regime is in effect. Therefore, the possibility that unplanned-for contingencies may arise and the cost of dealing with these contingencies may be a factor in regime adoption. In this section, I construct a simple formal model of regime adoption that encompasses each of these factors. The comparative statics derived from this model provide hypotheses that are tested in the empirical work that follows.

2.1 Demand, Cost, and Regulatory Structure

I assume that the demand for the regulated firm's product is perfectly inelastic as long as the total charges expected by any customer are below that customer's reservation value (R). This is a reasonable approximation for local telephone service.[6] It may also be a reasonable approximation where two-part pricing is used and income effects are negligible, in which case R is consumer surplus gross of the fixed charge. For simplicity, I normalize the number of consumers to one. Allowing an arbitrary number of different consumers would make no difference to the model as long as the consumer with the lowest reservation value chose to consume the service in question. I can describe a variety of regulatory regimes with three parameters: price, p, target earnings, $\hat{E}$, and the percent of observed earnings above or below the target to be retained by the firm, α.

RORR obtains if $\alpha = 0$. Under a stylized interpretation of RORR, the level of allowable earnings (revenue less measured costs) for some period is determined in regulatory proceedings at the beginning of the period. Prices are then set to achieve the desired level of revenue. If earnings differ from the target, some mechanism is employed to eliminate the discrepancy. For example, this may take the form of a refund to consumers or lower prices in the next period if

earnings exceed authorized levels. Since the firm is guaranteed a predetermined level of earnings regardless of its cost, it has no incentive to devote unmeasured effort to reduce costs. For example, the time that management spends motivating employees and streamlining production (as well as the intensity with which these endeavors are undertaken) is not easily observed and therefore may not be appropriately rewarded under RORR.[7]

Recently, alternative regulatory plans, intended to provide better incentives than RORR, have become popular in the telecommunications industry. For my purposes these alternative regimes can be grouped into two categories: earnings sharing regulation (ESR) and price cap regulation (PCR). ESR mitigates the incentive problems associated with RORR by allowing the firm to keep some fraction of its earnings. Values of α between 0 and 1 correspond to ESR. I assume that values of α for ESR regimes are chosen from the interval $[\underline{\alpha}, \overline{\alpha}]$ with $\underline{\alpha} > 0$ and $\overline{\alpha} < 1$. This reflects the fact that in RORR, ESR, and PCR are three distinct regulatory forms. Additional reasons for these bounds are taken up in note XXXX below. In practice, ESR regimes have typically involved a split of observed earnings along the lines of 50/50, 60/40, or 70/30. ESR induces the firm to increase cost reducing effort, but not to provide the optimal amount since it still does not capture all of the marginal benefits of its effort. Under PCR, prices are set at the beginning of the relevant period and the firm is allowed to keep any earnings it can generate at those prices. Thus $\alpha = 1$ corresponds to PCR. The firm captures all of the gains from cost reducing effort under PCR, so the optimal provision of cost reducing effort may be induced.[8]

The firm may exert effort, e, to reduce the cost of providing the regulated service. The disutility of effort is given by $V(e) = \frac{e^2}{2}$. The cost of the regulated service that is observed ex-

post by the regulator is $C(e) = c - be$ where b is the marginal benefit of cost reducing effort. It is common knowledge that both c and b are distributed uniformly on the intervals $[-\bar{c}, \bar{c}]$ and $[0, \bar{b}]$, respectively. The assumption that c has mean zero is not important since any non-zero mean can simply be subtracted from the reservation value up front.[9] The firm does not know the exact realization of b or c ex ante. The firm optimally sets the marginal cost of effort equal to its expected marginal benefit. The firm bears a fraction of observed cost equal to α and the expected marginal benefit of effort is $\frac{\bar{b}}{2}$. Therefore, the firm's choice of effort under different regulatory regimes and expected benefit levels, $e(\alpha, \bar{b})$, is given by $e(\alpha, \bar{b}) = \alpha \frac{\bar{b}}{2}$. Under PCR provides the level of effort that maximizes the net benefit from cost reduction activity while under RORR the firm exerts no effort. It may be useful to interpret $e = 0$ as the minimal level of managerial effort necessary to keep the firm functioning, so that e measures increments of effort above this minimal level.

The firm's earnings, E, are given by:

$$E = \alpha\left(p - C(e) - \hat{E}\right) + \hat{E}. \tag{1}$$

Rearranging gives:

$$E = \alpha p + (1 - \alpha)\hat{E} - \alpha C(e). \tag{1'}$$

It is evident that an indeterminacy between p and $\hat{E}$ will arise under ESR because of the simple structure regulatory structure I utilize. This is resolved by letting x represent the net payment to the firm, excluding cost sharing ($x = \alpha p + (1 - \alpha)\hat{E}$). Under RORR, $x = \hat{E}$, under PCR $x = p$, and under ESR, many combinations of p and $\hat{E}$ correspond to any particular value of x.

One might expect the state to adopt a price cap plan to yield the highest possible surplus and then to set prices in accord with the relative political strength of the firm and consumers. However, other constraints on the regulatory system may alter this intuition. In particular, it is usually incumbent upon the regulatory body to ensure the financial viability of the firm. Indeed, poor financial health for the firm can harm consumers, since supply disruptions or quality deterioration may arise. Ensuring that the firm is viable even when realized costs are high may require high prices. In such a setting consumers will be better off under earnings sharing even though some efficiency is sacrificed because prices can be set high enough to keep the firm whole while consumers get some relief ex post for low cost realizations.[10]

To capture this phenomenon I assume that the chosen regulatory regime must satisfy a no expropriation constraint that earnings be non-negative for even the highest cost outcomes. That is, a regime under which the firm would go bankrupt if the random component of its operating cost turns out to be very high may not be instituted. The no expropriation constraint does not apply to the type of rare events that might be classified as Z-factors, such as natural disasters or extreme economic downturns. Since the effects of such rare events can be observed and separated from the day to day operations of the firm, they may be adjusted for ex post as described below. However, in order for alternative forms of regulation to have better incentive properties than traditional regulation, the regulator must commit not to adjust the firm's earnings ex post beyond agreed to sharing and corrections for Z-factors, thus the need for the no expropriation constraint. Given the notation above, the no expropriation constraint (LL) becomes

$$x - \alpha\bar{c} \geq 0 . \qquad \text{(LL)}$$

The regulator incurs transition costs when moving from RORR to either ESR or PCR. These transition costs may flow from the activities associated with formulating and implementing a

new plan such as gathering and disseminating information or retraining personnel. They may also flow from the need to overcome institutional inertia. For convenience, I assume that all transition costs are netted out of consumer surplus. Transition costs are represented by $T(\alpha)$ with $T(\alpha) = 0$ if RORR is implemented, $T(\alpha) = T_{ESR}$ if ESR is implemented, and $T(1) = T_{PCR}$ if PCR is implemented.[11] Allowing both the regulator and the firm to incur transition costs in no way alters the results presented below.

2.2 The Relative Political Importance of the Firm and Consumers

A thorough explanation of state regulatory regime adoption patterns requires a theory of political economy. One such theory is what has become known as the Economic Theory of Regulation.[12] According to this theory, regulatory institutions allocate economic benefits in an effort to maximize their own objectives, usually interpreted as "political support." For example, elected regulators may be interested in garnering votes directly or campaign contributions that indirectly yield votes (as are those who appoint non-elected regulators). Similarly, appointed regulators might wish to secure favorable opportunities for future employment or to enhance their reputation in the community by securing charitable "civic" contributions. On the other side of the political market, the interest groups affected by regulatory decisions offer political support to the regulatory body (or engage in lobbying activities) in an effort to secure a higher level of economic benefits for themselves.

I model this process in the following way. As is common in the normative regulatory economics literature, I assume the regulator's preferences depend upon a weighted sum of consumer surplus (CS) and profit (π). The relative weight placed on consumer surplus, θ, may be interpreted to reflect the relative political influence of the consumers and the firm. The

regulator also values direct political support, L. L may represent, for instance, efforts to generate votes, campaign contributions, promises of future employment, civic programs. One unit of political support is defined as the amount direct political effort on the part of the firm required to make the regulator willing to forgo $\frac{1}{\theta}$ units of consumer surplus. The regulators' utility function is then given by $U^r = \theta CS + (1-\theta)\pi + L$. I assume $1 \geq \theta > \frac{1}{2}$, so in the absence of at least some direct political support from the firm, the regulator would favor consumer surplus over profit.

The firm may offer direct political support of L to the regulator at cost $K(L) = \frac{L^2}{2}$.[13] The marginal cost of generating one unit of direct political support is assumed to be increasing. This reflects the fact that the firm's ability to engage in such endeavors is constrained by many legal and social factors. For instance, outright bribery is illegal, states place limits on campaign contributions, and there are a limited number of jobs that may reasonably be offered to ex regulatory personnel.

2.3 Contingencies Beyond the Scope of the Initial Regime

Regulatory regimes must often deal with issues outside the scope of their original provisions. To capture the effects of such contingencies, I assume that there is some probability, ϕ, that a rare event occurs. The rare event causes a random and observable surplus of S to accrue to the firm. Any particular realization of S is drawn from the uniform distribution on $[-\overline{S}, \overline{S}]$.[14] Under RORR, it may or may not be necessary to hold additional hearings in order to decide what to do about the rare event. This is because, under RORR, the parties have already agreed to remove any random fluctuations from the firm's earnings, and so further negotiations in that regard are not be necessary. However, it may be necessary to hold additional hearings to determine the

magnitude of the rare event for ratemaking purposes. For instance, there may be a need to physically gather information or to provide sufficient documentation to protect against possible actions or political shakeups. I use δ to denote the probability that an additional hearing will need to be held regarding a rare event under RORR, conditional upon a rare event occurring. For simplicity, I assume δ is independent of S, $\overline{S}$, and ϕ. Therefore, under RORR the probability that an additional hearing, beyond those normally associated with running the regulatory regime, will be needed is $\phi\delta$. If additional hearings are necessary, they impose additional expenses on the regulator and the firm. I assume that the regulator's share of these costs is netted out of consumer surplus while the firm's share is taken from the profit it would otherwise receive. While the firm may be entitled to reimbursement for direct costs imposed by regulatory hearings, the full opportunity cost of the managerial time spent preparing for such hearings is not likely to be reimburses. Thus, the share of the regulatory costs borne by the firm is not likely to be zero. I denote the reductions in consumer surplus and profit due to hearings by k^{CS} and k^{π}, respectively.

Under ESR or PCR such rare events are often referred to as Z-factors. Since ESR agreements call for sharing according to a specified algebraic rule and PCR plans call for no sharing, emergency hearings will be needed any time the effects of a rare event are to be removed from the firm's earnings. However, under ESR and PCR rare events may not always lead to emergency hearings. Instead, the regulator or the firm may, at their discretion, request emergency hearings to net the effect of the Z-factor out of the firm's earnings since it was entirely beyond the firm's control. Formal hearings regarding rare events will only be held when one party finds its gain from removing the effect of the rare event from the firm's earnings to be greater than their share of the cost of the hearings.

$Z^r(\alpha)$ will denote the regulator's expected payoff from the possibility that a rare event may occur. Under RORR,

$$Z^r(0) = -\phi\delta\left(\theta k^{CS} + (1-\theta)k^{\pi}\right). \tag{2}$$

The regulator receives disutility from the costs to consumers, k^{CS}, multiplied by the weight placed on consumer surplus in the regulators objective function, θ. She also receives disutility from the costs imposed on the firm, k^{π}, weighted by $(1-\theta)$. These potential costs are weighted by the probability that hearings will be held, $\phi\delta$.

Under ESR and PCR, if formal hearings are not held the firm keeps αS and consumers receive $(1-\alpha)S$ of the surplus generated by the rare event. If hearings are held, consumers receive the entire surplus and each party incurs costs due to the hearing. The regulator will convene hearings and receive a payoff of $\theta\left(S - k^{CS}\right) - (1-\theta)k^{\pi}$ whenever $\theta\left(S - k^{CS}\right) - (1-\theta)k^{\pi} > \theta(1-\alpha)S + (1-\theta)\alpha S$. Similarly, the firm will convene hearings whenever $-k^{\pi} > \alpha S$.[15] Thus, for $\alpha \geq \underline{\alpha}$ (including $\alpha = 1$), it follows that:

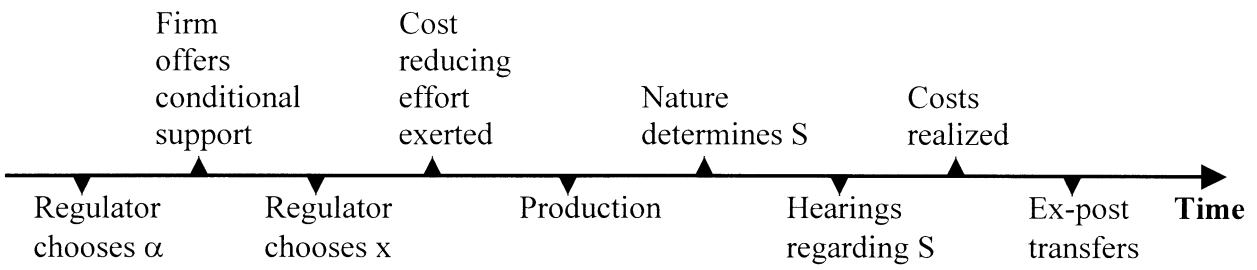
$$Z^r(\alpha) = \phi\left[\frac{\theta^2\left(k^{CS} + k^{\pi}\right)^2}{(2\theta-1)4\overline{S}} - \left(\theta k^{CS} + (1-\theta)k^{\pi}\right)\right]. \tag{3}$$

2.4 Timing

The timing in the model is as follows. First, the regulator chooses between RORR, ESR, and PCR, and specifies the value of the sharing parameter if ESR is chosen.[16] The regulator will choose the regime that provides her with the highest expected utility, anticipating the way in which future stages will play out. Next, the firm offers an amount of political support, L, conditional upon the level of expected profit that will be determined by the regulator's decision regarding the particular level of x support.[17]. Once the regime has begun, the firm exerts cost

reducing effort, and then engages in production. Nature determines if a rare event occurs, and hearings regarding the rare event are held if needed. After all costs are realized and the disposition of the surplus from any rare event is settled, ex-post transfers are implemented according to existing agreements. Figure 1 below illustrates the timing in the model.

Figure 1: Timing



2.5 Equilibrium Under the Various Regimes

Once the type of regime has been chosen and the firm has offered conditional political support, the regulator must choose the level of x. At worst, the regulator can decline the firm's offer and choose to maximize consumer surplus subject to the no expropriation constraint (recall that $\theta > \frac{1}{2}$). Since consumers dislike higher prices, the no expropriation constraint binds and the regulator chooses $x = \alpha\bar{c}$. Anticipating this, when the firm makes its offer of political support, it can induce the regulator to choose any level of x by providing just enough political support to keep the regulator indifferent between the firm's proposed x and the minimum x that satisfies the no expropriation constraint. Accordingly, the following represents the firm's problem (FP).

$$\textit{Maximize}_{x,L} \quad x - \frac{L^2}{2} \tag{FP}$$

$$\text{s.t.} \quad L - (2\theta - 1)(P - \alpha\bar{c}) \geq 0 \tag{RIR}$$

Since x and L do not affect future effort provision or the treatment of potential rare events, the firm simply wants to maximize its earnings gross of operating costs less its expenditures on political support. The constraint is an individual rationality constraint on the regulator's utility (RIR). It simply indicates that the firm must supply enough political support to compensate the regulator for the effect of increased charges to consumers. Solving the firm's problem yields the following equilibrium value of x, denoted $x^*(\alpha;\bar{c},\theta)$:

$$x^*(\alpha;\bar{c},\theta) = \alpha\bar{c} + \left(\frac{1}{2\theta - 1}\right)^2. \tag{4}$$

For the following empirical analysis, it is useful to note that equation 3 implies that under RORR the target level of the firm's earnings will be:

$$x^*(0;\bar{c},\theta) = \left(\frac{1}{2\theta - 1}\right)^2. \tag{5}$$

2.6 Regime Selection

At the first stage, the regulator will choose the regime that provides her with the highest expected utility, anticipating the way in which future stages will play out. For any particular value of the sharing parameter, the regulator's utility is given by:

$$U^r(\alpha) = \theta R - (2\theta - 1)\alpha\bar{c} + \theta(1-\alpha)\alpha\frac{\bar{b}^2}{4} + (1-\theta)\alpha^2\frac{\bar{b}^2}{8} - \theta T(\alpha) + Z^r(\alpha). \tag{6}$$

The first term is simply the reservation value multiplied by the utility weight. The second is the net disutility of the minimum price level that satisfies the no expropriation constraint. The third and fourth terms are the net utility from the benefits of cost reduction flowing to consumers and the firm, respectively. The fourth term gives the disutility incurred due to transition costs and the final term is the regulator's expected payoff from the possibility of rare events. The

firm's lobbying does not enter the regulator's expected utility because the firm's lobbying is just high enough to compensate for the effects of increasing prices above the minimum level. The envelope theorem implies that it is not necessary to solve for the optimum value of the sharing parameter under ESR to compare the regulator's expected utility under ESR to her expected utility under other regimes. Constructing the differences between the regulator's maximized expected payoff under ESR and RORR, PCR and RORR, and PCR and ESR and then differentiating with respect to the exogenous variables yields the comparative statics results discussed below. Since the results follow from straightforward differentiation of equation 6, formal derivations are omitted.

Observation 1. An increase in the transition costs associated with an alternative, T_{ESR} *or* T_{PCR}, *make that alternative less attractive relative to both of the other alternatives.*

Observation 1 is sufficiently straightforward that no additional discussion seems warranted.

Observation 2. Increases in uncertainty, $\bar{c}$, *make PCR less attractive relative to both ESR and RORR and make ESR less attractive relative to RORR.*

Increases in $\bar{c}$ indicate more uncertainty about production costs. Since greater degrees of profit sharing guard against the adverse effects of such uncertainty, ESR becomes more attractive relative to PCR when there is more uncertainty. Since the RORR weakens the no expropriation constraint to the greatest degree, both PCR and RORR become less likely relative to RORR when there is ore uncertainty.

Observation 3. Increases in the expected benefit of cost reducing effort, $\bar{b}$, *make both ESR and PCR more attractive relative to RORR.*

Under RORR, no cost reducing effort is provided, so both ESR and PCR become more attractive relative to RORR when the expected benefit of cost reducing effort is higher. The effect of an increase in the marginal productivity of effort on the choice between ESR and PCR depends on the relative political importance of consumers and the firm. More cost reducing effort is provided under PCR than under ESR, but consumers receive a share of profits under ESR if costs turn out to be very low. Therefore, increases in the expected benefits of cost reducing effort make PRC more (less) attractive relative to ESR if the regulator places a large (small) weight on profit relative to consumer surplus.

Observation 4. PCR is less attractive relative to ESR when the probability of a rare event, ϕ, or the costs associated with regulatory hearings, k^{CS} *and* k^{π}*, are higher.*

Under ESR, some of the effects of rare events on the firm's earnings are automatically removed by the sharing rule. Therefore, the chance that neither the firm nor the regulator will wish to initiate hearings is higher under ESR than under PCR. Thus, ESR economizes on the expense of hearings associated with rare events relative to PCR, making ESR more attractive relative to PCR when rare events are more likely or regulatory proceedings are more expensive. Since there is some chance ($1-\delta$) that hearings will not be needed under RORR when a rare event occurs, increases in the probability of a rare event will or the cost of regulatory proceedings have an ambiguous impact on the attractiveness of RORR relative to both ESR and PCR.[18]

Observation 5. Both ESR and PCR become more attractive relative to RORR when the probability that additional hearings will be needed under RORR when a rare event occurs, δ, is higher.

Under ESR and PCR, there is some chance that neither the firm nor the regulator will wish to convene additional hearings when a rare event occurs. The potential savings occasioned by this

possibility increase when hearings are less likely to be avoided under RORR, increasing the attractiveness of ESR and PCR relative to RORR.

The political importance of the firm and consumers also affects regime adoption. However, inspection of equation 6 reveals that whether an increase in the weight the regulator attaches to consumer surplus or profit will increase or decrease the likelihood of a particular alternative depends upon the values of the other variables in the regulator's maximized utility function. For instance, when the regulator places more weight on consumer surplus she will incur more disutility from the increases in x needed to satisfy the no expropriation constraint under ESR relative to RORR, but will receive more utility from the expected efficiency gains to be shared with consumers as well.

3. The Empirical Model

3.1 The Dependent Variable

The dependent variable, $PLAN_{it}$, takes on the values 0, 1, or 2 if state *i* employed RORR, ESR, or PCR as its primary form of regulation of intrastate telecommunications in year *t*.[19] Following the divestiture of the Bell System on January 1, 1984, each state continued to operate under RORR. In 1986, Georgia, Missouri, New York, and South Dakota instituted temporary moratoria on rate proceedings. In the late 1980's such short term rate freezes were a popular temporary solution among states looking for an alternative to traditional forms of regulation. As ideas developed and experience increased, many of these states moved to ESR. Gradually states adopted PCR until it became the dominant regulatory form in 1996. Table 1 shows the total number of each type of plan in effect in each year from 1986 to 1997.

Table 1
Regulatory Regime Prevalence in the United States: 1986-1997

Regime	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Traditional	47	37	36	30	24	20	19	17	20	18	14	12
Rate Freeze	4	10	11	10	9	8	6	5	2	2	4	4
Earnings Sharing	0	3	3	8	14	19	20	23	20	18	4	4
Price Cap	0	0	0	0	1	1	3	3	6	10	27	29
Deregulation	0	1	1	3	3	3	3	3	3	3	2	2

My sample includes regulatory plans in effect from 1991 through 1997. By the early 1990's, the number of states operating under rate case moratoria had fallen and most of those that that were in effect were long term plans, not stop gap measures, and long term rate case moratoria are essentially simple versions of PCR. Therefore, to simplify the empirical modeling, I count rate case moratoria adopted after 1990 as price cap plans.[20]

My sample includes 45 of the 50 states. Alaska, Hawaii, Idaho, Nebraska, and South Dakota are excluded from the analysis. Alaska and Hawaii are excluded because their unique circumstances may make them incompatible with the rest of the sample. For instance, no Regional Bell Operating Company (RBOC) maintains a presence in those states. Nebraska adopted near total deregulation of its telecommunications industry in 1987 and Idaho and South Dakota adopted very extensive deregulation in 1989.[21] These three states are excluded because three observations are not enough to form a separate category for analysis.

States obviously do not reevaluate their regulatory regimes every year. In fact, most non-RORR plans are scheduled to last for several years when they go into effect. Thus, while there are 315 total state plan years from 1991 to 1997, the number of real decisions regarding plan adoption is much lower. Therefore, only the observations for which the plan in effect was in its first scheduled year are included, reduced the number of observations to 209. This recognizes

that states committed to a plan for multiple years do not have the same latitude to make decisions as other states might.[22]

3.2 Estimation Technique

I employ the multinomial logit model to analyze the observed pattern of regulatory regime adoption across states.[23] Under the multinomial logit model, the probability that state i operates under alternative j in year t is given by

$$P(\text{PLAN}_{it} = j) = \frac{\exp(\beta'_j \mathbf{x}_{it})}{\sum_{l=0}^{2} \exp(\beta'_l \mathbf{x}_{it})}, \tag{7}$$

where $\mathbf{x}_{it}$ is the vector of explanatory variables for state i in year t and β_l, $l = 0,1,2$, are vectors of parameters to be estimated. It is conventional to set β_0 equal to 0 as a normalization. This gives:

$$P(\text{PLAN}_{it} = j) = \frac{\exp(\beta'_j \mathbf{x}_{it})}{1 + \sum_{l=1}^{2} \exp(\beta'_l \mathbf{x}_{it})}. \tag{8}$$

I estimate the model by maximum likelihood.

Given (1′), the individual coefficients β_{jk} are the derivatives of the log odds ratio between alternatives $j = 1,2$ and alternative 0 with respect to explanatory variable k:

$$\beta_{jk} = \frac{\partial}{\partial x_k} \ln\left[\frac{P(\text{PLAN}_{it} = j)}{P(\text{PLAN}_{it} = 0)}\right]. \tag{9}$$

Similarly, $(\beta_{1k} - \beta_{2k})$ gives the derivative of the log odds ratio between alternatives 1 and 2 with respect to explanatory variable k:

$$\beta_{1k} - \beta_{2k} = \frac{\partial}{\partial x_k} \ln\left[\frac{P(\text{PLAN}_{it} = 1)}{P(\text{PLAN}_{it} = 2)}\right]. \tag{10}$$

For purposes of interpretation, it should be noted that the coefficients themselves do not give the marginal effects of the independent variables on the individual probabilities. The marginal effects need not even have the same sign as the coefficient. For expository purposes, I will refer to coefficients in the vector β_1 as coefficients in the ESR equation since they give the derivative of the log odds ratio between ESR and RORR. Similarly, I will refer to coefficients in the vector β_2 as coefficients in the PCR equation.

3.3 Independent Variables Results

I now turn to the explanatory variables used to capture the theoretical effects identified above. Since the theory underlying the empirical model was thoroughly explored in the previous section, I proceed by defining an independent variable and discussing the empirical findings regarding that variable before moving on to the next variable definition. Descriptive statistics for all independent variables are presented in Table 2 below. Where possible, demographic variables are based upon the 1990 Census count to ensure greater accuracy. While based upon the 1990 Census, the variable HSERN nonetheless reflects 1989 data. For two demographic variables, UNION and LOBBY, 1990 Census data was not available. Therefore, the variables are for the available year closest to 1990 (1989 and 1990 respectively).

Table 3 contains the results of the multinomial logit estimation. The first three two columns contain the estimates of the coefficients in the ESR and PCR equations, respectively. The third column gives the difference between the coefficients in the PCR equation and the corresponding coefficients in the ESR equation. The numbers in parentheses below the coefficients and coefficient differences are *p*-values. The final three columns of Table 3 provide an estimate of the magnitudes of the effects of changes in the independent variables. With one exception, noted

below, these figures give the increase in the probability of each type of plan when the indicated variable is increased from the 40th percentile of the sample to the 60th, with all other variables evaluated at the sample medians. The entries at the bottom of Table 3 indicate that the model is highly significant overall and the predicted values from the model correctly classify 73.2% of the observations. Most of the hypotheses implied by the model of the previous section are statistically supported and none are statistically contradicted. Table 4 tabulates actual versus predicted regulatory regimes. Observation by observation inspection of incorrect classifications revealed no discernable pattern in state by state classification errors.

Table 2
Sample Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	40th %	Median	60th %	Maximum
ESRYEARS	69.143	39.336	14.000	47.000	67.000	90.000	128.000
PCRYEARS	7.714	8.025	.000	2.000	5.000	8.000	24.000
BUDGET	1.918	1.351	.269	1.248	1.457	1.809	5.877
CONTROL	.387	0.418	.000	.000	.500	.500	1.000
UNION	18.349	11.416	2.900	12.850	15.900	19.400	51.600
INCOME	101.156	114.105	7.700	51.050	60.300	84.450	617.700
HSEARN	30.743	2.852	26.007	29.699	30.301	31.029	37.755
%METRO	69.073	20.807	23.900	67.850	69.800	79.600	100.000
RATECASE	.844	.632	.000	1.000	1.000	1.000	2.000
LOBBY	5.685	4.937	.500	3.950	4.400	4.700	28.000
AROR	11.462	.944	9.310	11.545	11.750	11.938	12.700
EDUCATION	12.441	.425	11.534	12.365	12.496	12.560	13.207

Table 3
Multinomial Logit Estimation Results[a]

	Coefficients			Magnitudes[b]		
	β_{ESR}	β_{PCR}	$\beta_{PCR-ESR}$	RORR	ESR	PCR
ESRYEARS	.155	.006	-.149	-.763	.928	-.165
	(.001)	(.644)	(.002)			
PCRYEARS	-1.466	.077	1.543	.744	-.977	.233
	(< .001)	(.232)	(< .001)			
BUDGET	.218	.332	.114	-.032	.021	.011
	(.439)	(.027)	(.705)			
CONTROL	2.084	-.113	-2.196	-.185	.239	-.054
	(.010)	(.824)	(.011)			
UNION	-0.251	.015	.266	.307	-.393	.086
	(< .001)	(.522)	(< .001)			
INCOME	.013	-.003	-.016	-.087	.116	-.029
	(.008)	(.442)	(.002)			
HSEARN	.720	.283	-.437	-.203	.217	-.014
	(.001)	(.035)	(.059)			
%METRO	.113	.008	-.105	-.250	.305	-.055
RATECS[c]	.395	-.790	-1.185	-.063	.125	-.062
	(.499)	(.015)	(.054)			
LOBBY	.225	-.030	-.255	-.033	.043	-.010
	(.023)	(.494)	(.014)			
AROR	78.071	-3.626	-81.696	.080	-.098	.019
	(.001)	(.471)	(< .001)			
ARORSQ	-3.368	.153	3.521			
	(.001)	(.498)	(.001)			
EDUCATION	-6.283	-2.876	3.408	.253	-.268	.014
	(< .001)	(< .001)	(.021)			
Observations	209					
Log Likelihood	-126.980					
χ^2	174.310					
$P(\chi^2)$	< 0.001					
Pseudo R^2	0.407					
% Correct Predictions	73.206					

[a] Numbers in parentheses below coefficients are p-values.
[b] Estimated change in probability associated with increasing the independent variable from the 40th sample percentile to the 60th sample percentile, all other variables at the sample median, except for RATECASE. See c below.
[c] For RATECASE, both the 40th and 60th sample percentiles are 1. The changes listed are or an increase from the 40th sample percentile to the sample maximum (1 to 2).

Table 4
Predicted Versus Actual Regulatory Regimes

		Predicted Regime		
		RORR	ESR	PCR
Actual Regime	RORR	84	9	11
	ESR	7	30	2
	PCR	26	1	39

ESRYEARS (PCRYEARS) is the total number (over all states) of years that ESR (PCR) was in effect up to two years before the state's regulatory plan went into effect. For example, in 1990 and 1991 one state operated under PCR, so PCRYEARS would equal 2 for states whose regulatory plans went into effect in 1993. In 1992 3 states operated under PCR, so PCRYEARS would equal 5 for states whose regulatory plans went into effect in 1994. These variables are constructed in this manner because when planning for a regime the year prior before it goes into effect, regulators and firms can draw on experience cumulative through the year prior to that.[24] As experience with alternative regulatory structures increases, it becomes easier for states to structure their own plans, so transition costs decline. Thus, Observation 1 suggests that the coefficient on ESRYEARS in the ESR equation should be positive and larger than the coefficient in the PCR equation. Similarly, the coefficient on PCRYEARS in the PCR equation should be positive and larger than the equation in the ESR equation. The signs of the coefficients and coefficient differences reported in Table 3 agree with all of these predictions and all of the results except the coefficient on PCRYEARS in the PCR for which a hypothesis was expressed are statistically significant at conventional levels. The final three columns of Table 3 indicate that the magnitude of the effect of increases in experience is quite substantial.

BUDGET is the average budget of the state regulatory commission in 1984 and 1985 (when all states operated under rate of return regulation) expressed in per capita terms.[25] Regulatory budgets prior to 1986 are used because the regulatory budget is probably influenced by the type

of regulatory plan in place as well as the plans being considered for the near future. Higher regulatory budgets should increase knowledge and reduce uncertainty about costs, demand, and how to implement regulatory alternatives. Thus, increases in BUDGET might reflect reduced transition costs and lower uncertainty. If this is the case, Observation 1 and Observation 2 suggest that the coefficients in both the ESR and PCR equations will be positive. However, large budgets might also reflect an entrenched bureaucracy with an interest in maintaining the status quo and thus higher transition costs. Similarly, low regulatory budgets might reflect environments in which regulators are severely resource constrained. Regulators in such a situation might wish to implement a more streamlined regulatory alternative. Both of these possibilities would tend to counter the knowledge effect described above. Inspection of Table 3 reveals that both of the BUDGET coefficients are positive, as predicted, but only the PCR coefficient is significant. Compared to the other variables, the magnitudes of the effects of BUDGET are relatively small.

CONTROL averages the one period lag and three period lag of a variable that is 1 if either the Democratic party or the Republican party controls both houses of the state legislature and the governor's office and 0 otherwise.[26] Since legislative terms at the state level typically last two to four years, averaging the one and three period lags reflects the composition of the last to legislative assemblies. Control by one party might indicate a more stable political environment and might therefore make passage of any enabling legislation needed to implement a new regulatory regime easier. To the extent that this lowers transition costs, Observation 1 suggests both coefficients on CONTROL should be positive. The coefficient in the ESR equation is positive and statistically significant while the coefficient in the PCR equation is negative but statistically insignificant. The fourth column of Table 3 indicates that the magnitude of the

decrease in the probability of RORR associated with increases in CONTROL is moderate size relative to the other variables in the model.

UNION is the percent of manufacturing employees in the state that were union members in 1989.[27] Since there is little incentive to contain costs under RORR, telecommunications workers may have received substantial rents under traditional regulation. If this is the case, they may resist implementation of a regulatory regime that would create incentives to contain labor costs. Therefore, transition costs will be higher in states where organized labor is stronger due to opposition from this interest group. Thus, both coefficients on UNION should be negative. Table 3 reveals that the coefficient in the ESR equation is negative and statistically significant while the coefficient in the PRC equation is positive but insignificant. The fourth column of Table 3 shows that the positive effect of increased unionization on the probability of RORR is second in absolute magnitude only to the effects of increased experience.

I use three variables to proxy the potential benefits of improved incentives for cost reduction ($\bar{b}$). INCOME is the state's personal income in 1990, measured in billions of dollars.[28] It seems reasonable to expect that the possible efficiency gains from adopting some form of alternative regulation should increase with the size of the market in the state. HSEARN is the 1989 average annual earnings of male high school graduates age 35 to 44 in thousands of dollars.[29] HSEARN should provide a measure of the cost of constant quality labor across states. Where labor costs are higher, the potential gains from allocating labor efficiently should be larger. %METRO is the percent of the state's 1990 population contained in metropolitan areas.[30] If there are economies of scale in local operations, or if metropolitan markets of the same size are more profitable, the potential benefits of alternative regulation will be higher when %METRO is higher. To the extent that these variables capture the potential benefits from adopting an

alternative form of regulation, Observation 3 suggests that the coefficients on each variable in the ESR and PCR equations should be positive. These predictions receive strong support in Table 3. Of the six coefficients, only the coefficient on INCOME in the PCR equation has the wrong sign, and it is insignificant. Of the five coefficients with the predicted sign, only the PCR coefficient on %METRO is statistically insignificant. The coefficients on INCOME and %METRO in the PCR equation may fail to support Observation 3 because they also proxy the political strength of consumers to some degree, and the effects of the relative political strength of consumers and the firm are theoretically ambiguous.[31] All of these variables lead to declines in the probability of RORR that are moderate in magnitude compared to the other variables in the model.

The variable RATECASE records the number of rate cases filed in each state from 1984 to 1985.[32] Like BUDGET, RATECASE incorporates only pre-1986 data to avoid endogeneity problems. Higher numbers of rate cases probably reflect higher levels of uncertainty (higher $\bar{c}$), a higher probability that a rare event will occur (higher ϕ), and a higher probability that a hearing will be needed when a rare event occurs under RORR (higher δ). Therefore, while an increase in RATECASE might either increase or decrease the likelihood of ESR or PCR relative to RORR, Observation 4 suggests that it will decrease the likelihood of PCR relative to ESR. The information recorded in Table 3 supports this hypothesis, as the coefficient on RATECASE in the PCR equation is statistically smaller than the coefficient in the ESR equation. This finding is also, of course, consistent with the hypothesis that more rate cases simply indicate a regulator that wants to keep closer control over the firm, thus preferring ESR to PCR. The magnitude of the effect of an additional rate case is modest relative to the effects of the other independent variables.

LOBBY is the number of registered lobbyists per state legislator in each state in 1991.[33] In states where there are more interest groups competing for influence, it seems quite likely that there will be more groups seeking to influence regulatory proceedings and to be heard at regulatory hearings. Thus, negotiation and political costs associated with the regulatory process (k^{CS} and k^{π}) may be higher in states where LOBBY is higher. It would be better to have a direct measure of the number of groups actively seeking to exert influence on telecommunications issues, but such data is not readily available. Observation 4 thus implies that increases in LOBBY should make PCR less likely relative to RORR, and the estimated coefficient in the PCR equation is statistically smaller than the coefficient in the ESR equation. The magnitudes of the effects of LOBBY are modest relative to the other variables.

Observation 5 indicates that decreases in the probability that additional hearings would be needed under RORR when a rare event occurred (δ) make RORR more attractive relative to both ESR and PCR. However, it is difficult to obtain a variable that might proxy this probability that is also independent of the probability of a rare event. One might hypothesize that when one group is dominant in the regulatory process, decisions favoring that group will seldom be challenged and the regulator may be able to accommodate the wishes of the dominant group when a rare event occurs without additional hearings. If this is the case, the possibility of rare events will tend to make RORR more attractive relative to ESR and PCR when either group dominates the regulatory process. Further, when either group dominates the process, the costs of regulatory proceedings may be lower for the same reasons, making PCR more likely relative to ESR.

To capture this possibility, I include AROR and its square, ARORSQ, in the model. AROR is the maximum rate of return on rate base allowed by the regulatory authority, averaged over

1984 and 1985.[34] Equation 5 shows that the target earnings level approved by the regulator under RORR ($\hat{E}$) will approach zero when the weight the regulator places on consumer surplus is very large relative to the weight she places on profit. Similarly, it will be limited only by the reservation value of the service, as the weight placed on consumer surplus becomes very small. Therefore, extremely low values of AROR may be associated with consumer dominance while extremely high values may be associated with firm dominance.

To the extent that extreme values of AROR correspond to states where additional hearings are less likely to be needed under RORR when a rare event occurs, Observation 5 suggests that both coefficients on AROR should be positive while both coefficients on ARORSQ should be negative. This sign pattern hypothesis is also consistent with the hypothesis in Donald and Sappington (19??) that a firm experiencing high returns under RORR may have no interest in changing while a firm experiencing low returns under RORR may not wish to face any additional downside risk. To the extent that extreme values of AROR indicate lower costs of regulatory proceedings, Observation 4 suggests that the coefficient on AROR in the PCR equation should be smaller than its coefficient in the ESR equation. Similarly the coefficient on ARORSQ in the PCR equation should be smaller than its coefficient in the ESR equation. This is because ESR economizes on the costs of hearings to deal with rare events relative to RORR. This effect might tend to counter the previous one though since the effect of higher costs of regulatory proceedings on the choice between RORR and ESR or PCR is ambiguous. Inspection of Table 3 shows that the coefficient on AROR in the ESR equation is indeed positive and larger than the coefficient in the PCR equation. Similarly, the coefficient on ARORSQ in the ESR equation is negative and smaller than the coefficient in the PCR equation. Each of these results is statistically significant. The coefficients in the PCR equation do not have the predicted sign

pattern overall, but neither is significant statistically. In magnitude, the effects of AROR on regime adoption are modest relative o the other variables in the model.

EDUCATION is the mean number of years of education of the citizens in the state in 1990.[35] A more educated populace should be more able to promote its interests. Thus, in states where EDUCATION is higher, the relative political strength of consumers should be higher. I thus include EDUCATION as an additional control for the (theoretically ambiguous) effects of the relative political strength of consumers and the firm. While the coefficients on EDUCATION are highly significant, the magnitudes of its effects on regime adoption are moderate relative to the other variables.

4. Conclusion

In this paper, I developed a simple theoretical model of regulatory regime adoption and used it to inform an empirical investigation of intrastate telecommunications regulation. My work adds to that of Donald and Sappington (1995 and 1997) on telecommunications regulatory regime selection in two important respects. First, I allow for important differences between the two dominant alternatives to traditional rate of return regulation. Second, I give more explicit consideration to the role of uncertainty, political concerns, and the possibility of unplanned for contingencies (Z-factors). I find that regime adoption patterns can be explained fairly well using the theoretical differences in the incentive properties of regulatory alternatives and a simple theory of the political economy of regulation. The empirical model is highly significant overall and it correctly classifies 72.3% of the observations. Most of the predictions of the theoretical model were confirmed statistically and none were statistically contradicted.

Several empirical regularities consistent with the theoretical predictions of my model emerged, including the following. The empirical relationships between regime adoption and experience, regulatory budgets, and union strength are consistent with the simple notion that a state will be less likely to switch from RORR when transition costs are higher. The size of the market as reflected by total state personal income, labor costs as reflected by the annual earnings of earnings of high school graduates, and the percentage of the population residing in metropolitan areas were found to be positively related to the adoption of an alternative to RORR. This evidence supports the hypothesis that an alternative regulation will be more likely relative to RORR when the potential benefits from improved incentives are larger.

I found the historical incidence of rate cases to be significantly related to regime adoption. In particular, ESR was found to be more likely relative to PCR when more rate cases were filed in the past. This is consistent with both the hypotheses that ESR economizes on regulatory costs due to unforeseen contingencies (Z-factors) relative to PCR and the hypothesis that ESR reduces the adverse effects of uncertainty relative to PCR. It is also, of course, consistent with the hypothesis that more rate cases simply indicate a regulator that wants to keep closer control over the firm. Finally, I found that the number of registered lobbyists per legislator in a state was a significant determinant of regime adoption. In particular, ESR was found to be more likely relative to PCR when there are more registered lobbyists per legislator. More lobbyists per legislator may indicate an environment in which regulatory proceedings are more costly because more groups are competing for influence and placing demands upon the regulator's and the firm's time. If this is the case, this finding provides further support for the hypothesis that ESR will be more likely relative to PCR when it is more desirable to economize on regulatory costs.

The analysis presented here implies that recent changes in regulatory institutions in the telecommunications industry and the current prevalence of PCR are more than simple stepping stones on the way toward less intrusive regulation and finally deregulation. While regulatory regimes may have moved in that general direction, the growth of alternative regulatory regimes has been fueled at least in part by reductions in transition costs due to a gradual accumulation of experience. Further, the path states take when moving toward less intrusive forms of regulation is influenced in fairly intricate but, at least in part, reasonable and predictable ways by its economic and political circumstances. These findings may allow a better understanding of regulatory change in other industries. More broadly, the paper may be construed as a study in constitutional political economy. In that light, the paper provides strong evidence that the rules of the game are not exogenously set. Rather, polities design the rules for their interactions to deal with the real political and economic issues that they expect to encounter in the foreseeable future.

There are, of course, a number of avenues for future work on regulatory regime adoption in the telecommunications industry. While the 3-way classification used here is more general than past investigations, there are wide variations across plans of a particular type. A more complete exploration of regime adoption might examine approved rates or return and rate base in rate of return states, the determination of specific sharing rules in earnings sharing states, and the initial level of and adjustment mechanisms for prices in price cap plans. All of these things are part of the full character of a regulatory regime. In addition, if the expected wave of deregulation does materialize, analyzing movement all the way from RORR to deregulation will be a logical step to take.

Footnotes

[1] Who to cite here??

[2] A few examples are Averch and Johnson (1962), Bailey (1978), Brown et al. (1991), Lewis and Sappington (1989), and Schmalensee (1989). Sappington and Weisman (1996) provide a comprehensive and non-technical overview of the role of regulation in the modern telecommunications industry.

[3] See Kridel, Sappington, and Weisman (1996) for a comprehensive survey of the empirical literature on the effects of incentive regulation on performance in the telecommunications industry. Berg and Foreman (1996) provide a compact appraisal of this literature.

[4] Classifying all plans other than rate of return regulation as "incentive regulation", as in Donald and Sappington (1995 and 1997), Zhuang (1997) uses an ordered probit model to examine the timing of the adoption of incentive regulation. There is a large empirical literature concerning the determinants of other regulatory outcomes. See, for example, Primeaux et al. (1984), Nowell and Tschirhart (1990), Teske (1991), Kaserman, et al. (1993), and Foreman (1995).

[5] Moral hazard exists when the principal can not observe whether or not an agent had taken the desired action. Therefore, contracts between the principal and the agent must be based upon indirect indicators of the agent's action.

[6] Several empirical studies have found the elasticity of demand for basic local telephone service to be near zero. See, for example, Taylor (1993).

[7] For simplicity I treat RORR as simple cost of service regulation. In doing so I abstract from several institutional details, such as regulatory lag.

[8] When the firm's performance is used to set future price caps, or when the firm is allowed to petition for rate relief if earnings turn out to be below a certain level, the ability of the price cap plan to induce effort is obviously reduced. Therefore, the difference in incentives between a price cap plan and traditional rate of return regulation with regulatory lag may, in actuality, be less drastic.

[9] The functional forms used throughout this paper are chosen only to ease the presentation. All of the results hold much more generally. Any convex disutility of effort function may be used. The cost function may be easily generalized as follows. Define cost as C and let

$C = c - B$ where B is cost reduction due to effort. Let B be distributed on the interval $[0, \overline{B}(e,b)]$ according to the density function g(B,e,b) where e is effort and b is a parameter reflecting the marginal productivity of effort. Defining $\hat{B}(e,b)$ to be the expected benefit of effort given a particular effort level and productivity parameter, it is sufficient to make the standard assumptions that $\hat{B}(e,b)$ is concave in e, $B(0,b) = 0$, $\hat{B}_b > 0$, and $\hat{B}_{eb} > 0$.

Let c be distributed on the interval $[\underline{c}(b,\sigma), \overline{c}(b,\sigma)]$ according to the density function f(b,σ) with mean $\hat{c}(b)$ where σ is a noise parameter that effects the variance and the bounds of c, but not the mean. Changes in the potential benefits from cost reducing effort may shift both the mean and the bounds of the distribution of c. For instance, higher labor costs lead to higher mean cost, a higher upper bound on cost, and more opportunities for cost savings from allocating effort efficiently. It is useful to impose the restriction that $\overline{c}_b - \hat{c}_b = 0$. That is changes in the potential benefits of effort do not substantially effect the difference between the upper bound on cost and the mean cost corresponding to a zero effort level.

[10] See Schmalensee (1989) for an in depth discussion and numerical simulations of this point.

[11] In actuality, some transition costs may be intangible costs imposed on regulatory personnel. Allowing two types of transitions costs formally, however, only makes the notation more complex. I do not explicitly consider the possibility of moving from ESR or PCR back to RORR or of moving between ESR and PCR. It is rare for a state to switch from ESR or PCR to RORR, so there is not enough data to check predictions about such changes. It has been fairly common for states to move from ESR to PCR, but predictions regarding the choice between ESR and PCR follow readily from the simpler model presented here.

[12] The ET began in earnest with Stigler's (1971) paper. Peltzman (1976) and Becker (1983) provided early formal models. For further theoretical work, see Goodman and Porter (1988), Grossman and Helpman (1994), and Finkelshtain and Kislev (1997). Laffont (1996) and Laffont and Tirole (1991) study the role of interest groups in regulation under asymmetric information and a very simple political structure.

[13] Allowing the lobbying term, L, to enter the regulator's utility though a concave sub-utility function, Y(L), changes nothing. Similarly, any convex lobbying cost function, K(L) changes nothing. These functional forms are used only to ease the exposition. Of course,

either Y(L) must be strictly concave or K(L) must be strictly convex for a unique interior maximum to exist.

[14] Again, this functional form is assumed only to ease the presentation. The results hold for any distribution on any finite interval $[\underline{S}, \overline{S}]$.

[15] In this note I discuss the upper and lower bounds on sharing parameters associated with ESR. The upper bound is useful because the transition costs associated with moving from RORR to ESR and from RORR to PCR may be very different. If $\alpha = .9999$ were feasible and the transition costs associated with ESR were slightly less than those associated with PCR, PCR would never be selected. This problem could be avoided by allowing $T(\alpha)$ to be a continuous weakly monotonic function with that reaches a (possibly non-unique) maximum on the interior of the interval [0,1]. This, however, complicates the analysis without yielding any further insight. To see the role of the lower bound, recall that the regulator convenes hearings whenever $\theta\left(S - k^{CS}\right) - (1-\theta)k^{\pi} > \theta(1-\alpha)S + (1-\theta)\alpha S$. Thus, if $\underline{\alpha} < \frac{(\theta k^{CS} + (1-\theta)k^{\pi})}{\overline{S}(2\theta - 1)}$ there would be some range of earnings sharing parameters where hearings would never be held. While allowing this possibility this does not change the results or add greater insight, it complicates the presentation considerably. Therefore, I assume that the lower bound is large enough to rule this out under ESR.

[16] In reality, the regulator can not unilaterally institute ESR or PCR because regulated firms are typically entitled to RORR unless they agree to another alternative. To simplify the presentation, I abstract from this point, in effect assuming that the firm is always at least as well off under ESR or PCR as under RORR. If a constraint is imposed upon the regulator's decisions that she can not make the firm worse off than they would be under RORR, none of the results change. The exposition becomes slightly more complex because over some portion of the parameter space the no expropriation constraint will be binding while over another portion this constraint would bind.

[17] In this sense, the model is similar to that in Grossman and Helpman (1994) and Finkelshtain and Kislev (1997). All of the qualitative results used to inform the empirical analysis continue to hold it all of the bargaining power is given to the firm by letting the offer of support be contingent upon the type of regime, or if it is all given to the regulator by allowing

them to demand a certain level of support in return for a particular level of profit.

[18] Similarly Dewey (1998) shows that institutionalized profit sharing arrangements reduce strategic lobbying activity, lowering political costs, and Weisman (1994) shows earnings sharing can smooth relations between the regulator and the firm regarding competitive entry by partially aligning the interests of the firm and consumers.

[19] The classification of Regulatory plans was derived from information reported in BellSouth Telecommunications (1987-1995), and *State Telephone Regulation Report* (1994-1997) Some states use different plans for companies of different sizes (when there are multiple companies within the state). In such cases, the plan prescribed for the Regional Bell Operating Company (RBOC) in the state is used as the RBOCs are the dominate intrastate telecommunications firms and this procedure makes the choice most comparable across states.

[20] Starting the sample in 1992 instead of 1991 or dropping the states with rate case moratoria does not qualitatively alter the results presented below.

[21] Including these states as price cap plans does qualitatively alter the result presented below.

[22] Again, including all plans does not qualitatively alter the results presented below. Also, a few states switched from ESR back to RORR during the period in which ESR was scheduled to remain in effect. I count these states as RORR states during the year they switch if they operate under RORR for more than half of that year. Otherwise, I county them as RORR beginning the next year. Waiting until the next full year to change the classification of these few observations does not alter the results.

Perhaps the best way to model plan adoption would be to include the every observed plan along with four dummy variables to capture the following five possibilities: 1) previous commitment to ESR, 2) previous commitment to PCR, 3) no previous commitment and operation under ESR in the previous year, 4) no previous commitment and operation under PCR in the previous year, or 5) no previous commitment and operation under RORR in the previous year. Unfortunately, these dummy variables can not be supported by the data. It was exceedingly rare for a state pre-committed to earnings sharing to not operate under earnings sharing and all states previously committed to price caps operated under price caps. Similarly, while a number of earnings sharing states switched to price caps, only a few

earnings sharing states switched back to rate of return plans, and no state switched from a true price cap plan to any other plan. Thus, a model including these dummy variables would not be identified.

[23] See Greene (1993) or Madalla (1983) for a detailed discussion of the multinomial logit model.

[24] Using a one period lag instead of a two period lag does not effect the results qualitatively.

[25] Source: National Association of Regulatory Utility Commissioners (1984 and 1985). BUDGET reflects commission expenditures, not the actual budget allocation. While both series are available, there are more missing data for the budget allocation. Of the 45 states in the sample, actual expenditures were missing only for Arizona and Louisiana. For these states, however, the budgetary allocation was available. The actual expenditure for the state was then estimated by multiplying the budget allocation by the average percent of the budget allocation actually spent in the year in question (across states for which both observations were available). As it probably requires more effort to regulate larger firms, or more firms where applicable, budget must be corrected for the size of the firms' operations within the state.

[26] Source: U.S. Department of Commerce, *Statistical Abstract of the United States,* 1989-1997.

[27] Source: U.S. Department of Commerce, *Statistical Abstract of the United States*, 1997.

[28] Source: U.S. Department of Commerce, *Statistical Abstract of the United States*, 1997.

[29] Source: U.S. Department of Commerce, data collected for the *1990 U.S. Census*.

[30] Source: U.S. Department of Commerce, *Statistical Abstract of the United States*, 1997

[31] Income depends upon both per-capita income and population. Foreman (1995) found evidence that intra-LATA toll rates were lower where per-capita incomes were higher. This might be because larger consumers of intra-LATA service exert more pressure for low rates. HSEARN reflects not only labor costs, but also the value of time. Filer, Kenny, and Morton (1993) find that the average citizen has less political clout when the value of their time is higher. %METRO reflects the geographic concentration of consumers. Many studies, including Stigler (1971) and Becker (1986) have found that interest groups are more effective when they are more concentrated geographically.

[32] Source: National Association of Regulatory Utility Commissioners (1982-1985).

[33] Data for LOBBY is taken from Morgan et al (1993).

[34] Source: National Association of Regulatory Utility Commissioners (1984 and 1985).

[35] Source: U.S. Department of Commerce, *1990 U.S. Census*. EDUCATION is calculated from calculated from reported categorical data.

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