

Information Asymmetries and Regulatory Decision Costs: An Analysis of U.S. Electric Utility Rate Changes 1980–2000

Adam R. Fremeth
University of Western Ontario

Guy L. F. Holburn*
University of Western Ontario

We argue that information asymmetries between regulators and firms increase the administrative decision costs of initiating new policies due to the costs of satisfying evidentiary or “burden of proof” requirements. We further contend that regulators with better information about regulated firms—that is, with lower information asymmetries—have lower decision costs, thereby facilitating regulator policy making. To empirically test our predictions, we examine the relationship between regulatory informational environments and changes to regulated rates for all investor-owned electric utilities from 1980 to 2000. We exploit several natural sources of variation in the informational environments of US state utility regulators. These stem from the prior experiences and administrative resources of regulators, observable policy decisions of other regulatory agencies for a given utility, and differences in procedural regulations pertaining to rate increases and decreases. Our results suggest that as regulators acquire more information about utility operations, including from experience in office, they are more likely to enact rate decreases and less likely to implement rate increases.

1. Introduction

Since Baron and Myerson (1982), an extensive theoretical, and mainly normative, literature has explored the impact of asymmetric information on the design of optimal regulatory policies for natural monopolies (Laffont and Tirole 1993; Armstrong and Sappington 2007). Although there is some

*Richard Ivey School of Business, University of Western Ontario, London, Canada. Email: gholburn@ivey.uwo.ca.

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evidence that this research stream has had an impact on actual regulatory policies implemented in various jurisdictions, specifically the adoption of incentive-pricing mechanisms (Kridel et al. 1996; Ai and Sappington 2002), there has been little analysis of the impact of information asymmetries on policy making from a positive theoretical perspective.

In this article, we adopt such a positive approach by arguing that asymmetric information affects policy outcomes by increasing regulatory “decision costs.” Decision costs reflect the administrative resources utilized in the process of making regulatory rules and orders and arise from legal requirements that agencies follow due process in their decision making (Mashaw 1990; Tiller and Spiller 1999; Stephenson 2007). A central requirement is that regulators conduct formal hearings and base their decisions on documented evidence presented therein. In the United States, utility regulators must specify “findings of fact” after hearings which form the basis for establishing rates.¹ Obtaining supportive evidence, however, can be a costly exercise for regulators who wish to initiate new policies. In particular, we contend that the costs to the regulator of collating evidence increase with the extent of information asymmetries that exist between the regulator and the firm: regulators who are less well informed about the firm, and thus about policy alternatives and consequences, find it more costly to justify a change in policy since it takes longer to collect data, conduct analyses, and consult with other parties. Hence, information asymmetries, by raising the costs of regulator-initiated policy adjustments, tend to insulate policies against regulator-induced change. On the other hand, lesser informed regulators are more likely to implement policies initiated by regulated firms who present evidence in favor of their proposal; obtaining counterevidence to contest the firm’s claims and to support the status quo is again a costly exercise for informationally disadvantaged regulators (Dal Bo 2006).

Here we conduct one of the first empirical investigations of the relationship between regulators’ information about regulated firms and their policy decisions. Although directly observing the extent of regulatory information presents a measurement challenge for researchers, we instead identify mechanisms through which information about regulated entities is revealed to external parties, including regulators. We focus our attention on three types of mechanism: the first considers the development of tacit knowledge through a regulator’s prior experience in office in the task of administering regulatory policies; the second is the publication of codified knowledge about a firm in the form of other agency, or judicial, rules or orders. Greater first-hand regulatory experience and greater amounts of external information both reduce the evidentiary barriers to regulators implementing new policies, increasing their incidence. Third, organized interest groups, such as consumers or NGOs (Grossman and Helpman 2001; Kwoka 2002), can provide information that, if credible, can establish the evidentiary basis for a policy decision.

1. In the absence of providing a rationale for their decisions, regulators would risk being overturned by the courts for making “arbitrary and capricious” policy (Spulber and Besanko 1992; Bawn 1997; Shipan 2000).

We test our hypotheses by examining the incidence of changes to regulated rates in the US electric utility industry between 1980 and 2000. During this period, state regulatory agencies implemented 947 rate increases and 218 rate decreases through formal rate reviews. Consistent with our predictions, we find that regulatory agencies were more likely to implement rate reductions and/or less likely to implement utility requests for rate increases, when (a) agency commissioners had longer experience in office, (b) agency staff were relatively larger in number, and (c) other agencies had enacted similar rate changes, or assessed operational penalties, for the same utility. These results are consistent with improved informational flows reducing the evidentiary costs to regulators of implementing rate reductions and contesting utility rate increase requests.

Our arguments and empirical analysis additionally provide new insights into the extent to which regulatory policies tend to favor industry or organized interest groups (Stigler 1971; Posner 1974; Becker 1976; Peltzman 1976). The economic theory of regulation contends that organized interests can “capture” policy since regulators will exchange policy favors in return for politically valuable resources such as electoral campaign contributions or votes. Our theoretical arguments here regarding regulatory decision costs imply that, over time or with regulator experience, policy will automatically shift toward consumer interests, independent of organized consumer attempts to influence policy decisions. As regulators gain more information about utilities through experience in office (e.g.), the decision costs of implementing rate reductions or contesting utility requests for rate hikes decrease.

Nonetheless, utilities and organized interest groups may still exert a concerted influence on policy through various means, such as by making campaign contributions to executive and legislative actors who oversee agency activities (De Figueiredo and Edwards 2007) or by making promises of future private-sector employment to agency heads (Eckert 1981; Spiller 1990). Although data availability limitations prevent us from incorporating measures of such influence strategies, we do include measures of interest group organization in our investigation of utility rate making. Consistent with the interest group literature, our statistical results suggest that agencies are indeed sensitive to the balance of interest group pressures within the jurisdiction in their decisions to increase utility rates, though much less so in their decisions to reduce rates. We thus attempt to control for interest group influences in our empirical design when we assess the effect of regulatory commissioner experience and staff resources.

In the next section, we discuss our central theoretical argument and thesis. Following that, in Section 3 we develop specific hypotheses regarding the informational conditions under which regulatory agencies are likely to implement changes to regulated rates in the utilities sector. In Sections 4 and 5, we describe our empirical setting, methodology, and findings along with alternative potential interpretations. Section 6 contains a broader discussion of how our results contribute to existing literature, the limitations of our approach, and opportunities for further research.

2. Asymmetric Information and Regulatory Decision Costs

In the canonical principal-agent formulation of regulatory policy making under conditions of asymmetric information, regulatory institutional processes are typically not modeled for purposes of parsimony. Institutional features of the administrative process, such as conducting hearings for affected parties, obtaining evidence, and documenting testimony, are not included in the scope of such models. Similarly excluded are the explicit effects of political and judicial institutions on regulatory decisions.² In contrast to this institutional abstraction, a separate stream of political science research considers the rationale for, and impact of, administrative procedures on regulatory decisions. Asymmetric information exists not only between the regulatory agency and the utility but also between elected political actors—who have ultimate responsibility for regulatory policies—and regulatory agencies. Politicians may delegate policy-making authority to agencies who develop private expertise on policy alternatives and consequences, but this creates a control problem for the political principal: how to ensure that expert agencies implement the principal's preferred policy when the principal cannot easily know or specify that policy *ex ante* (McCubbins and Schwartz 1984).

Scholars have argued that politicians are able to use administrative procedures in addition to traditional oversight activities as strategic instruments to ensure that bureaucratic agencies do not drift too far in their subsequent policy making from the politicians' ideal positions (McCubbins et al. 1987, 1989; Balla 1998). For instance, statutory requirements that agencies provide public notice of intended rulings, and the opportunity to interested parties to comment and participate in hearings, can reduce the informational disadvantage of political actors. By also requiring agencies to admit certain interest groups, such as consumer advocates, into their proceedings, political coalitions can “stack the deck” in favor of these groups without the need to continuously monitor agency decisions *ex post* (Holburn and Vanden Bergh 2006). The costs of achieving agency compliance can thus be shifted from politicians toward the agencies themselves, as well as organized interest groups and the courts, though at the expense of limiting policy flexibility and the ability to adapt to future shocks (Holburn 2001).

Although a large body of literature has examined the conditions under which legislatures, executives, and courts have incentives to shape agency decision-making environments by implementing or enforcing procedural requirements (Epstein and O'Halloran 1994, 1996; Bawn 1995, 1997; Huber and Shipan 2000), there has been remarkably little further theoretical development of the precise mechanisms through which the various instruments actually affect policy. For instance, enabling interest groups to participate in administrative hearings is argued to send signals to politicians about which interest groups are organized and concerned about proposed policy changes, as well as to affect the informational basis of agency decisions (McCubbins et al. 1987: 258), though issues of information credibility and the potential for “cheap talk”

2. For exceptions see Spiller (1990) and Faure-Grimaud and Martimort (2003).

are not fully addressed. Furthermore, there have been only a few empirical tests of the predicted policy impacts. In one study, Balla (1998) found no evidence that physician participation in US Medicare reform processes during 1990 and 1991 affected final policy decisions. Nor did Spence (1999) find convincing evidence that new statutory requirements significantly altered federal agency hydroelectric licensing outcomes. These null results support legal scholars' counterargument that due process provides social, not political-strategic, value in the context of societal preferences for procedural "fairness" (Mashaw 1990), though additional empirical studies in other industry settings are needed to advance the debate.

Here we contribute to this stream of literature by focusing on the impact of a single specific administrative procedure, the requirement that regulatory agencies base their policy decisions on available evidence. At the federal level, the US Administrative Procedure Act (APA) states the evidentiary requirement for agency decision making: "The proponent of a rule or order has the burden of proof . . . a rule or order [may not be] issued except on consideration of the whole record . . . and supported by and in accordance with reliable, probative, and substantial evidence" (Title 5, Pt 1, Chapter 5.II, 556(d)). Judicial precedent has established that an agency demonstrate that it has "examine[d] the relevant data and articulate[d] a satisfactory explanation for its action, including a rational connection between the facts found and the choice made" (*State Farm v. Motor Vehicles Manufacturers' Association*, 463 U.S. 29 (1983)). Similar "hard look" provisions exist for state-level agencies. In Maine, for example, "Every agency decision . . . shall be in writing or stated in the record, and shall include findings of fact sufficient to apprise the parties and any interested member of the public of the basis for the decision" (Maine Code Chapter 5 section 9061).

We argue that evidentiary requirements create additional decision costs of changing policies since obtaining sufficient evidence and formulating arguments take time and skill. Tiller and Spiller define decision costs as "the amount of organizational resources required to calculate the likely policy consequences of one's own actions and . . . the resources required to perform the processes and procedures required to issue a decision" (1999: 351). In general, then, the need to provide evidence creates a bias toward the status quo or an "ossification" of agency rulemaking as the expected benefits of a new policy may be outweighed by the costs of affecting the change, even though courts may be selective in enforcing such standards (McGarity 1992; Revesz 1997).

Decision costs, however, are likely to vary among regulatory agencies, depending on the extent of information asymmetries between agencies and regulated entities. Agencies differ in their knowledge and understanding of the firms they regulate—that is, the degree of information asymmetry is not a fixed constant as commonly assumed in principal-agent models but depends on factors such as staff experience and learning from prior monitoring activities. Agencies may also vary in their willingness to invest in the acquisition of expertise and information (Bawn 1995; Aghion and Tirole 1997;

Bendor and Meirowitz 2004; Stephenson 2007). Organized interest groups can be an additional source of information for regulatory agencies though the degree of organization varies by jurisdiction.

Well-informed agencies are better able to identify and assess the impact of alternative policies on firms and external parties, and hence to collate supporting evidence for their decisions at relatively low cost. In the pharmaceutical industry, for example, more experienced Food and Drug Administration regulators have a greater tendency to detect noncompliant manufacturing processes during inspections, and hence to impose sanctions (Macher et al. 2009). Conversely, more poorly informed agencies will be less likely to identify firms that are out of compliance. If they do so, they will incur greater costs of obtaining sufficient evidence to justify a change in policy.

There are two implications for policy making: first, all else equal, agencies with better information will be more likely to initiate policy changes since the costs of obtaining the necessary evidence to justify the change will be lower. Less informed agencies will be less likely to initiate, bearing a greater evidentiary cost. Without evidence, the agency would be at risk of being overturned by the courts on procedural grounds. Courts have often deferred to regulatory agencies on matters of substance though are more willing to overturn on procedural grounds (Studness 1992).³ Section 706 of the APA enables federal courts to “set aside agency actions, findings, and conclusions found to be arbitrary, capricious, [or] an abuse of discretion.”

Second, more expert agencies will be better positioned to block firm-initiated policy proposals. When regulated firms present evidence to support a new policy—for example, the authorization of a new pharmaceutical drug, new utility rates, or a new technical standard—agencies with a deeper understanding of the firms or industries will be more able to identify biases in their arguments and to assess the validity of their claims, thereby providing the grounds for denial. Less expert agencies, on the other hand, will have a higher cost of countering the evidentiary basis of such proposals, increasing the probability of acceptance.

In the next section, we develop this thesis in greater depth in the context of changes to regulated rates in the utilities sector.

3. Hypotheses

In the United States, regulatory policies in the utilities sector are primarily designed and implemented by state-level independent agencies, Public Utility Commissions (PUCs). PUC mandates are broadly defined: federal legal

3. In 1991, the US Supreme Court declined to review an earlier decision by both the Louisiana Supreme Court and the Louisiana Public Service Commission supporting a US\$1.4 billion disallowance to the rate base of Gulf States Utilities. In that decision, the state court deferred to the regulator and found that “Imprudence may be measured as the extent to which a utility fails to achieve optimality in retrospect, not on the extent to which it failed to exercise reasonable judgment” and that “commission orders are to be upheld unless they are arbitrarily or capriciously rendered, or are not reasonably supported by the evidence” (*Gulf States Utilities Co. v. LPSC*, 578 So. 2d (La. 1991)).

precedent establishes that PUCs must set rates that enable utilities to earn a “fair and reasonable” return on “used and useful” assets (Howe 1985; Lesser 2002), though methodologies for assessing such criteria are not specified.⁴ Procedural requirements are more closely delineated, however, in state legislation. In California, for instance, PUC “decision[s] shall contain, separately stated, findings of fact and conclusions of law by the commission on all issues material to the order or decision” (Public Utility Code section 1705). Similar requirements obtain in other states. Rates are determined through periodic rate reviews that can be initiated at any point by the PUC or the utility. Upon initiation of a rate review, a series of public hearings is held where the utility, PUC staff, and any admitted interest groups present information, arguments, and evidence supporting their positions about justifiable allowed rates of return, operating costs, and assets to be included in the rate base (Hyman 2000).⁵ At the end of this process, which may extend up to a year or more in duration, PUC commissioners make a majority decision on the rates that final consumers are obliged to pay. Depending on the commissioners’ assessment of the evidence presented, rates may increase or decrease as compared to the status quo.

Utilities have an incentive to initiate rate reviews if they expect that the PUC will establish the allowed rate of return at a level above the actual level the utility is currently earning. Since rates are otherwise fixed, the actual earned rate of return on assets decreases as the utility’s operating and investment costs increase, all else equal. Historically, utilities have thus tended to initiate reviews after periods when costs have risen, for instance after the construction of new infrastructure facilities, operating cost increases, or after interest rates rises (which affect financing costs), in order to obtain higher rates and profits (Joskow 1974). PUCs, on the other hand, have an incentive to trigger rate reviews if they consider actual earned profits to be above the level determined by the target allowed rate of return. In this case, a rate review would lead to a reduction in rates and profits for the utility.

The temporal pattern of rate reviews in the electric utility sector during the 1980s and 1990s reflects, in part, the changing cost conditions of the industry. During the 1980s, increasing investment in new generation capacity and other assets, higher levels of inflation, and high interest rates all contributed to substantial utility requests for rate increases (see Figure 1). In 1981, the value of rate revenue increases across the industry peaked at \$8 billion. Conversely, lower investment levels in utility assets, low inflation levels, and falling interest rates during the 1990s coincided with a substantial decrease in the amount of rate increases and an increase in the value of rate reductions.

4. Precedent setting cases for this regulatory standard include *Smyth v. Ames*, 169 U.S. 466 (1898), *FPC v. Hope Natural Gas Co.*, 320 U.S. 591 (1944), *Jersey Central Power & Light v. FERC*, 810 F. 2d 1168 (D.C. Cir. 1987), and *Duquesne Light Co. v. Barasch*, 488 U.S. 299 (1989).

5. The rate base is the value of the utility’s assets that the PUC deems prudently incurred and on which the utility is allowed to earn a financial return. Changes in the rate base arise as the PUC formally approves new investments that the firm has recently completed, for example, the completion of new electric generation capacity or the extension of transmission facilities.

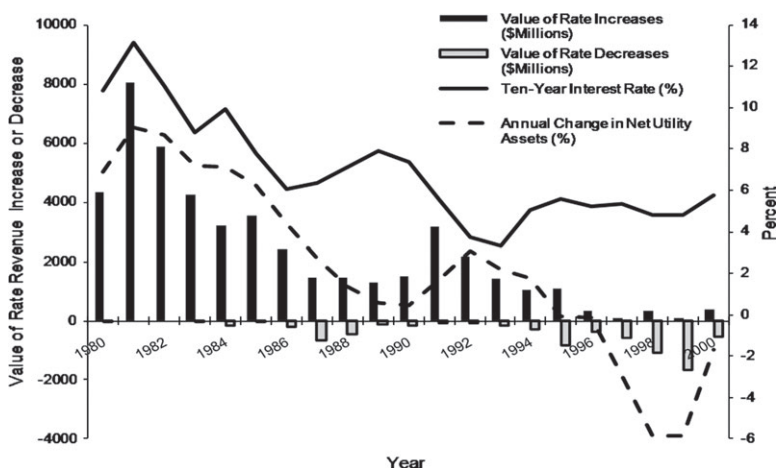


Figure 1. Value of Electric Utility Rate Increases and Decreases 1980–2000.

Information asymmetries between the utility and PUC affect the initiation decisions of each party. For the PUC, it is difficult to observe accurately the utility's earned rate of return at any point in time and hence whether a rate reduction is justified. Better informed PUCs are more likely to identify, and be able to document, whether a utility is overearning, and hence to implement rate reductions. More astute PUCs are also better able to assess the validity of any utility claims that they are underearning and that rate increases are required. Anticipating greater levels of scrutiny and an increased probability of denial, utilities will be less likely to initiate reviews that call for rate increases when PUCs have better information about the utility. In general, then, we predict that conditions of reduced information asymmetries will be correlated with more rate reductions and fewer rate increases. We now identify several natural sources of information heterogeneity among regulators in order to develop specific hypotheses about factors affecting the incidence of utility rate increases and decreases.

3.1 Regulator Experience and Agency Resources

One source of information about utility costs, operations, and market conditions is through regulators' direct experience in the practice of regulation (Macher et al. 2009). Experience enables individuals to "learn by doing" (Arrow 1962), and hence to improve their own and their organization's performance (Argote and Epple 1990). In regulated industries, Carpenter (2004) argues that regulators develop more accurate information about firms through repeated interactions over time. As regulatory commissioners and staff accumulate more experience through monitoring and evaluation activities, they develop deeper knowledge about specific regulated entities. A longer period of experience in office facilitates the greater accumulation of tacit knowledge. Some of this knowledge exists tacitly within agency personnel. Other aspects

become codified and transmitted through documented analyses and reports and lead to the development of organizational routines (Nelson and Winter 1982). Agencies with relatively greater financial resources are also able to devote more resources to overseeing each regulated firm, thereby contributing to the stock of organizational knowledge.

With greater experience in office or agency resources, regulators become more adept at understanding utility true costs, profits, and managerial capabilities, as well as the impact of exogenous events—such as changes in weather patterns, regional economic growth, environmental standards, or financial market conditions—on utility earnings, and hence whether utility profits are above or below the allowed rate of return. All else equal, then, regulators with greater experience or agency resources will be better able to identify when rate reductions are justified and to provide the necessary evidence during a rate review, and to contest utility requests for rate increases. Hence:

Hypothesis 1. Regulators with longer experience in office or with greater agency resources are (a) less likely to implement rate increases and (b) more likely to implement rate decreases.

3.2 Information from Other Regulatory Agencies

Information on utility costs and operations can originate from sources other than an agency's own experience and oversight activities. For instance, credible information obtained and revealed by independent agencies in the course of policy making can shape PUC beliefs about utility costs and management prudence. State and federal agencies are generally subject to procedural requirements that they document and disclose the evidentiary basis for their decisions. In the electric utility sector, federal agencies such as the Nuclear Regulatory Commission (NRC) or the Environmental Protection Agency monitor selected aspects of utility performance and have the authority to punish violations. The NRC, for example, can impose financial penalties, ranging from \$75,000 for security breaches to \$450,000 for technical violations requiring a plant shutdown (Feinstein 1989). Similarly, for utilities that operate in multiple states, other PUC rate determinations can also yield valuable information about corporate management practices and abilities (Lyon and Mayo 2005). Both types of information, if credible, can assist PUCs in justifying rate reductions or in countering utility claims that costs have risen and that rates should be increased.

Hypothesis 2. External evidence from other agencies on higher (lower) utility costs (a) increases the likelihood of a rate increase (decrease) and (b) reduces the likelihood of a rate decrease (increase).

3.3 Interest Group Opposition

Organized interest groups also have an incentive to provide evidence to PUCs on regulated firms and regulatory policy consequences (McCubbins et al.

1989; De Figueiredo et al. 1999; Grossman and Helpman 2001). The provision of information during regulatory decision-making procedures is one mechanism by which interest groups can influence policy decisions since agencies have a statutory duty to consider all available evidence (McCubbins et al. 1989). Agencies are typically prohibited from accepting financial benefits from the parties they regulate (unlike elected politicians who may solicit campaign contributions), so the provision of information during administrative procedures is a central means by which opposing interest groups attempt to shape regulatory policy.

State administrative procedure acts generally grant authority to major interested parties, such as large industrial consumers or consumer advocates, to have standing in public rate hearings (De Figueiredo and Vanden Bergh 2004; Holburn and Vanden Bergh 2006). Standing provides interest groups with the chance to access utility informational filings, to present arguments and evidence regarding policy, and to challenge utility claims. In jurisdictions with relatively well-organized interest groups, PUCs will have greater flows of information about utilities resulting from these groups' monitoring activities.

We argue that interest group opposition has an asymmetric impact on the direction of policy change. Specifically, we contend that organized interest groups that oppose utilities are more effective at limiting the incidence of rate increases than at promoting rate decreases. When a utility initiates a rate review, it makes available to the PUC and interested parties the informational basis of its claim for a rate increase, providing detailed evidence of increased operating costs or assets. Organized interest groups thus gain access to detailed utility information that they would not otherwise obtain outside the scope of a rate review. Information asymmetries are consequently substantially reduced at the outset of a utility-initiated rate review. This documentation can provide the basis for interest groups to more carefully scrutinize utility operations and to contest utility arguments. The prospect of confronting organized interest group opposition during rate hearings acts as a disincentive for utilities to request rate increases in adverse environments.

On the other hand, during periods when utilities do not initiate rate reviews, the existence of informational asymmetries regarding utility costs makes it difficult for interest groups to independently obtain and provide evidence of any cost decreases to a PUC that would justify a reduction in rates.⁶ Interest

6. A vivid illustration of the challenge for interest groups, and indeed regulators, in identifying utility cost reductions, or overearning, is provided by the case of Duke Energy in North Carolina during 2002. According to a whistleblower, Barron Stone, a senior business analyst within the accounting department at Duke, the firm had used illegal accounting practices to intentionally underreport its regulated income by \$124 million from 1998 to 2000. Duke had allegedly included expenses from its unregulated retail operations in its regulated accounts and had additionally not correctly reported \$84 million of insurance rebates on its nuclear power plants. Such accounting maneuvers enabled Duke to effectively boost its regulated profits significantly above the level permitted by the North Carolina Utilities Commission. These remained undetected by the commission for almost a 3-year period until alerted by an insider. See "Duke Energy settles accounting case with North Carolina Utilities Commission," *The Charlotte Observer*, October 30, 2002.

groups do not have authority to access utility records or management accounts on a regular basis in the same ways that PUCs do. Collective action challenges within diffuse groups—such as residential consumers—also hinder the ability to organize and obtain the resources needed to effectively scrutinize utility actions on a continuing basis. Imperfect information about utility operations thus raises the costs for interest groups to credibly petition the PUC to initiate a rate review with the purpose of ultimately reducing rates.

Hypothesis 3. Interest group opposition reduces the incidence of rate increases but has a smaller effect on increasing the incidence of rate decreases.

3.4 Political Competition

Our final hypothesis considers the political conditions under which agencies have an incentive to expend effort in gaining additional expertise that reduces information asymmetries regarding utilities. The credible threat of ex post political sanctions—in the form of budget cuts, committee hearings, or new legislation—can induce agency compliance (McCubbins and Schwartz 1984). Ex ante procedural controls, such as the need to justify policy decisions with documented evidence, however, raise the costs of complying. As with interest group opposition, the costs of complying with political pressures are asymmetric across rate increases and rate decreases. Once a utility has filed for a rate increase and provided evidence, it is less costly for the PUC to challenge selected aspects than to independently obtain evidence that would support a rate decrease in the absence of a utility filing. In political environments that are hostile to utility policy positions, then, utilities would be less likely to request a rate increase, anticipating the potential effect of political pressures on PUC decisions. However, such pressures would be less effective in prompting the PUC to initiate a rate review with the objective of reducing rates: even though the PUC would benefit politically, it would incur the administrative costs of providing evidence that could withstand judicial review.

Research suggests that political pressures on regulatory policies can intensify when competition between rival politicians or parties increases, making them more willing to trade policy favors with interest groups for their votes and financial campaign contributions (Grier et al. 1994; Ansolabehere et al. 2003). We anticipate that political party competition in the state legislature will tend to benefit consumers rather than utilities since utilities tend to develop political ties or connections with only a minority of legislators—utility headquarters and regional offices are often concentrated in just a few political geographic districts. Legislators in districts with a strong utility employment or corporate base will thus be more likely to support utility interests in political and regulatory policy-making arenas. However, utilities serve consumers distributed over multiple political districts, if not statewide. In jurisdictions where a utility has less of an employee or corporate presence but still serves consumers, legislators are more likely to maximize their electoral chances by gaining the support of utility consumers than utilities. These jurisdictions generally outnumber those where

utility employment is concentrated, leading to a pro-consumer bias in the legislature when utility regulatory policy is publicly salient.⁷

When the rivalry between competing political parties is strong, legislators will be more likely to seek the support of voters by promoting pro-consumer (i.e., voter) utility policies. In such environments, utilities—expecting adverse political pressure to be exerted on PUCs—will be less likely to trigger rate reviews. As argued above, the impact of political competition will be more effective in limiting the incidence of utility requests for rate increases than in actively promoting rate decreases. Hence:

Hypothesis 4. Political competition reduces the incidence of rate increases but has a smaller effect on increasing the incidence of rate decreases.

4. Empirical Analysis

4.1 Data

We compiled a panel data set of all PUC changes to rates for investor-owned electric utilities covering 48 states between 1980 and 2000. In this time period, there were 947 rate increases and 218 rate decreases across 190 utilities (see Table 1). The majority of the rate increases occurred during the 1980s, whereas the majority of rate decreases occurred during the 1990s. We excluded any rate changes due to legislation accompanying electricity deregulation or market restructuring. The unconditional annual probability of a rate increase was 24% and of a rate decrease was 5%. Thus, in any given year a utility would generally not experience a rate change. Our primary data source for information on rate reviews was Regulatory Research Associates, a private consulting firm, which tracks regulatory policies in the utilities sector.⁸

Our level of analysis is the utility-year. The potential panel of 3990 observations (190 utilities times 21 years) is reduced by 327 observations due to utility merger and acquisition activity. An additional 21 observations were dropped as we excluded the single utility operating in the District of Columbia due to its anomalous political environment. Together these lead to a final panel of 3642 utility-year observations.

7. For instance, Xcel Energy, the major electric utility in Minnesota, supplies power to customers in 109 of the state's 134 electoral districts of the state-level House of Representatives. However, the utility only maintains significant operations in 13 of those districts (power plants and office buildings). Furthermore, only 3 of 13 Representatives in those districts where Xcel is active sat on the House Energy Finance and Policy Committee in 2007–08. This committee directly oversees the enactment and implementation of energy-related policy and the activities of the Minnesota Public Utility Commission. In addition, none of these three Representatives had held leadership positions, such as Chair or Vice-Chair.

8. Regulatory Research Associates reports all major rate reviews involving investor-owned utilities. The data do not indicate which party initiated the rate review. We confirmed the accuracy of the data for a subsample of rate reviews using Moody's Annual Public Utility Manual, Public Utilities Fortnightly, and annual reports from the National Association of Regulatory Utility Commissioners.

Table 1. Electric Utility Rate Reviews 1980–2000

Year	Rate increases			Rate decreases		
	Number	Total value (\$ millions)	Median value (\$ millions)	Number	Total value (\$ millions)	Median value (\$ millions)
1980	99	4345.5	30.6	1	-15.1	-15.1
1981	117	8041.5	30.2	0	0	0
1982	118	5869.4	25.05	0	0	0
1983	98	4243.4	23.4	2	-22.6	-11.3
1984	73	3198.6	23	7	-166.5	-10
1985	56	3562	22.65	4	-24.6	-5.15
1986	50	2428.8	16.9	15	-227.8	-5.8
1987	29	1472.3	15.3	28	-673.4	-15
1988	23	1472.7	25	16	-467	-14.25
1989	21	1288.3	21.8	11	-124.1	-9.3
1990	36	1494.7	13.4	7	-154.5	-29.7
1991	43	3184.3	33.1	4	-85.4	-19.85
1992	47	2158.8	22.2	5	-72.3	-4.5
1993	32	1408	26.35	8	-152.5	-13.3
1994	27	1041.6	17.9	13	-280.3	-12.7
1995	30	1094.6	19.3	9	-825.3	-40.9
1996	15	347.8	8.8	16	-356.9	-16
1997	7	86.3	6.8	16	-576.1	-31.7
1998	11	347.7	14.4	20	-1096.1	-26.15
1999	4	64.6	10.3	20	-1649.2	-14.8
2000	11	366.8	13.1	16	-560.4	-16.75
1980–2000	947	47,517.7	23.0	218	-7530.1	-15.0
1980–1990	720	37,417.2	24.2	91	-1875.6	-11.6
1991–2000	227	10,100.5	20.3	127	-5654.5	-17.4

Source: Regulatory Research Associates, 2001.

4.2 Empirical Model and Estimation Methodology

We model a PUC's decision each year to increase, decrease, or leave unchanged a utility's rates using a multinomial logit specification. This approach is appropriate when the dependent variable is categorical rather than continuous and does not have a natural rank ordering (Maddala 1983).⁹

The multinomial logit estimates the probability of a PUC implementing a rate decision of type j given by

9. A potential alternative to this estimator would be a model that considers the ordered nature of the dependent variable. However, tests of the proportional odds ruled against the use of an ordered logit in this case (Peterson and Harrell 1990; Agresti 1990). The proportional odds assumption only holds if the independent variables' effect on the cumulative odds does not change from one cumulative odds to the next and that the only change is to the constant term. A significant result on the chi-square test found that this assumption does not hold and that the dependent variable cannot be treated as ordered. Nevertheless, for robustness we estimated the model using an ordered probit and found the results quantitatively and statistically similar to those using the multinomial logit estimator.

$$\text{Prob}(y_{i=j}) = \frac{e^{x_j \beta_j}}{1 + \sum_{j=1}^J e^{x_j \beta_k}} \text{ for } j = 1, 2, \quad (1)$$

and

$$\text{Prob}(y_{i=j}) = \frac{1}{1 + \sum_{j=1}^J e^{x_j \beta_k}} \text{ for } j = 0, \quad (2)$$

where j represents the different discrete choices, with $j = 0$ representing no change to rates in that period, $j = 1$ a decrease to rates, and $j = 2$ an increase to rates. X_j represents a vector of independent political, institutional, and economic variables, and β_j is the vector of estimated coefficients specific to the discrete choice j . Equation (2) represents the normalization of the most common outcome, $j = 0$, which acts as the comparison group so that coefficients can be compared to the decision to not change rates at all.

4.3 Independent Variables

4.3.1 Regulator Experience and Agency Resources. We created two variables to test the impact of experience and agency resources on PUC decisions. *Average Commissioner Tenure*, which varies each year, is equal to the sum of each commissioner's tenure to date in years divided by the total number of commissioners on the PUC. This provides a proxy for overall PUC commissioner experience. The measure of agency resources, *PUC Staff*, is the number of the commission's professional and administrative staff per thousand state population. Information on PUC commissioner names and staffing was gathered from annual volumes of the *Book of the States*, annual reports of the *National Association of Regulatory Utility Commissioners*, and PUC Web sites.

4.3.2 Other Agency Information. We created several variables to assess whether rulings by other administrative agencies affected PUC rate decisions. First, since approximately 25% of utilities operate in multiple states we constructed two measures of rate decisions in other states. The rulings of other commissions are publicly available legal documents and can provide valuable information to a focal PUC on the operations of a particular utility. *Other State Rate Increases* and *Other State Rate Decreases* are the cumulative dollar values of increases and decreases in a utility's affiliated state operations, respectively, over the prior 3 years. We assume that larger rate changes will generally be supported by greater amounts of evidence. Second, in order to measure management quality we use a novel data set from the NRC that records civil penalties levied on utilities for noncompliant behavior. Using these data, published annually as part of the NRC's Annual Report, we generated *NRC Penalty* which equals one in the year that a utility receives a penalty and the 2-year period afterwards (reflecting a reputational effect) and zero otherwise.

We interacted this variable with a dummy variable for utilities with nuclear generating capacity to identify the impact of NRC penalties specifically for these firms.

4.3.3 Interest Group Opposition. Four variables capture different sources of interest group competition that utilities may encounter in policy arenas. *Consumer Advocate* is a dummy variable that indicates whether a state-funded utility consumer advocate existed in a particular state-year. During the 1970s and 1980s, a number of states created consumer advocacy offices to explicitly represent utility consumers before PUCs during rate reviews (Holburn and Vanden Bergh 2006). *Urbanization*, measured as the urban percentage of the state population, also acts as a proxy for the level of residential consumer lobbying. One might expect that the problems of collective action are differentially overcome in more densely populated areas. Relatedly, *Industrial Sales*, constructed using data from the Federal Energy Regulatory Commission, measures the proportion of the utility's sales to industrial or commercial consumers. This captures the dependence of the utility on larger customers who are more likely to be mindful of energy costs and engaged in the regulatory process. Finally, *Sierra Club Membership* is a count of the state membership per capita in the Sierra Club, the largest environmental lobbying organization in the United States. This variable captures the extent to which state populations participate in environmental and other nongovernmental activist organizations (Lyon and Kim 2006). Such groups have historically been particularly active against utilities regarding the siting of new power generation plants and the environmental impact of existing facilities. Annual information on state membership was provided directly to us by the Sierra Club. We expect that vigorous interest group opposition presents obstacles to potential utility rate increases by providing evidence to support their case in rate hearings, hence raising regulator decision costs of adopting a different position.

4.3.4 Political Rivalry. Two variables, *Legislature Rivalry* and *Governor Rivalry*, account for the degree of political competition within a state. For the former, we construct the following statistic using data on party seats obtained in the most recent state legislature election:

Legislature Rivalry

$$= 1 - \frac{(\text{Majority party seats in Legislature} - \text{Minority party seats in Legislature})}{\text{Total seats in Legislature}}$$

We constructed a similar variable for *Governor Rivalry* based on the number of votes cast for the winning and second placed candidates in the prior gubernatorial election. Higher values on each of these measures (maximum value equals one) reflect a slimmer overall majority by the dominant party.¹⁰

10. Although swings in the degree of rivalry between political parties can be a slow-moving process, states such as Alabama and South Carolina moved from unanimous Democrat controlled legislatures in the 1980s to almost a 50/50 split between parties by the mid 1990s.

4.3.5 Controls. We include a number of other variables that could motivate the PUC or utility to initiate a rate review. Consistent with the interest group hypothesis, we incorporate a measure of a utility's political strength within a state, *Utility's Share of Total Electricity Sales within State*. Using data on electricity sales in megawatt hours from the Energy Information Administration, this variable measures the percentage of a state's electricity that is sold by the focal utility. We propose that more dominant utilities, reflecting a more concentrated utility sector, will be better able to organize against opposing interest groups and to lobby in political and regulatory arenas for favorable policy decisions.

A utility's cost of capital is a central component in the PUC's calculations of an appropriate allowed rate of return. *Change in Interest Rate* measures the percentage point difference between the interest rate on the US 10-year Treasury Bill for a particular year minus the interest rate at the time of the last rate review for the utility.¹¹ Similarly, we include a measure of the change in the utility's fuel cost which represents a major input in the generation of electricity. *Change in Fuel Cost* represents the percentage change in a utility's annual dollar expenditures on fuel since its last rate review. Utility-level fuel cost data are available from annual Form 1 disclosure filings made to the Federal Energy Regulatory Commission. The total annual dollar amount spent by a utility on fuel was also included as a separate variable, *Fuel Cost*; utilities with higher fuel costs may face differential pressures to moderate rate increases. Utilities also tend to seek rate increases after making large-scale investments, such as the construction or acquisition of new generating units. *Change in Net Utility Plant* measures the percentage change in the book value of assets since the last rate review. However, since utility investment may be endogenous to our model (causally correlated with included regressors or the error term), we substituted *Change in Net Utility Plant* with an instrumental variable in one of our specifications.¹²

We include a further set of measures that consider rate rulings that have been made for other utilities that operate within a focal state. *Other Utility Rate Increases* and *Other Utility Rate Decreases* are measured as the dollar value of rate increases and decreases, respectively, from rate reviews over the last 3 years for utilities in the same state other than the focal utility. Commissions

11. To avoid losing observations when constructing this variable, we collected data on the utility's last rate review before 1980 and used the Treasury Bill rate at that time when calculating this measure. We applied the same approach in calculating *Change in Fuel Cost* and *Change in Net Utility Plant*.

12. We applied a two-stage least squares instrumental variable approach to control for the potential endogeneity bias that may result from including the *Change in Net Utility Plant* variable in our model. As changes to both regulated rates and a utility's asset base may be jointly determined by factors outside our model, such as the growth in demand for electricity, we used the 5-year state population growth rate as an instrument. In the first-stage regression, the estimated coefficient on this variable was signed positively, as expected, and statistically significant at the 1% level. The *F* statistic testing the hypothesis that coefficients on the instrument are jointly zero was very high (128.63), suggesting that the instrument is valid.

may accrue new knowledge from the rate reviews of other utilities and apply this information concerning costs or demand to the case of a utility operating in the same institutional environment.

State electricity market or corporate utility restructuring may also be correlated with the incidence of rate changes. Legislatures have frequently frozen retail rates as part of deregulation laws, limiting (though not completely eliminating) the ability of utilities to initiate rate reviews. We thus include *Deregulation* as a dummy variable equal to one in years when a state has enacted wholesale or retail electricity market deregulation reforms. Another dummy variable, *Merger and Acquisition*, is equal to one in years that a utility undertook corporate restructuring through merger or acquisition with another utility.

We control for both firm- and state-specific (and time-invariant) characteristics by including a series of dummy variables in our specifications.¹³ Similarly, we include a dummy variable, *1990s Decade*, which is equal to one for observations from 1990 to 2000 to capture the temporal trend differences in the incidence of rate increases and decreases as noted above between the 1980s and 1990s.

Descriptive statistics and sources for all variables are presented in Table 2.

5. Results

5.1 Electric Utility Rate Changes

We present multinomial logit model coefficient estimates and robust standard errors in Table 3. Model 1 includes the full set of independent and control variables. Model 2 differs only with the substitution of the instrumental variable for *Change in Net Utility Plant*. Each model has a pseudo R-squared value of approximately 0.27, implying that the specifications provide a relatively good explanatory fit to the data. We focus our discussion below on the coefficients estimated in Model 2 given our theoretical preference for the instrumental variable. We note, however, that the pattern of statistical significance on the coefficient estimates is very similar across the two models.

One potential concern in panel data is the existence of serial correlation between the error terms which leads to underestimation of standard errors. Following the approach of Wooldridge (2002) and Drukker (2003), we implemented a Wald test on each model; nonsignificant *F* statistics strongly suggested that the idiosyncratic errors are serially uncorrelated. A Hausman-McFadden test also rejected the alternative hypothesis of dependence between alternative choices which would generate biased coefficient estimates in multinomial models (Hausman and McFadden 1984).

Whereas standard errors can identify variables of statistical significance, we calculate marginal effects estimated for Model 2 (reported in Table 4) which quantify the magnitude of the impact on the predicted probability of rate

13. By including state fixed effects, we are unable to include state-level variables that do not change over time in our sample time period.

Table 2. Variable Descriptions, Sources and Summary Statistics

Variable	Description	Mean	SD	Minimum	Maximum
Average Commissioner Tenure ^a	Average years of experience in office of state PUC commissioners	3.906	2.798	0	21.333
PUC Staff ^a	Full-time employees at the PUC per thousand state capita	0.039	0.044	0.003	0.338
Other State Rate Increase ^b	Value of rate increases allowed to affiliated utilities in other states in the past 3 years (\$ millions)	24.274	81.757	0	784
Other State Rate Decrease ^b	Value of rate decreases allowed to affiliated utilities in other states in the past 3 years (\$ millions)	5.643	33.084	0	360.7
Nuclear Generator ^c	Dummy variable = 1 if the utility has nuclear generation capacity	0.416	0.493	0	1
NRC Penalty × Nuclear ^d	Dummy variable = 1 if a utility had been levied a civil penalty in excess of \$50,000 in the past 3 years from the NRC and had nuclear generating capacity	0.146	0.353	0	1
Utility Share of Total Electricity Sales within State ^e	Percentage of the state's total electricity (in megawatt hours) sold by a utility	0.270	0.255	0.003	1
Consumer Advocate ^f	Dummy variable = 1 if state has a legislated consumer advocate	0.600	0.489	0	1
Industrial Sales ^c	Electric utility sales to industrial and commercial consumers as a percentage of total utility revenue	0.639	0.080	0.399	0.902
Sierra Club Membership ^g	State membership of the Sierra Club per thousand capita	1.596	1.092	0.285	8.477
Urbanization ^h	Percentage of state population in urban centers	0.697	0.139	0.322	0.944
Legislature Party Competition ^a	One minus percentage of seat majority of dominant party in state legislature in last election	0.718	0.229	0.057	1
Governor Competition ^a	One minus percentage margin of victory by state governor in last election	0.837	0.135	0.338	0.999
Change in Interest Rate ^h	Percentage point change in interest rate on the US 10-year Treasury Bill since the utility's last rate review	-0.859	2.427	-8.66	7.71

Continued

Table 2. *Continued*

Variable	Description	Mean	SD	Minimum	Maximum
Change in Fuel Cost ^c	Percentage change in the utility's total fuel cost since the last rate review	0.313	9.552	-1.003	573.79
Change in Net Utility Plant ^c	Percentage change in the book value of a utility's net plant assets since its last rate review	0.169	0.544	-0.877	17.347
Fuel Cost ^c	Value of electric utility fuel cost (\$100 million)	2.336	2.604	0	23.249
Election Year ^a	Dummy variable = 1 in years of state legislature or gubernatorial elections	0.474	0.499	0	1
Deregulation ⁱ	Dummy variable = 1 in years of electricity market deregulation	0.023	0.148	0	1
Merger and Acquisition ^c	Dummy variable = 1 in years that utility engaged in either corporate merger or acquisition	0.049	0.217	0	1
Other Utility Rate Increase ^b	Value of rate increases allowed to other utilities in the same state over the past 3 years (\$ millions)	172.784	295.02	0	1845.6
Other Utility Rate Decrease ^b	Value of rate decreases allowed to other utilities in the same state over the past 3 years (\$ millions)	20.065	58.035	0	716.8
1990s Decade	Dummy variable = 1 in years 1990-2000	0.514	0.499	0	1

^aBook of the States, various years.

^bRegulatory Research Associates rate case report (2001) and the NARUC Annual Report on Utility and Carrier Regulation, various years.

^cFERC Form 1 database and Financial Statistics of Selected Investor-Owned Electric Utilities, various years.

^dAnnual Report of the NRC, various years.

^eEnergy Information Administration Form EIA-861.

^fHolburn and Vanden Bergh (2006).

^gSierra Club National Headquarters.

^hBureau of Economic Analysis.

ⁱStatus of State Electric Industry Restructuring Activity, US Department of Energy.

Table 3. Multinomial Logit Model of Electric Utility Rate Changes, 1980–2000

DV = rate change ($j = 0, 1, 2$)	Model 1		Model 2 (IV)	
	Rate increase ($j = 1$)	Rate decrease ($j = 2$)	Rate increase ($j = 1$)	Rate decrease ($j = 2$)
Average Commissioner Tenure (Hypothesis 1)	-0.0545** (0.0279)	0.1247*** (0.0488)	-0.0494** (0.0276)	0.1216*** (0.0486)
PUC Staff (Hypothesis 1)	2.4651 (2.7967)	5.2013* (3.1781)	3.3425 (2.9233)	5.8595** (3.2256)
NRC Penalty \times Nuclear (Hypothesis 2)	-0.3263** (0.1931)	0.5776 (0.3785)	-0.3229** (0.1927)	0.5388 (0.3766)
Nuclear Generator (Hypothesis 2)	-0.1368 (0.2367)	-0.1409 (0.4445)	-0.2686 (0.2296)	-0.1595 (0.4586)
Other State Rate Increase (Hypothesis 2)	0.0026** (0.0007)	-0.0024 (0.0025)	0.0024** (0.0007)	-0.0025 (0.0024)
Other State Rate Decrease (Hypothesis 2)	-0.0020 (0.0059)	0.0054** (0.0028)	-0.0030 (0.0061)	0.0049** (0.0027)
Utility Share of Total Electricity Sales within State	1.5804 (1.7912)	5.4689 (7.5023)	3.7605** (2.0017)	7.7639 (6.8942)
Consumer Advocate (Hypothesis 3)	-0.7100*** (0.2863)	1.2667 (0.8131)	-0.6149** (0.2851)	1.2175 (0.8036)
Sierra Club Membership (Hypothesis 3)	-0.2971** (0.1664)	0.1799 (0.2200)	-0.3250** (0.1746)	0.1714 (0.2209)
Urbanization (Hypothesis 3)	-0.3637 (4.4998)	9.5943 (7.4446)	-0.8435 (4.4139)	9.2248 (7.3384)
Industrial Sales (Hypothesis 3)	-8.5266*** (2.6000)	10.8962** (5.8319)	-8.2267*** (2.5872)	10.7493** (5.7784)
Legislature Party Competition (Hypothesis 4)	-2.2476*** (0.4704)	1.5530 (1.0377)	-2.0723*** (0.4618)	1.5728 (1.0232)
Governor Competition (Hypothesis 4)	-0.0767 (0.3851)	0.7290 (0.7677)	0.0204 (0.3801)	0.8093 (0.7783)
Change in Interest Rate	0.1218*** (0.0250)	-0.3347*** (0.0668)	0.1092*** (0.0254)	-0.3468*** (0.0665)
Change in Fuel Cost	0.0069** (0.0041)	-0.3925** (0.2171)	0.0559 (0.0623)	-0.3333* (0.2061)
Change in Net Utility Plant	0.8321*** (0.2712)	0.8033 (0.5679)	3.0566*** (0.8199)	1.9006 (1.4934)
Deregulation	-1.4566** (0.7671)	0.9341** (0.4186)	-1.5367** (0.7690)	0.9353** (0.4140)
Election Year	0.0534 (0.0945)	0.0952 (0.1675)	0.0581 (0.0944)	0.0994 (0.1673)
Merger and Acquisition	-0.3799 (0.3135)	-0.0167 (0.3700)	-0.4313 (0.3078)	-0.0225 (0.3691)
Other Utility Rate Increase	0.0016*** (0.0003)	-0.0015** (0.0007)	0.0016*** (0.0003)	-0.0015** (0.0007)
Other Utility Rate Decrease	-0.0042** (0.0019)	0.0047*** (0.0016)	-0.0049*** (0.0020)	0.0045*** (0.0016)
Fuel Cost	-0.1173** (0.0524)	-0.0801 (0.1298)	-0.0898** (0.0517)	-0.0577 (0.1230)
1990s Decade	-0.5131*** (0.1526)	-0.8137*** (0.2628)	-0.5631*** (0.1550)	-0.8639*** (0.2707)

Continued

Table 3. *Continued*

DV = rate change ($j = 0, 1, 2$)	Model 1		Model 2 (IV)	
	Rate increase ($j = 1$)	Rate decrease ($j = 2$)	Rate increase ($j = 1$)	Rate decrease ($j = 2$)
Constant	4.9786 (3.4849)	-49.8284*** (8.0394)	7.2104** (4.3291)	-24.4750*** (8.0683)
State fixed effects		Yes		Yes
Utility fixed effects		Yes		Yes
Observations		3642		3642
Pseudo R-squared		0.269		0.265
Log likelihood		-2020.945		-2030.642

Robust standard errors in parentheses. Significant at * $p < 0.1$ (one-tailed), ** $p < 0.05$ (one-tailed), *** $p < 0.01$ (one-tailed).

Table 4. Estimated Change in Predicted Probability of Rate Increase or Rate Decrease

Independent variables	ΔPr (Rate increase)		ΔPr (Rate decrease)	
	Mean + 1SD	Minimum to Maximum	Mean + 1SD	Minimum to Maximum
Average Commissioner Tenure	-0.023	-0.160	0.019	0.172
PUC Staff	ns		0.012	0.092
NRC Penalty \times Nuclear dummy	na	-0.051	na	na
Other State Rate Increase	0.031	0.318	ns	
Other State Rate Decrease	ns		0.012	0.126
Utility Share of Total Electricity Sales within State	0.101	0.311	ns	
Consumer Advocate	na	-0.102	na	na
Sierra Club Membership	-0.049	-0.271	ns	
Industrial Sales	-0.092	-0.544	0.059	0.289
Legislature Party Competition	-0.066	-0.306	ns	
Change in Interest Rate	0.048	0.300	-0.037	-0.268
Change in Net Utility Plant	0.053	0.402	ns	

ns, nonsignificant; na, not applicable.

increases or decreases. Marginal effects have been calculated at the means of continuous variables and at zero for discrete variables.

Beginning with the main variables of interest, we find strong support for our first hypothesis regarding the impact of regulatory resources on rate decisions. The coefficients on *Average Commissioner Tenure* are signed as expected and statistically significant at the 5% level or less for the rate decrease and rate increase components of the multinomial logit.¹⁴ The magnitudes of the effects are not trivial: increasing the value of this variable by one standard deviation from its mean decreases the probability of a rate increase in any year by 2.3% and increases the probability of a rate decrease by 1.9%. Raising similarly the number of *PUC Staff* relative to the state population is also estimated to increase the likelihood of a rate decrease by 1.2% (the coefficient on the rate increase component is not statistically significant). Greater regulatory agency experience and financial resources thus appear to exert downward pressure on utility rates, consistent with our argument that these factors reduce agency decision and evidentiary costs.

The results also provide support for the hypothesized impact of other agency decisions (Hypothesis 2): the estimated coefficients on *Other State Rate Increases* and *Other State Rate Decreases* are statistically significant for, respectively, the increase and decrease components of the multinomial logit model. That is, the value of prior recent rate changes in other jurisdictions is correlated with similar rate changes in the focal state. A standard deviation increase in each of these variables raises the probability of a similar rate change in any year by approximately 3.1% and 1.2%, respectively. Some caution is warranted here, however, in our interpretation of this result since we do

14. We use one-tailed tests since these are appropriate for one-sided hypotheses.

not observe the underlying mechanism. One interpretation may be that other PUC rate rulings provide political legitimacy, or credibility, to the PUC in its own decisions, thereby facilitating similar rate changes. We leave exploration of this alternative hypothesis for future work.

A history of NRC penalties is also found to affect PUC rate decisions by decreasing the likelihood of a rate increase for utilities with nuclear capacity, though there is no statistically significant effect on the probability of a rate decrease.

Consistent with our expectations regarding the asymmetric impact of interest group opposition on utility rate changes (Hypothesis 3), we find that organized consumer and environmental groups tend to limit the incidence of rate increases but generally do not increase the incidence of rate decreases. The coefficient estimates for *Consumer Advocate* and *Sierra Club Membership* are negatively signed and statistically significant at the 5% level for rate increases but are not significant for rate decreases. Again, the estimated magnitude of the impact is not small: the likelihood of a PUC awarding a rate increase to a utility is reduced by 10.2% in a state with an independent utility consumer advocacy office. Increasing *Sierra Club Membership* by one standard deviation from its mean is associated with a 4.9% reduction in the probability of a rate increase. Industrial consumers, however, appear to be tougher opponents for utilities. Utilities that sell a greater proportion of their output to industry witness fewer rate increases *and* more rate decreases (the coefficient estimates for *Industrial Sales* are statistically significant at the 5% or 1% levels for both the rate increase and decrease components of the multinomial logit). Increasing the value of *Industrial Sales* by one standard deviation from its mean increases the chance of a rate decrease by 5.9% and reduces the chance of a rate increase by 9.2%. The substantial and symmetric impact of industry on rate changes may be explained by their relative energy intensity as well as by their greater access to financial resources—which facilitate greater levels of organization, monitoring of utility costs, and regulatory hearing participation.

Our results suggest as well that, in addition to interest group competition, PUC rate decisions respond to political pressures (Hypothesis 4). One such source is the state legislature: the coefficient on *Legislature Rivalry* is negative and statistically significant at the 1% level for rate increases. The impact of political party competition within the state senate and house on the incidence of utility rate increases is quite substantial. A one standard deviation increase in the value of our measure of political competition from its mean reduces the annual likelihood of a rate increase by 6.6%. State legislators thus appear to weigh consumer rather than utility interests more heavily in competitive political environments. As with interest group competition, we find too that the effect of political competition is asymmetric across rate increases and decreases: the coefficient on *Legislature Rivalry* is statistically insignificant for rate decreases. By contrast, we do not find that party competition for the state governor's office influences PUC decisions to change utility rates (the coefficient estimates on *Governor Rivalry* are not statistically significant).

Finally, we note that many of the control variables have correctly signed coefficients and are statistically significant, giving us greater confidence in our specification. The estimated coefficients on *Change in Interest Rate* are statistically significant at the 1% level for both the rate increase and decrease equations and are signed as expected. Increasing the change in interest rate since the last rate review by one standard deviation from the sample mean value increases the likelihood of a rate increase by 4.8% and reduces the likelihood of a rate decrease by 3.7%. Increases in the value of a utility's assets are also associated with more frequent rate increases, though there is no assessed impact on the frequency of rate decreases. Similarly, utilities that hold a greater share of total state sales of electricity are much more likely to experience a rate increase (statistically significant at 5%).

Periods of deregulation are associated with fewer rate increases and more rate decreases, perhaps reflecting broader political motivations to reduce electricity costs through legislated or regulatory mechanisms. Interestingly, changes in fuel costs and corporate mergers and acquisitions are not correlated empirically with changes to rates. This may be due to the implementation of automatic fuel adjustment clauses in many states that enable rates to change outside the scope of normal rate reviews. Corporate restructuring has generally occurred only recently, coincident with deregulation and legislated rate freezes in a number of states. Rate changes across utilities within the same state tend to be highly correlated (the coefficients on *Other Utility Rate Increases* and *Decreases* are statistically significant at the 5% or 1% levels), however, possibly reflecting the influence of common economic and political conditions within a particular state-level jurisdiction.

5.2 Alternative Interpretations of Empirical Results

A shortcoming of our research design, which limits our ability to draw firmer conclusions, is that we do not directly observe the state of regulatory information asymmetries or of agency decision costs. This leaves open the possibility of alternative explanations for the underlying cause of the observed statistical correlation between commissioner experience and regulated rate changes. One competing alternative is that with longer time in office, regulatory commissioners become more susceptible to organized capture by consumer groups (Peltzman 1976). We are able to test this alternative interpretation by introducing interaction terms into our empirical model. In Table 5, we report two models which include, separately, an interaction between *Average Commissioner Tenure* and *Industrial Sales* and between *Average Commissioner Tenure* and *Utility's Share of Total Electricity Sales within State*.

Under the consumer capture hypothesis, we would expect a greater impact of increasing *Industrial Sales* on the probability of rate decreases as *Average Commissioner Tenure* increases (and a lower impact on the probability of a rate increase): more organized industrial consumers should be better able to achieve favorable rate changes the longer that PUC commissioners have been

Table 5. Interaction Models

DV = rate change ($j = 0, 1, 2$)	Model 3		Model 4	
	Rate increase ($j = 1$)	Rate decrease ($j = 2$)	Rate increase ($j = 1$)	Rate decrease ($j = 2$)
Commission Tenure × Industrial Sales	0.3358 (0.3579)	-1.0606 (0.6663)		
Commission Tenure × Utility Sales			-0.0194 (0.1118)	0.1424 (0.2094)
Average Commissioner Tenure (Hypothesis 1)	-0.2638 (0.2293)	0.7992** (0.4305)	-0.0429 (0.0447)	0.0705 (0.0848)
PUC Staff (Hypothesis 1)	3.4339 (2.8962)	5.6368** (3.2922)	3.3248 (2.9302)	5.9516** (3.2173)
NRC Penalty × Nuclear (Hypothesis 2)	-0.3291** (0.1930)	0.5572 (0.3809)	-0.3205** (0.1933)	0.5523 (0.3781)
Nuclear Generator (Hypothesis 2)	-0.2745 (0.2297)	-0.1232 (0.4663)	-0.2655 (0.2311)	-0.1603 (0.4563)
Other State Rate Increase (Hypothesis 2)	0.0024*** (0.0007)	-0.0029 (0.0026)	0.0024*** (0.0007)	-0.0026 (0.0025)
Other State Rate Decrease (Hypothesis 2)	-0.0031 (0.0061)	0.0049** (0.0027)	-0.0030 (0.0061)	0.0049** (0.0027)
Utility Share of Total Electricity	3.8122** (1.9966)	7.6976 (6.8505)	3.8468** (2.0773)	6.9619 (7.0306)
Sales within State				
Consumer Advocate (Hypothesis 3)	-0.6104** (0.2851)	1.1721 (0.8116)	-0.6151** (0.2851)	1.2211 (0.8063)
Sierra Club Membership (Hypothesis 3)	-0.3131** (0.1751)	0.1606 (0.2197)	-0.3242** (0.1745)	0.1819 (0.2235)
Urbanization (Hypothesis 3)	-0.9830 (4.4086)	9.3536 (7.3061)	-0.7956 (4.4138)	9.3126 (7.3337)
Industrial Sales (Hypothesis 3)	-9.2571*** (2.8214)	14.7901*** (6.2199)	-8.2256*** (2.5857)	10.8897*** (5.7791)
Legislature Party Competition (Hypothesis 4)	-2.0508*** (0.4623)	1.4276 (1.0397)	-2.0768*** (0.4622)	1.6207 (1.0296)
Governor Competition (Hypothesis 4)	0.0285 (0.3798)	0.7342 (0.7811)	0.0208 (0.3803)	0.8303 (0.7795)
Change in Interest Rate	0.1088*** (0.0254)	-0.3500*** (0.0666)	0.1095*** (0.0255)	-0.3488*** (0.0668)
Change in Fuel Cost	0.0568 (0.0628)	-0.3333* (0.2047)	0.0560 (0.0624)	-0.3386* (0.2061)
Change in Net Utility Plant	3.0879*** (0.8199)	1.6257 (1.5030)	3.0488*** (0.8197)	1.9592 (1.5120)
Deregulation	-1.5327** (0.7701)	0.9259** (0.4202)	-1.5343** (0.7690)	0.9341** (0.4127)
Election Year	0.0587 (0.0944)	0.1047 (0.1670)	0.0575 (0.0946)	0.1014 (0.1675)
Merger and Acquisition	-0.4315 (0.3067)	-0.0183 (0.3658)	-0.4300 (0.3078)	-0.0260 (0.3675)
Other Utility Rate Increase	0.0016*** (0.0003)	-0.0015** (0.0007)	0.0016*** (0.0003)	-0.0015** (0.0007)

Continued

Table 5. *Continued*

DV = rate change ($j = 0, 1, 2$)	Model 3		Model 4	
	Rate increase ($j = 1$)	Rate decrease ($j = 2$)	Rate increase ($j = 1$)	Rate decrease ($j = 2$)
Other Utility Rate Decrease	-0.0050*** (0.0021)	0.0043*** (0.0016)	-0.0049*** (0.0020)	0.0045*** (0.0016)
Fuel Cost	-0.0922** (0.0518)	-0.0602 (0.1198)	-0.0895** (0.0517)	-0.0617 (0.1242)
1990s Decade	-0.5742*** (0.1562)	-0.8440*** (0.2709)	-0.5633*** (0.1549)	-0.8740*** (0.2717)
Constant	7.9233** (4.3997)	-26.9076*** (8.1899)	2.4755 (3.4778)	-52.026*** (6.3914)
State fixed effects		Yes		Yes
Utility fixed effects		Yes		Yes
Observations		3642		3642
Pseudo R-squared		0.266		0.266
Log likelihood		-2029.08		-2030.39

Robust standard errors in parentheses. Significant at * $p < 0.1$ (one-tailed), ** $p < 0.05$ (one-tailed), *** $p < 0.01$ (one-tailed).

in office. The inverse of this relationship would be expected when including the *Utility's Share of Total Electricity Sales within State* in the interaction with *Average Commissioner Tenure*, which would be consistent with Stigler's regulated utility capture hypothesis.

Interpreting the coefficients of interaction variables in nonlinear models, such as the multinomial logit, presents particular challenges. Ai and Norton (2003) have illustrated how neither the sign of the coefficient nor the standard errors of the estimate can provide direct information about the direction of the effect or its statistical significance. As a result, we rely on a stochastic simulation technique that allows us to identify the conditional effect of an interaction term by focusing on changes to predicted probabilities (King et al. 2000; Zelner 2009).¹⁵ In addition, this approach provides confidence intervals that identify statistical significance at varying ranges of the explanatory variables.

In order to facilitate interpretation of the coefficients, we illustrate the effects graphically in Figures 2 and 3 by estimating the changes to the predicted probability that a PUC implements a rate increase or decrease. The x axis depicts the range of the data for the measure of either *Industrial Sales* (Figure 2) or *Utility's Share of Total Electricity Sales within State* (Figure 3). The y axis presents the percentage change in probability that a PUC implements a rate increase (decrease) when the *Average Commissioner Tenure* variable increases by one standard deviation from its mean.¹⁶ Statistical significance is represented by the bars that identify 95% confidence intervals. The effect is significant at the 5% level where the bars do not cross zero (represented by a horizontal line).

In Figure 2, we observe a negative slope in the first panel which demonstrates that as industrial sales increase (representing stronger consumer pressure on the agency), the impact of increasing commissioner experience on the likelihood of a rate reduction *decreases*. This negative correlation is statistically significant at low to mid value ranges of the *Industrial Sales* variable.

15. This approach uses Monte Carlo simulation to provide a more precise depiction of the probability distribution by using the parameter estimates and variance-covariance matrix of the model to make 1000 random draws of estimates from a multivariate normal distribution. The simulated distribution is then used to estimate the predicted probability of a rate increase or decrease at specified values of the covariates. Changes to predicted probabilities are then easily computed by finding the difference in predicted probabilities as discrete changes are made to these covariates. The logic of this procedure is analogous to a survey-based approach that is able to improve the accuracy of its estimate of a population by increasing sample size. However, in this case the focus is on the probability distribution, which when properly accounted for in nonlinear models improves statistical interpretation. This approach to the interpretation is preferable to the analytical delta method which is technically demanding and can lead to biased results if the Taylor series is not approximated beyond the second order (King et al. 2000). For other empirical analyses that have adopted this technique, see Balla (2000), Krause and Bowman (2005), Epstein et al. (2006), and Holburn and Zelner (2010).

16. This is the difference in the probability that a PUC implements a rate increase (decrease) when the *Average Commissioner Tenure* variable is set one standard deviation above its mean ($x = 6.704$) from the probability when the *Average Commissioner Tenure* variable is set at its mean ($x = 3.906$).

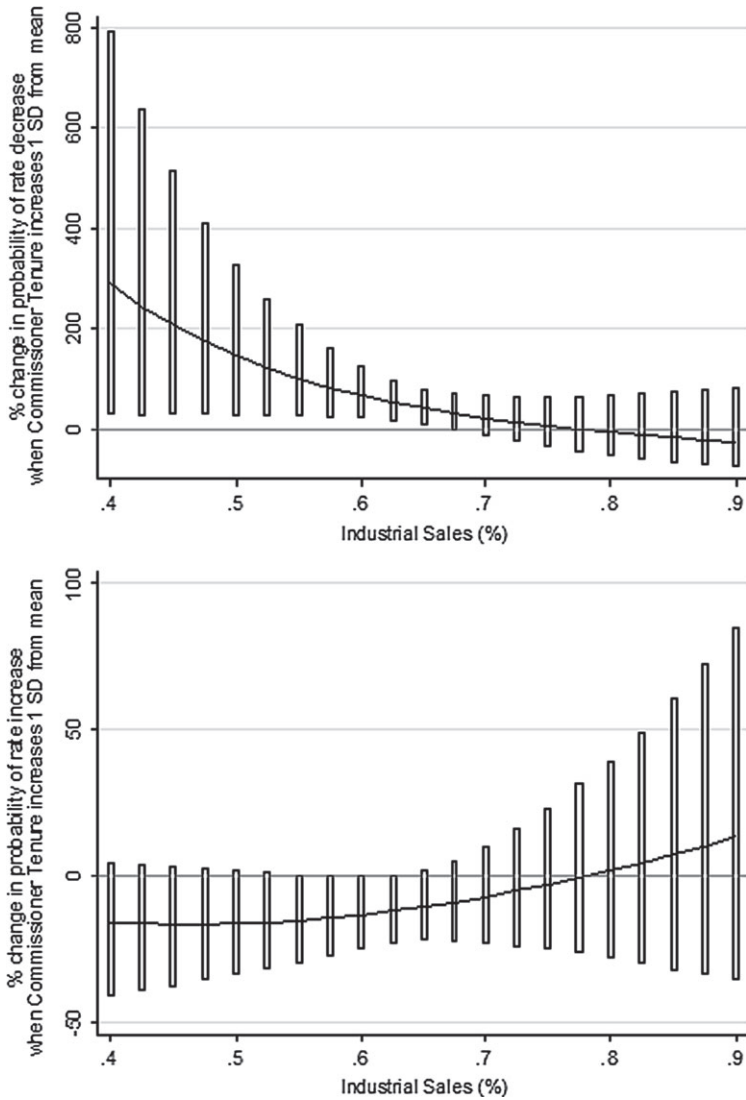


Figure 2. Interaction between *Average Commissioner Tenure* and *Industrial Sales*.

This pattern is not consistent with the consumer capture hypothesis, which would be supported by a positive slope: we would expect more experienced commissioners to be more “captured” when industrial consumers are stronger and hence to increase their incidence of rate reductions. Instead, our interpretation is that commissioner experience and industrial consumer monitoring of the utility each provides partially substitutable informational benefits to the regulatory agency: as either one increases, thereby improving agency information about utility earnings, the marginal benefit of the other decreases. In other

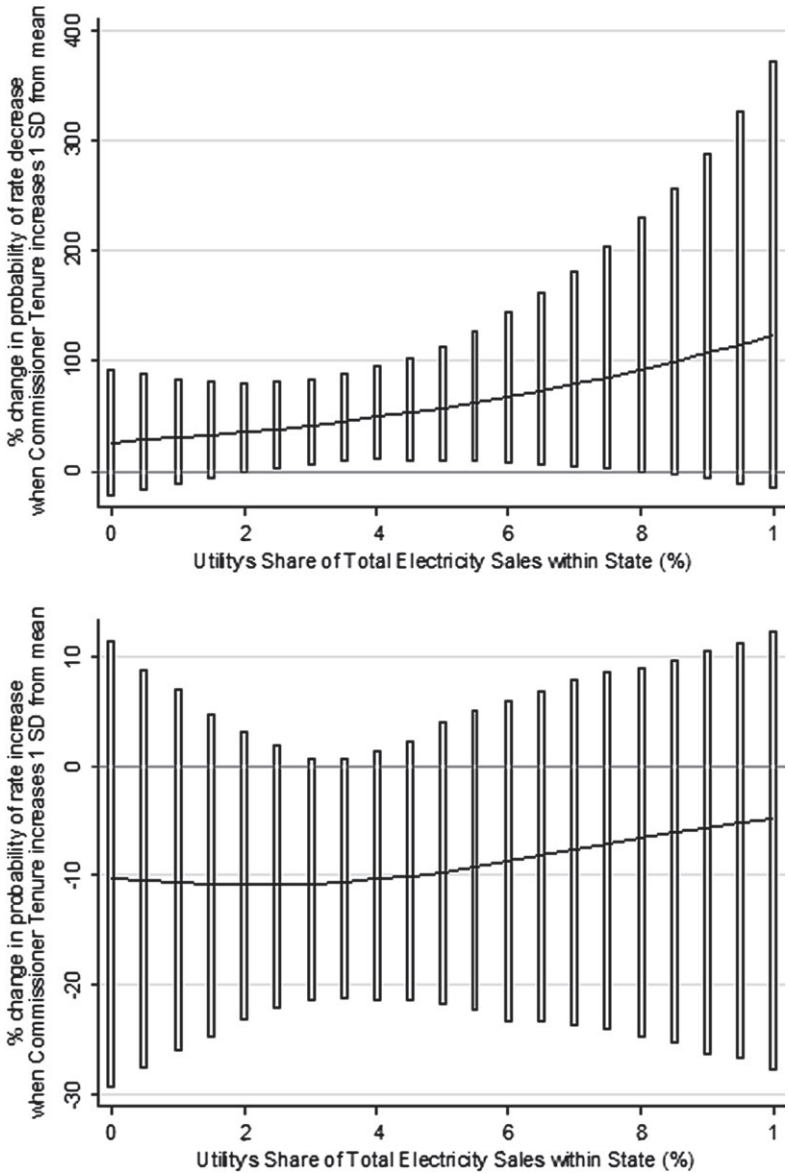


Figure 3. Interaction between *Average Commissioner Tenure* and *Utility Share of Total Electricity Sales within State*.

words, the benefits (e.g., identifying situations when a rate reduction is justified) of a highly organized industrial consumer advocacy group to a very experienced regulatory commission are less than to a newly appointed commission that has much to learn about the utilities it regulates. We note

that the interaction results are statistically insignificant at all values of the *Industrial Sales* variable in the rate increase panel at the bottom of Figure 2.

In Figure 3, we apply a similar interpretation to the positive correlation in the upper panel between utility dominance and commissioner experience, which is statistically significant in the mid range of values of *Utility's Share of Total Electricity Sales within State*. When utilities have a more dominant market position, commissioner experience becomes more important in enacting rate reductions (the interactions are again insignificant for rate increases). One interpretation is that informational asymmetries are greater for relatively large utilities, or in states where there are fewer benchmark comparisons to be made among multiple utilities. In these types of environments, commissioner experience is more valuable in identifying when utilities are overearning, and hence when rate reductions may be required.

The inclusion of interaction terms in our analysis thus does not provide evidence suggesting that consumer capture is driving the tendency for more experienced commissioners to adopt more pro-consumer policies. Nonetheless, we recognize that further investigation and analyses are required to more comprehensively explore our findings.

6. Discussion

In this article we argue that due to legal burden of proof requirements governing regulatory decision making, information asymmetries between regulators and firms increase the cost to the regulator of initiating new policies or of defending existing policies against firm-initiated proposals. When regulators are less knowledgeable about the firms they regulate, they incur greater costs of collecting and assessing information, constructing logical arguments, and documenting the evidence necessary to support their policy position such that it will subsequently withstand judicial review. Such decision costs insulate policies against regulator-initiated change but make firm-induced proposals more likely. We argue further, however, that regulators are not homogenous in the degree of asymmetric information but vary in their knowledge about regulated firms. Knowledge gained tacitly through prior regulatory experience, directly from other agencies' public rulings, or from organized interest groups can all reduce information asymmetries—thereby, all else equal, facilitating regulatory policy making and/or deterring firms' proposals for change.

We find support for our hypotheses in an empirical analysis of the relationship between regulatory informational environments and changes to regulated rates for all investor-owned electric utilities during a 21-year period up to 2000. Regulatory agencies with more experienced commissioners, with larger staffs, and with the ability to observe other agencies' related rate rulings on the same utility all tended to implement more frequent rate reductions. Similarly, our results suggest that utilities behave strategically in their decisions to initiate policy reviews: they were significantly less likely to request and obtain rate increases in environments where regulatory agencies were arguably better informed, notably those agencies with more experienced commissioners and

when there was publicly available evidence from other agencies of asset mismanagement. As agency commissioners gain experience with time then, they tend to implement rate policies that increasingly favor consumer interests.

One interpretation of these empirical findings may be that they simply reflect an increasing ability of consumer interests to capture agencies over time, rather than the effect of diminishing information asymmetries on agency decisions. We incorporate a variety of measures of consumer organization to control for such influences on regulatory decisions. Indeed, our results provide new evidence on the ability of organized consumer groups to affect policy outcomes. Consistent with the Stigler-Peltzman prediction, we find that organized consumer groups do appear to have an influence on regulator decisions to change regulated rates but primarily in situations where utilities may initiate requests for rate increases. Agencies are less likely to grant rate increases, which would occur following a utility request, in states with more organized consumer representation. By contrast, consumers appear generally less successful in themselves initiating favorable policy changes (specifically rate reductions) in regulatory forums, with the exception of industrial consumers. Consumer groups thus have an uneven impact on the direction of rate changes. Similarly, we find that regulatory agencies are sensitive to political pressures originating in the legislature, primarily in their decisions to increase, rather than to decrease, utility rates. Consequently, utilities are somewhat insulated against consumer and political adversaries as long as they do not “open the gates” to the opposition by requesting a rate increase.

This pattern of interest group influence is consistent with our argument that information asymmetries between utilities and other parties present a considerable hurdle for consumer and other groups wishing to effect rate reductions: obtaining evidence of utility overearnings—which could motivate the PUC to implement a full rate review—is extremely costly. Instead, these groups exert their effect primarily through participating in reviews that consider utility requests for rate increases, during which utilities themselves reduce information asymmetries by publicly providing the evidentiary basis for their case. We also find some evidence, through our inclusion of interaction terms, that more organized consumer groups have less influence on the rate decisions of more experienced PUCs. Even though our analysis is only preliminary, further exploring the regulatory conditions under which organized interest groups shape policy decisions is likely to be a fruitful area for future research.

Our analysis contributes to two established streams of research. First, we provide some of the first empirical evidence in a large theoretical literature on the impact of information asymmetries on policy making. Whereas the majority of existing research focuses on developing normative prescriptions for optimal regulatory mechanisms, our analysis adopts a positive approach that is susceptible to empirical testing. Although we are not able to directly observe the extent of asymmetric information between regulators and firms, we have identified some observable *sources* of information, such as prior experience, which we argue are likely to be correlated with regulators’ information sets and

which we can leverage in our research design. As far as we know, this is the first study to adopt such a measurement strategy in the regulation literature.

Our second central contribution is to the long-standing debate on industry capture of regulatory institutions and how this evolves dynamically (Stigler 1971; Dal Bo 2006). Early theorists argued that, over time, regulatory agencies would become more dependent on industry for support, advice, and information and that the initial enthusiasm for publicly interested regulation would gradually wane (Bernstein 1955). Martimort (1999) formalized this approach more recently in a dynamic principal-agent model of the interactions between a regulated firm, an agency, and a political principal. Due to the repeated interactions between the regulator and the firm, and the continuous flow of information over time, the regulator gains new opportunities to extract rents from the firm, which in turn creates an incentive for the firm to collude with the regulator. In this sense, the regulator becomes captured by the industry since he hides information from the political principal and uses his discretion to obtain bribes or other rewards from the industry (such as future employment), leaving informational rents with the firm. Unfortunately, however, as one survey of the capture literature comments, “empirical evidence on the causes and consequences of capture is scarce . . . there is virtually no evidence of how (or whether) asymmetric information fosters regulatory capture” (Dal Bo 2006: 214).

Unlike the predictions of Bernstein and Martimort, we find that more experienced commissions (one proxy for asymmetric information) tend to implement more pro-consumer policies, specifically in the form of more frequent rate reductions and fewer rate increases. Larger agencies are similarly more likely to reduce utility rates. Further investigation is needed here, however. For instance, our measure of commission knowledge, based on the average of individual commissioners’ time in office, is relatively crude. Future refinements could consider the distribution of experience within a commission, allowing for the ability of inexperienced commissioners to learn from those with greater experience. Time in office is also only a rough proxy for the extent of information flows between a utility and regulatory commissioners. Institutional knowledge is additionally likely to exist within agency personnel, for instance executive directors. Nonetheless, although only preliminary and confined to a single sector, these findings suggest that reduced information asymmetries lower the ability of industry to capture regulatory policy.

The impact of interest rate changes on utility rates is also consistent with the dynamic pattern of PUC pro-consumer decision making. As interest rates decline since a utility’s last rate review, the probability of the PUC instituting a rate reduction through a rate review increases. PUCs thus do not “sit on their hands” while financing costs fall, enabling utilities to earn an unrestricted rate of return, but instead impose a ceiling. Again, this finding contrasts with prior claims that PUCs effectively operate in utility interests during periods of cost deflation by not implementing rate reductions through rate reviews. Joskow argued that during the 1970s, “[Electricity] Firms . . . have been permitted to earn virtually any rate of return that they can. . . . This regulatory process

is therefore extremely passive” (1974: 298). Since the 1980s, however, PUCs have initiated a substantial number of rate reductions. Indeed, during each year from 1996 to 2000 there were more rate reviews that resulted in reductions than in increases (see Table 1).

Even so, utilities benefit from a lower responsiveness of PUC policy making to exogenous cost reductions than to cost increases. When interest rates increase by 2.4 percentage points since the utility’s last rate review (representing one standard deviation from the sample mean), the probability of the utility achieving a rate increase increases by 4.8% points (see Table 4). When interest rates fall by the same amount, however, the probability of a PUC implementing a rate decrease increases by only 3.7% points. Utilities thus appear quick to request rate relief after costs rise, whereas PUCs are slower to cut rates after costs decrease. Such asymmetric behavior need not reflect industry capture of regulatory agencies. Rate reviews tend to be resource-intensive administrative processes; PUCs, which operate under fixed budgets (determined through the political budgeting process), simply may not have the available resources to undertake additional rate reviews even if they suspect that utility costs have fallen.

One corollary is that true utility earned rates of return should depend in part on whether uncontrollable costs are rising or falling. During periods of exogenous cost increases—such as due to fuel price changes or unusual weather patterns that affect electricity demand—utilities are exposed to downward pressure on rates of return from opposition political and interest groups when they initiate compensatory rate increase requests. On the other hand, when costs fall, utilities are protected from these downward pressures since they do not have an incentive to voluntarily initiate rate-reducing reviews. Actual earned rates of return should then be higher during periods of cost deflation than cost inflation, all else equal. We leave this avenue of research for the future.

Naturally, there are a variety of limitations in our analysis that should lead to some caution in interpreting the results. First, although we argue that asymmetric information affects policy outcomes by raising regulatory decision costs, we are not able to observe such costs in this study. Further research could develop appropriate measures and directly test the hypothesized relationship. Second, we have excluded the role of the courts from our analysis of policy-making institutions. Some scholars have argued that strategic interactions between agencies and courts may lead agencies to deliberately manipulate the extent of their decision costs (through their choice of policy-making instruments) in order to insulate rulings from future judicial override (Tiller and Spiller 1999). Incorporating an additional institutional actor, however, is beyond the scope and objectives of this study and would likely not alter our central insights. Again, this provides an avenue for future development. Despite these and other limitations, our analysis takes a step toward a more comprehensive understanding from a positive theoretical approach of the impact of information asymmetries on regulatory policy making.

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References

- Aghion, Philippe, and Jean Tirole. 1997. "Formal and Real Authority in Organizations," 105 *Journal of Political Economy* 1–29.
- Agresti, Alan. 1990. *Categorical Data Analysis*. New York: Wiley.
- Ai, Chunrong, and Edward C. Norton. 2003. "Interaction Terms in Logit and Probit Models," 80 *Economic Letters* 123–9.
- Ai, Chunrong, and David E. M. Sappington. 2002. "The Impact of State Incentive Regulation on the U.S. Telecommunication Industry," 22 *Journal of Regulatory Economics* 133–60.
- Ansolabehere, Stephen, John M. de Figueiredo, and James M. Snyder Jr. 2003. "Why Is There So Little Money in U.S. Politics?," 17 *Journal of Economic Perspectives* 105–30.
- Argote, Linda, and Dennis Epple. 1990. "Learning Curves in Manufacturing," 247 *Science* 920–4.
- Armstrong, Mark, and David E. M. Sappington. 2007. "Recent Developments in the Theory of Regulation," in M. Armstrong and R. Porter, eds., *Handbook of Industrial Organization*. Vol. 3. Amsterdam, The Netherlands: North-Holland.
- Arrow, Kenneth J. 1962. "The Economic Implications of Learning by Doing," 29 *Review of Economic Studies* 155–73.
- Balla, Steven J. 1998. "Administrative Procedures and Political Control of the Bureaucracy," 92 *American Political Science Review* 663–73.
- . 2000. "Legislative Organization and Congressional Review of Agency Regulations," 16 *Journal of Law, Economics, and Organization* 424–48.
- Baron, David P., and Roger B. Myerson. 1982. "Regulating a Monopolist with Unknown Costs," 50 *Econometrica* 911–30.
- Bawn, Kathleen. 1995. "Political Control Versus Expertise: Congressional Choices about Administrative Procedures," 89 *American Political Science Review* 62–73.
- . 1997. "Choosing Strategies to Control the Bureaucracy: Statutory Constraints, Oversight, and the Committee System," 13 *Journal of Law, Economics, and Organization* 101–26.
- Becker, Gary. 1976. "Toward a More General Theory of Regulation," 19 *Journal of Law and Economics* 245–8.
- Bendor, Jonathan, and Adam Meirowitz. 2004. "Spatial Models of Delegation," 98 *American Political Science Review* 293–310.
- Bernstein, Marver H. 1955. *Regulating Business by Independent Commission*. Princeton, NJ: Princeton University Press.
- Carpenter, Daniel P. 2004. "Protection without Capture: Product Approval by a Politically Responsive, Learning Regulator," 98 *American Political Science Review* 613–31.
- Dal Bo, Ernesto. 2006. "Regulatory Capture: A Review," 22 *Oxford Review of Economic Policy* 203–25.
- De Figueiredo, Rui J., and Geoff Edwards. 2007. "Does Private Money Buy Public Policy? Campaign Contributions and Regulatory Outcomes in Telecommunications," 16 *Journal of Economics and Management Strategy* 547–76.
- De Figueiredo, Rui J., Pablo T. Spiller, and Santiago Urbiztondo. 1999. "An Informational Perspective on Administrative Procedures," 15 *Journal of Law, Economics, and Organization* 283–305.
- De Figueiredo, Rui J., and Richard G. Vanden Bergh. 2004. "The Political Economy of State-Level Administrative Procedure Acts," 47 *Journal of Law and Economics* 569–88.
- Drukker, David. 2003. "Testing for Serial Correlation in Linear Panel-Data Models," 3 *Stata Journal* 168–77.
- Eckert, Ross D. 1981. "The Life Cycle of Regulatory Commissioners," 24 *Journal of Law and Economics* 113–20.

- Epstein, David, and Sharyn O'Halloran. 1994. "Administrative Procedures, Information, and Agency Discretion," 38 *American Journal of Political Science* 697–722.
- . 1996. "Divided Government and the Design of Administrative Procedures: A Formal Model and Empirical Test," 58 *Journal of Politics* 373–97.
- Epstein, Lee, René Lindstädt, Jeffrey Segal, and Chad Westerland. 2006. "The Changing Dynamics of Senate Voting on Supreme Court Nominees," 68 *Journal of Politics* 296–307.
- Faure-Grimaud, Antoine, and David Martimort. 2003. "Regulatory Inertia," 34 *RAND Journal of Economics* 413–37.
- Feinstein, Jonathan S. 1989. "The Safety Regulation of U.S. Nuclear Power Plants: Violations, Inspections, and Abnormal Occurrences," 97 *Journal of Political Economy* 115–54.
- Grier, Kevin B., Michael C. Munger, and Brian E. Roberts. 1994. "The Determinants of Industry Political Activity, 1978–1986," 88 *American Political Science Review* 911–26.
- Grossman, Gene M., and Elhanan Helpman. 2001. *Special Interest Politics*. Cambridge, MA: MIT Press.
- Hausman, Jerry, and Daniel McFadden. 1984. "Specification Tests for the Multinomial Logit Model," 52 *Econometrica* 1219–40.
- Holburn, Guy L. F. 2001. "Regulatory Institutions and Firm Strategy: Theory and Evidence, from the Electric Power Industry." Ph.D. dissertation, University of California, Berkeley.
- Holburn, Guy L. F., and Richard G. Vanden Bergh. 2006. "Consumer Capture of Regulatory Institutions: The Creation of Public Utility Consumer Advocates in the United States," 126 *Public Choice* 45–73.
- Holburn, Guy L. F., and Bennet A. Zelner. 2010. "Policy Risk, Political Capabilities and International Investment Strategy: Evidence from the Global Electric Power Industry," *Strategic Management Journal* (forthcoming).
- Howe, Shippen. 1985. "The Used and Useful Standard: What Should the Criteria Be?" *Public Utilities Fortnightly*, February 7.
- Huber, John D., and Charles R. Shipan. 2000. "The Costs of Control: Legislators, Agencies, and Transaction Costs," 25 *Legislative Studies Quarterly* 25–52.
- Hyman, Leonard S. 2000. *America's Electric Utilities: Past, Present and Future*. Arlington, VA: Public Utilities Reports.
- Joskow, Paul L. 1974. "Inflation and Environmental Concern: Structural Change in the Process of Public Utility Price Regulation," 17 *The Journal of Law and Economics* 291–327.
- King, Gary, Michael Tomz, and Jason Wittenberg. 2000. "Making the Most of Statistical Analyses: Improving Interpretation and Presentation," 44 *American Journal of Political Science* 341–55.
- Krause, George A., and Ann O.'M. Bowman. 2005. "Adverse Selection, Political Parties, and Policy Delegation in the American Federal System," 21 *Journal of Law, Economics, and Organization* 359–87.
- Kridel, David J., David E. M. Sappington, and Dennis L. Weisman. 1996. "The Effects of Incentive Regulation in the Telecommunications Industry: A Survey," 9 *Journal of Regulatory Economics* 269–306.
- Kwoka, John E. 2002. "Governance Alternatives and Pricing in the U.S. Electric Power Industry," 18 *Journal of Law, Economics, and Organization* 278–94.
- Laffont, J. J., and Jean Tirole. 1993. *A Theory of Incentives in Regulation and Procurement*. Boston, MA: MIT Press.
- Lesser, Jonathan A. 2002. "The Used and Useful Test: Implications for a Restructured Electric Industry," 23 *Energy Law Journal* 349–82.
- Lyon, Thomas P., and Eun-Hee Kim. 2006. "Greenhouse Gas Reductions or Greenwash?: The DOE's 1605b Program." Working Paper, University of Michigan.
- Lyon, T. P., and John W. Mayo. 2005. "Regulatory Opportunism and Investment Behavior: Evidence from the U.S. Electric Utility Industry," 36 *RAND Journal of Economics* 628–44.
- Macher, Jeffrey T., John W. Mayo, and Jackson A. Nickerson. 2009. "Regulator Heterogeneity and Endogenous Efforts to Close the Information Asymmetry Gap: Evidence from FDA Regulation." Working Paper, Georgetown University.

- Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge: Cambridge University Press.
- Martimort, David. 1999. "The Life Cycle of Regulatory Agencies: Dynamic Capture and Transaction Costs," 66 *Review of Economic Studies* 929–48.
- Mashaw, Jerry L. 1990. "Explaining Administrative Process: Normative, Positive, and Critical Stories of Legal Development," 6 *Journal of Law, Economics, and Organization* 267–98.
- McCubbins, Mathew D., Roger G. Noll, and Barry R. Weingast. 1987. "Administrative Procedures as Instruments of Political Control," 3 *Journal of Law, Economics, and Organization* 243–77.
- . 1989. "Structure and Process, Politics and Policy: Administrative Arrangements and the Political Control of Agencies," 75 *Virginia Law Review* 431–82.
- McCubbins, Mathew D., and Thomas Schwartz. 1984. "Congressional Oversight Overlooked: Police Patrols versus Fire Alarms," 28 *American Journal of Political Science* 165–79.
- McGarity, Thomas O. 1992. "Some Thoughts on 'Deossifying' the Rulemaking Process," 41 *Duke Law Journal* 1385–1462.
- Nelson, Richard R., and Sidney G. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.
- Peltzman, Sam. 1976. "Toward a More General Theory of Regulation," 19 *Journal of Law and Economics* 211–40.
- Peterson, Bercedis, and Frank E. Harrell Jr. 1990. "Partial Proportional Odds Models for Ordinal Response Variables," 39 *Applied Statistics* 205–17.
- Posner, Richard A. 1974. "Theories of Economic Regulation," 5 *Bell Journal of Economics* 335–58.
- Revesz, Richard L. 1997. "Environmental Regulation, Ideology, and the D.C. Circuit," 83 *Virginia Law Review* 1717–72.
- Shipan, Charles R. 2000. "The Legislative Design of Judicial Review," 12 *Journal of Theoretical Politics* 269–304.
- Spence, David B. 1999. "Managing Delegation Ex Ante: Using Law to Steer Administrative Agencies," 28 *Journal of Legal Studies* 413–59.
- Spiller, Pablo T. 1990. "Politicians, Interest Groups, and Regulators: A Multiple-Principals Agency Theory of Regulation, or 'Let Them Be Bribed'," 33 *Journal of Law, Economics, and Organization* 65–101.
- Pulber, Daniel F., and David Besanko. 1992. "Delegation, Commitment, and the Regulatory Mandate," 8 *Journal of Law, Economics, and Organization* 126–54.
- Stephenson, Matthew C. 2007. "Bureaucratic Decision Costs and Endogenous Agency Expertise," 23 *Journal of Law, Economics, and Organization* 469–98.
- Stigler, George J. 1971. "The Theory of Economic Regulation," 2 *Bell Journal of Economic and Management Science* 3–21.
- Studness, Charles M. 1992. "Implications of Imprudence and Deregulation for Utility Financial Policy," *Public Utilities Fortnightly*. May 1.
- Tiller, Emerson H., and Pablo T. Spiller. 1999. "Strategic Instruments: Legal Structure and Political Games in Administrative Law," 15 *Journal of Law, Economics, and Organization* 349–77.
- Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.
- Zelner, Bennet A. 2009. "Using Simulation to Interpret Results From Logit, Probit, and Other Nonlinear Models," 30 *Strategic Management Journal* 1335–448.