Bureaucratic Minimal Squawk Behavior: Theory and Evidence from Regulatory Agencies*

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Abstract

This paper argues that bureaucrats are susceptible to 'minimal squawk' behavior. I develop a simple model that shows that a desire to avoid criticism can prompt, otherwise public-spirited, bureaucrats to behave inefficiently. Decisions are taken to keep interest groups quiet and thus mistakes out of the public eye. The policy implications of this model are at odds with the received view that agencies should be structured to minimise the threat of 'capture' (pecuniary side-contracting with interest groups). I test between theories of bureaucratic behaviour using a matched panel of Public Utility Commissions and investor-owned electric utilities. The data soundly reject the capture hypothesis and are consistent with the minimal squawk hypothesis: longer terms of office *increase* the incidence of rate reviews in periods of falling input costs and, in turn, *reduce* average annual household electricity bills.

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1. Introduction

Since it promises something for nothing, improving the efficiency of the public sector ranks high on most politician's agendas. In 1993, within months of his election, Bill Clinton instigated the National Performance Review 'to bring about greater efficiency and lower costs of Government'.[1] In 1998, early in his first term, Tony Blair created the Public Services Productivity Panel to advise on ways 'to improve the productivity and efficiency of government departments and other public sector bodies'; an initiative that was strengthened upon Blair's re-election in 2001 with the creation of the Prime Minister's Office of Public Sector Reform.[2] Not to be outdone, the newly elected Leader of the Opposition, Michael Howard, is currently waging his own, very public, war on Government waste.[3]

Such efficiency drives, often referred to as the New Public Management (NPM, see World Bank 2000), have produced a wealth of reforms. Our public services are now delivered via new mechanisms (executive agencies, compulsory competitive tendering, public-private partnerships, quasi-markets). We are all better informed thanks to ubiquitous performance measures (test scores and truancy rates in the education sector, waiting times and mortality rates in the health sector, Performance Plans and Public Service Agreements in government departments). Our civil servants now face performance incentives in addition to tenure-based pay (performance related budgets in job training agencies, individual performance bonuses in schools and Makinson agencies, earned autonomy for hospitals).

It is tempting to think that public sector reform is one area where political competition is unambiguously beneficial. Unfortunately, many policies have been predicated on assumption rather than hard facts. Clinton and Gore proudly announced that 'we will: replace regulations with incentives, inject competition into everything we do [and] search for market, not administrative solutions'.[4] Yet it is hard to think of even one study that justifies such confidence.

In truth, quantitative social science has largely neglected public organization. Public economists have been preoccupied with what motivates our politicians and hence how electoral, rather than organizational, institutions impact on efficiency. Political scientists have tended to focus on legislative control of the bureaucracy without really pursing what makes individual bureaucrats tick (Moe 1997). This paper adds to the small literature that is plugging this gap. Its aim is simple, by exploring the forces that shape bureaucratic behavior, I hope to offer an insight into the efficacy of politically driven NPM reforms.

[1] Taken from Clinton's speech inaugurating the NPR available at http://govinfo.library.unt.edu/npr/library/-speeches/030393.html

[2] PSPP mission statement available at http://www.hm-treasury.gov.uk. See also the OPSR mission statement at http://www.pm.gov.uk/output/page270.asp.

[3] See, for instance, Howard's advertisements in the UK national press (January 2 and 14, 2004) and his new website, www.cutredtape.org, that urges visitors to submit experiences of red tape and Government waste.

[4] National Performance Review Reinvention Principles, available at http://govinfo.library.unt.edu/npr/-library/papers/bkgrd/princip.html

Historically, at least, plenty has been written about bureaucratic behavior. The Public Choice movement ushered in two schools of thought. One, due to William Niskanen, emphasized the bilateral monopoly between bureaus and their legislative sponsors. Bureaucrats were said to exploit their monopoly power to secure maximal budgets (Niskanen 1971) or slack (Migue and Belanger 1974). The other, due to George Stigler, gave preeminence to special interest groups. Drawing on Olson's (1965) logic of collective action, Stigler (1971) proposed that producers could capture regulatory agencies and hence supply policy to meet their own ends. Stigler's claim was subsequently weakened by neopluralism (Becker 1983) and later formalized as collusion in regulatory hierachies (Laffont and Tirole 1991).

Public Choice theories of bureaucracy are, however, hard to square with survey evidence from the Public Administration literature. When asked, bureaucrats commonly cite doing, and being seen to do, a good job as an important occupational reward. An illuminating example is Schofield's (2001) survey of British National Health Service (NHS) managers. Undertaking a textual analysis of interviews with NHS managers as they learnt to operate the internal market, Schofield points to two classes of bureaucratic motivation : (i) vocation or fealty to the centre and (ii) protection of professional reputation, particularly among the accountants, finance directors and clinical staff, as exemplified by one manager's candid admission

> 'I have done nearly 20 years in the NHS and I have no intentions of falling over and making a mistake that someone can criticize me on'.[5]

Schofield's finding that NHS managers demonstrate a dual accountability to the NHS and their profession clearly echoes Wilson's (1989) celebrated study of US government agencies. Drawing on the contrasting experiences of the National Forest and Park Services, Wilson argues that public sector employees lie on a sliding scale of professionalism. At one end are "bureaucrats" who derive their occupational rewards from within the agency, at the other are "professionals" who receive important rewards from an external reference group whose membership is limited to people who have undergone specialized formal training and have accepted a group defined code of proper conduct.

One might initially think that dual accountability is all to the good: reputational concerns will ensure that bureaucrats (hereafter read public sector employees) try even harder not to make a mistake. Indeed, Schofield draws this conclusion from her interviews with NHS managers.[6] However, such a conclusion overlooks the fact that bureaucrats often operate in an environment populated by *informed special interests*. That is, groups that have a vested interest in policy and are better placed to spot mistakes than the public at large. Utilities, for

[5]Schofield (2001) pg. 90.

[6]'The public have reason to be thankful that there is this degree of bureaucratic obedience, whether it is due to vocational fealty in the form of public service or self interest and the desire to please superiors and keep one's job', Schofield (2001) pg. 91.

instance, typically seek lenient regulation and have private information pertinent to the merits of a decision to file for a rate review and/or cut cost pass-through. Given such groups have an incentive to use their informational advantage to secure policy favours, it seems possible that the existence of reputational concerns may actually bias policy.

In Section 2 I develop a simple model of bureaucratic behavior that draws on these observations. I show that, in the presence of an informed interest group, reputational concerns can indeed prompt bureaucrats to behave inefficiently. The desire to maintain a favourable reputation results in what I term 'minimal squawk' behavior: bureaucrats take decisions to keep interest groups quiet and mistakes out of the public eye.

This model has three key features. First, 'doing a good job' requires knowledge of some underlying state of the world. Public Utility Commissioners should initiate a rate review if and only if a firm's costs have changed; Food and Drug Standards Agency officials should license a new drug if and only if it will not later cause death and injury; Immigration and Naturalization service workers should 'find and expel illegal immigrants but not break up families, impose hardships, violate civil rights, or deprive employers of low-paid workers'.[7] Second, bureaucrats differ in their decision-making ability: more able bureaucrats receive more accurate signals of the state of the world. Third, bureaucrats have dual accountability; they care about doing a good job but also about their reputation with an external evaluator (professional peers and/or future employers who value decision-making skills).

In this set up reputational concerns bias bureaucratic decision-making under two relatively weak assumptions over the information structure. Bureaucrats have private information over their decision-making *ability* but interest groups have private information over the state of the world and hence decision-making *quality*.

The intuition behind this inefficiency is as follows. Suppose that an interest group threatens to draw attention to a mistake (squawk) if a bureaucrat has been tough but stay silent if she has been generous. To fix ideas, imagine a regulated utility implicitly threatens to issue defamatory press releases if its regulator initiates a rate review when its costs have risen but stay silent if its regulator does nothing when its costs have fallen. As long as the evaluator believes that able bureaucrats are trying to make good decisions, good decisions will be seen as an indication of high ability and bad decisions an indication of low ability. Able bureaucrats relish the opportunity such selective disclosure gives them to demonstrate their superior decision-making skills. In contrast, less able bureaucrats recognize that tough decisions expose their poor decision-making skills to the evaluator's scrutiny. Less able bureaucrats therefore have an incentive to hide behind generous decisions to ensure their professional reputation remains intact.

Of course, if the evaluator believes that less able bureaucrats are *always* generous it will simply treat tough decisions as evidence that the bureaucrat is able. But then less able

[7] Wilson (1989), pg. 158.

bureaucrats have an incentive to be tough. I establish that less able bureaucrats strike a balance between these two effects. Formally, a hybrid perfect Bayesian sub-game equilibrium exists in which able bureaucrats try to make good decisions but less able bureaucrats mix between attempting to make good decisions and always being generous. Since this selective disclosure policy serves the interest group better than, for instance, pointing out every mistake, generous decisions occur too often. Comparative statics exercises confirm that good decisions are less likely as reputational concerns increase in importance relative to public service. Bureaucrats optimally take generous decisions (say doing nothing rather than filing for a rate review) upon receipt of a signal that this is the right course of action (an upward trend in operating costs) but also, with increasing probability, upon receipt of a signal that they should really be tough (a downward trend in operating costs).

This simple model demonstrates that reputational concerns *can* be destructive. To the extent that incentive effects (for instance, effort to improve signal accuracy) are less important than minimal squawk behavior, it suggests that public sector reformers should seek to decrease the importance bureaucrats attach to their reputation. Obvious suggestions are to hire fewer "professionals" and, given the likely negative correlation between term length and reputational concerns, to reduce the use of short fixed-term contracts in executive agencies and job rotation among the permanent secretariat.[8]

The latter policy implication, however, is at odds with the received wisdom that short terms of office are needed to minimise the threat of 'capture' (cf. the intuition sketched in Tirole 1986). In Section 3 I test between theories of bureaucratic behavior using data from regulatory agencies (a matched panel of US State Public Utility Commissions (PUCs) and investor-owned electric utilities). A motivational modification of the model of Section 2 − regulators are, potentially, corruptible and differ in terms of their public service motivation rather than ability − yields the empirical prediction that statutory term length should decrease the probability that PUCs initiate rate reviews in periods of falling operating costs. I term this negative interaction effect the 'capture hypothesis'. In contrast, the 'minimal squawk hypothesis' predicts the reverse: statutory term length should *increase* the probability that PUCs initiate rate reviews in periods of falling operating costs.

To test these hypotheses I estimate the partial effect of PUC term length on the conditional probability that an electric utility faces a new rate review in a given year. In doing so, I allow for firm-level unobserved effects and dynamics (including learning by PUCs) and instrument for the potential endogeneity of term-length, proxying for cost signals with lagged changes in firm operating expenses. The data soundly reject the capture hypothesis: PUC term length *never* exerts a negative effect on the probability of review. Moreover, the data appear

[8] A negative relationship between contract duration and reputational concerns is intuitive and, as shown in Section 3, can be derived directly from the minimal squawk model. Further policy implications are discussed in Section 4.

to be consistent with the minimal squawk hypothesis. In all bar the static FE specifications, term length has a significantly stronger positive effect during periods of falling operating costs.

Given unobserved firm effects prove unimportant throughout, explore economic significance using a dynamic pooled Probit specification. These estimates suggests that, at the mean of all variables, an additional year of PUC term length increased the probability of review by .0634, rising to .1244 at the bottom percentile, and falling to zero at the top percentile, of lagged percentage change in operating expenses. Firm-level price regressions provide a robustness check and also provide further evidence of the economic significance of minimal squawk behavior. Other things equal, an additional statutory year of office decreased the average revenue from residential customers by .0666 cents per kwh. During the sample period the average US household consumed 105 Million BTU of electricity, suggesting that a one year reduction in PUC term length cost the average family in the region of $20 a year.[9]

I draw two policy conclusions from my analysis. First, short terms of office for regulators may not be the panacea that some have hoped for. US State Governments in, for instance, Colorado, Illinois, Ohio, Maryland and Pennsylvania may want to revisit earlier decisions to decrease the statutory term of office for their PUC Commissioners. Likewise the UK government may want to rethink its bold statement that the new National Lottery Commission, in which the term of the key decision-maker was slashed from 5 years to 12 months, will 'reduce the risk, actual or perceived, of conflicts of interest and regulatory capture'.[10] Second, and more fundamentally, NPM reforms should proceed on the basis that bureaucrats are neither selfish nor saintly, but human and hence averse to criticism. In circumstances where this motivation is likely to combine with informed interest groups, reformers should be alert to the possibility of minimal squawk behavior.

1.1. Related Approaches

Minimal squawk, Hilton (1972), Joskow (1974). Career concerns, (i) in government agencies: Dewatripont et al (1999), Le Borgne and Lockwood (2001), Persson and Tabellini (2000, Ch.4); (ii) for experts: Sharfstein and Stein (1990), Levy (2003), Prat (2001). Alternative channels of interest group influence: McCubbins and Schwartz (1984), McNollgast (1987,1989), Dal Bó and Di Tella (2003). See also Prendergast (2003): similar point but without a model of reputational concerns, different timing. Public service motivation, Besley and Ghatak (2003), Francois (2000). PUC Data: Besley and Coate (2003).

[9] The usual caveat that average revenue may not accurately reflect prices due to quantity discounting applies.

[10] Chris Smith MP, taken from Hansard Written Answer, April 1 1998, available at www.open.gov.uk.

2. A Model of Minimal Squawk behavior

2.1. The Model

The model is the simplest needed to show that reputational concerns can bias bureaucratic decision-making: all choice sets are binary, state variables are binary and occur with equal probability. Key assumptions are discussed at the end of the following section.

Description There are three players: a bureaucrat (she), an informed interest group and an evaluator (he). Anticipating the empirical analysis, I focus on the example of regulatory agencies and refer to the first two players as regulator and firm.[11] The evaluator can be thought of as future private sector employers or, interchangeably, a professional peer group.

The regulatory problem is one of hidden information. The firm faces unavoidable input costs (wage/fuel costs determined by competitive forces or costs involved in meeting environmental legislation) that are either 'low' or 'high' with equal probability. This cost state of the world is denoted by $\omega \in \{l, h\}$ and is observed perfectly only by the firm. The regulator must take a decision that is 'tough' or one that is 'generous'. This action space is denoted by $a \in \{t, g\}$ and is observed by all players. Under rate of return regulation (RoR) this choice can be thought of as 'file for a formal rate review to decrease the firm's revenue requirement' or 'do nothing' (see Section 3.2). Under incentive regulation (IR) it can be thought of as a 'low' or 'high' cost-past through factor in the $RPI - x + k$ formula.

The socially optimal decision depends on the cost state of the world. A tough decision maximises social welfare if input costs are low but a generous decision maximises social welfare if input costs are high. This assumption is easy to motivate under both RoR and IR. Under RoR, state-dependency arises because the formal rate review process creates an administrative deadweight loss. Under IR, firms are likely to shave on socially desirable investment if they are unable to pass-through unavoidable costs. The four possible regulatory outcomes are defined in Table 2.1. It is common knowledge that the outcomes (l, t) and (h, g) are 'good' and (h, t) and (l, g) are 'bad'.

The regulator can conduct an experiment which generates an informative private cost signal $s \in \{l, h\}$. The accuracy of this signal is termed her decision-making ability. There are two ability types: well informed or 'smart' (S) and less well informed or 'dumb' (D). It is assumed that the regulator knows her ability for certain, while the firm and evaluator know only that either type may have been appointed with equal probability. This ability state of the world is denoted by $\theta \in \{\theta_S, \theta_D\}$, where $\theta_S = \Pr(s = \omega \mid \omega,\, \theta_S)$, $\theta_D = \Pr(s = \omega \mid \omega,\, \theta_D)$ for $\omega = l, h$ and $\frac{1}{2} < \theta_D < \theta_S < 1$. It will prove useful to define $\Delta_\theta \equiv \theta_S - \theta_D > 0$.

The regulator has dual accountability: she wants to achieve a good outcome but, being human, also cares about her reputation. Formally, she derives utility from two sources: the

[11] The applicability of the model to other government agencies is discussed in Section 4.

Table 2.1: The Four Regulatory Outcomes

True Cost State (ω)	Regulatory Decision (a): tough	generous
low	(l,t)	(l,g)
high	(h,t)	(h,g)

regulatory outcome (*policy preferences*) and her reputation with the evaluator (*reputational concerns*). The former are given by $u(l,t) = u(h,g) = W > u(h,t) = u(l,g) = 0$, where $u(\omega, a)$ denotes her pay-off to choosing policy a in cost state ω and W the warm glow she gets from making a good decision, hereafter her degree of public service motivation (PSM).[12] The latter are given by the evaluator's posterior belief μ that she is smart.[13] Adopting a simple additive specification, the regulator's objective function is $u(\omega, a) + \delta\mu$, where $\delta > 0$ is a weighting term that reflects the relative importance of reputation.

The firm weakly prefers a generous decision in all cost states, receiving H if the regulator is generous when its costs are low, L if she makes a good decision and nothing if she is, mistakenly, tough when its costs are high. Its policy preferences are therefore given by $v(l,g) = H > v(h,g) = v(l,t) = L > v(h,t) = 0$, where $v(\omega, a)$ denotes its pay-off when the regulator chooses a in cost state ω.

Aware that the regulator cares about her reputation, the firm attempts to persuade her to be generous by strategically threatening to 'squawk', or rather publicise the quality of her decision-making. Formally, the firm takes the first move and publicly announces a disclosure rule d that states how it will behave after each regulatory outcome. To maintain tractability, the firm can either (costlessly) reveal the true quality of the regulator's decision, or stay silent.[14] This action is denoted by $r \in \{\omega, \emptyset\}$. A typical strategy d is given Table 2.2.

Formally, there are four types of regulator: a smart regulator that receives a low signal, a smart regulator that receives a high signal and so on. Let $\sigma_i = (p_i, q_i)$ denote the probability that a regulator i chooses $a = t$, where p_i denotes the probability that she chooses t when $s = l$, q_i the probability that she chooses t when $s = h$ and $i = S, D$. With some abuse of terminology, it is now possible to define four pure 'strategies' for each ability type: 'follow'

[12] The strict inequality pins down equilibria. There are no PSM types on the assumption that PSM is of no use in the private sector and professional peers are impressed by ability, rather than desire, to do the right thing.

[13] Under the career concern interpretation, decision-making skills must therefore be valued by a competitive job market. If future employers/peer groups care strongly about the regulatory outcome, it must also be assumed that they cannot commit to retaining their priors.

[14] The implication that ω is hard information suggests a relatively straightfoward contractual solution to the regulatory problem. I abstract from the possiblity of mechanism design in an attempt to show how minimal squawk behaviour might arise under real world institutions such as RoR or IR. Note also the advantage the firm has in commiting not to reveal ω to the regulator.

Table 2.2: A Typical Disclosure Rule ('squawk on tough')

True Cost State (ω)	Regulatory Policy (a): tough	generous
low	$r = \emptyset$	$r = \emptyset$
high	$r = h$	$r = \emptyset$

($\sigma_i = (1, 0)$, i.e. t if $s = l$ and g if $s = h$); 'contradict'($\sigma_i = (0, 1)$); 'always tough' ($\sigma_i = (1, 1)$); and 'always generous' ($\sigma_i = (0, 0)$). In what follows I will say the regulator *uses* her signal if she plays either of the first two strategies but that she *ignores* it if she plays either of the last two strategies.

To summarise, the timing of the game is as follows:

Stage 1. The firm publicly announces a disclosure rule d. At the end of this stage nature chooses the cost state ω and the ability state θ.[15]

Stage 2. Observing d, θ and her signal s, the regulator chooses a according to σ_i.

Stage 3. Given ω and a, the firm carries out the revelation decision r stipulated by d.

Stage 4. Observing d, a and r, the evaluator forms the posterior belief μ over θ.

The solution concept is perfect Bayesian equilibrium (PBE). As Lizzeri (1999) notes, an observable disclosure rule implies that a PBE in a game of this structure is a list of PBE in every sub-game together with the requirement that d maximises the firm's expected utility. Since the evaluator's action is completely characterised by its beliefs the solution is obtained via backwards induction.

Discussion of Assumptions The model outlined above and models of regulatory capture (e.g. Laffont and Tirole 1991) are effectively motivational substitutes. Decision-makers care about their reputation in the former and side-transfers in the latter but never both. Assuming that the regulator does not 'have her price' removes the need to solve for the firm's choice *between* channels of influence. Since bribes are likely to absent when reputational concerns are strong (i.e. due to a high shadow cost of transfers via short contracts and post-agency employment restrictions) my basic message – that reputational concerns *can* be destructive – is likely to be robust to the possibility of direct collusion. My approach does, however, limit the policy conclusions one can draw from the data, as discussed in Section 4.

[15] Assuming nature moves at the end of this stage eases notation by ruling out type-dependent disclosure rules. Given the firm weakly prefers g in all cost states, cost types induced by an earlier move would pool on their choice of disclosure rule.

The disclosure rule is assumed to be public for convenience. Minimal squawk behavior is also part of an equilibrium when the disclosure rule is private but, in this case, μ must be derived from the firm's, as well as the regulator's, strategy. Costless revelation eases notation and also ensures that the existence (although not uniqueness) results are robust to the firm's ability to commit. The eagerness of the media to attend regulatory hearings and report regulatory news suggests that such costs are likely to be low.

If revelation costs are positive then, as the model stands (ω unobserved absent firm intervention), commitment is essential. The usual 'reputation in a repeated game argument' applies (see Lizzeri 1999) with one caveat: since the regulator learns ω with $\Pr\theta < 1$ she will only be able to apply an effective punishment if the firm squawks on both (l, a) and (h, a). This concern may also be mitigated by the fact that evaluators are often better informed about the quality of tough decisions for reasons beyond a firm's control. For instance, under RoR, third parties are better placed to judge the quality of the tough decision 'file for a review' than the generous decisions 'do nothing' because cost data necessarily comes out in court.

The unilateral relationship between the regulator and firm is an obvious simplification. Collective action problems suggest that environmental and consumer interests may struggle to form and hence counteract a firm's threat. All the same, it seems likely that minimal squawk behavior would diminish as the number of informed interests and/or regulatory commissioners increase.[16]

2.2. Analysis

The aim of this section is to establish conditions under which the firm can exploit the regulator's reputational concerns to bias policy in its favour. As a benchmark, I begin by characterising the regulator's behavior when she is motivated solely by her policy preferences.

2.2.1. Benchmark ($\delta = 0$)

For notational convenience, let $\Pr(good) = \Pr(l, t) + \Pr(h, g)$ and $\Pr(bad) = \Pr(h, t) + \Pr(l, g)$. Bayes' rule implies $\Pr(\omega = s \mid s, \theta) = \theta$. Upon receipt of $s = l$, regulator $i = S, D$ knows that $\Pr(l, t \mid l, \theta_i, \sigma_i) = p_i\theta_i$ (i.e. the probability that she chooses t and her signal is correct) and $\Pr(h, g \mid l, \theta_i, \sigma_i) = (1 - p_i)(1 - \theta_i)$ (i.e. the probability that she chooses g and her signal is incorrect). Similarly, if she receives $s = h$, she knows that $\Pr(l, t \mid h, \theta_i, \sigma_i) = q_i(1 - \theta_i)$ and $\Pr(h, g \mid h, \theta_i, \sigma_i) = (1 - q_i)\theta_i$. By the Law of Total Probability $\Pr(s = l) = \Pr(s = h) = \frac{1}{2}$, implying

$$\Pr(good \mid \theta_i, p_i, q_i) = \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right). \tag{2.1}$$

[16] In the UK single Commissioners (Director Generals) are common. In the US, however, the average PUC board size is 4. Since board members have an incentive to share their private information (s and θ), PUC decisions should, other things equal, improve with board size.

Substituting for the four pure strategies we have $\Pr(good \mid \theta_i, 1, 0) = \theta_i$, $\Pr(good \mid \theta_i, 0, 0) = \Pr(good \mid \theta_i, 1, 1) = \frac{1}{2}$ and $\Pr(good \mid \theta_i, 0, 1) = (1 - \theta_i)$. Thus, in the absence of reputational concerns, both smart and dumb regulators play 'follow' since this maximises the probability of making a good decision. Hereafter, this (socially optimal) benchmark behavior is referred to as 'attempting to make a good decision'. Note, of course, that S actually makes good decisions with higher probability (θ_S) than D (θ_D).

2.2.2. When Reputation Matters ($\delta > 0$)

In games of hard information revelation, saying nothing can often be informative. Here such unraveling partitions the set of possible disclosure rules into four classes - 'no disclosure', 'squawk on tough', 'squawk on generous' and 'full disclosure' - according to the information sets (equivalently sub-game) that each rule induces. For instance, if the firm plays a rule that requires it to squawk only on tough, irrespective of whether it actually squawks on (l, t), (h, t) or both, the evaluator can deduce the quality of the regulator's decision-making if she is tough but not if she is generous.

Letting o denote an equilibrium value, a PBE in such a sub-game is a pair of strategy functions $\sigma^o = (\sigma^o_S, \sigma^o_D)$ and a set of beliefs μ^o such that (i) at information sets on the equilibrium path these beliefs are derived by Bayes' Rule from the regulator's strategy and (ii) σ^o_S and σ^o_D maximise the regulator's objective function given μ^o. However, to ease the exposition, I assume that the evaluator has passive beliefs off the equilibrium path and ignore equilibria in which S tries to signal her ability by attempting to make *bad* decisions.[17]

It will prove helpful to illustrate the steps involved in solving for such sub-game equilibria with the case of 'squawk on tough'. Let $\widetilde{\sigma} = (\widetilde{\sigma}_S, \widetilde{\sigma}_D)$ denote the strategy function that the evaluator believes the regulator is playing. Since the evaluator observes the regulator's actions, he can deduce that $\Pr(t \mid \theta_i, \widetilde{\sigma}) = \frac{1}{2}(\widetilde{p}_i + \widetilde{q}_i)$ and $\Pr(g \mid \theta_i, \widetilde{\sigma}) = \frac{1}{2}(2 - \widetilde{p}_i - \widetilde{q}_i)$. Following each action, Bayes' Rule implies that his beliefs must satisfy

$$\begin{aligned} \mu(t) &= \frac{\Pr(t \mid \theta_S, \widetilde{\sigma}_S) \cdot \Pr(\theta_S)}{\Pr(t)} \\ &= \frac{\widetilde{p}_S + \widetilde{q}_S}{\widetilde{p}_S + \widetilde{q}_S + \widetilde{p}_D + \widetilde{q}_D} \end{aligned} \tag{2.2}$$

and

$$\mu(g) = \frac{2 - \widetilde{p}_S - \widetilde{q}_S}{4 - \widetilde{p}_S - \widetilde{q}_S - \widetilde{p}_D - \widetilde{q}_D}. \tag{2.3}$$

Under 'squawk on tough' the evaluator also learns the quality of the regulator's decision making if she chooses t. Since the evaluator can deduce that $\Pr(l, t \mid \theta_i, \widetilde{\sigma}) = \frac{1}{2}(\widetilde{p}_i\theta_i + \widetilde{q}_i(1 - \theta_i))$

[17] Passive beliefs remove the possibility that both S and D ignore their signals (a possibility under any disclosure rule). The full set of equilibria are characterised in Leaver (2001). Since minimal squawk behaviour is a feature of both the 'good' and 'bad' equilibria ignoring the latter does not change the qualitative nature of the results.

(i.e. the probability that the regulator chooses t when $s = l$ and this signal is correct plus the probability that she chooses t when $s = h$ and this signal is incorrect) and $\Pr(h, t \mid \theta_i, \widetilde{\sigma}) = \frac{1}{2}(\widetilde{p}_i(1-\theta_i) + \widetilde{q}_i\theta_i)$, his posterior beliefs at the information sets (l, t) and (h, t) are given by

$$\mu(l,t) = \frac{\widetilde{p}_S\theta_S + \widetilde{q}_S(1-\theta_S)}{\widetilde{p}_S\theta_S + \widetilde{q}_S(1-\theta_S) + \widetilde{p}_D\theta_D + \widetilde{q}_D(1-\theta_D)} \tag{2.4}$$

and

$$\mu(h,t) = \frac{\widetilde{p}_S(1-\theta_S) + \widetilde{q}_S\theta_S}{\widetilde{p}_S(1-\theta_S) + \widetilde{q}_S\theta_S + \widetilde{p}_D(1-\theta_D) + \widetilde{q}_D\theta_D}. \tag{2.5}$$

Note that a regulator of ability θ_i will deduce that $\Pr(l, t \mid \theta_i, \sigma_i) = \frac{1}{2}(p_i\theta_i + q_i(1-\theta_i))$, $\Pr(h, t \mid \theta_i, \sigma_i) = \frac{1}{2}(p_i(1-\theta_i) + q_i\theta_i)$ and $\Pr(g \mid \theta_i, \sigma_i) = \frac{1}{2}(2 - p_i - q_i)$. Using these probabilities, together with the probability of a good decision given in (2.1), the regulator's problem is given by

$$\max_{p_i,q_i} \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1-2\theta_i)\right) W + \delta \begin{bmatrix} \frac{1}{2}(p_i\theta_i + q_i(1-\theta_i))\mu(l,t) + \\ \frac{1}{2}(p_i(1-\theta_i) + q_i\theta_i)\mu(h,t) + \frac{1}{2}(2 - p_i - q_i)\mu(g) \end{bmatrix}. \tag{2.6}$$

The set of sub-game equilibria when the firm plays 'squawk on tough' can then be obtained by solving (2.6) for every set of beliefs defined by (2.3)-(2.5).

Define the row vector of parameters $\mathbf{z} \equiv (\theta_S, \theta_D, W)$. Then, repeating the above procedure for the three remaining sub-games and solving for the firm's optimal choice of disclosure rule, yields the following result.

Proposition 1. *There exists a critical value of δ, $\delta^* > 0$, such that:*

(i) if reputation is of low importance ($\delta \leq \delta^*$), then (a) the firm plays any disclosure rule, (b) smart and dumb regulators play 'follow' ($\sigma_S^o = \sigma_D^o = (1,0)$) and (c) the probability of observing a tough decision conditional on δ, s and $\mathbf{z}$ is

$$\Pr(t \mid \delta, l, \mathbf{z}) = 1 \quad \text{and} \quad \Pr(t \mid \delta, h, \mathbf{z}) = 0;$$

(ii) if reputation is of high importance ($\delta > \delta^*$), then (a) the firm plays 'squawk on tough', (b) smart regulators play 'follow' ($\sigma_S^o = (1,0)$) but dumb regulators mix between 'follow' and 'always generous' ($\sigma_D^o = (p_D^o(\mathbf{z}), 0)$ for some $p_D^o(\mathbf{z}) \geq \underline{p}_D(\mathbf{z}) > 0$), and (c) the probability of observing a tough decision conditional on δ, s and $\mathbf{z}$ is

$$\begin{aligned} \Pr(t \mid \delta, l, \mathbf{z}) &= \Pr(\theta_S \mid \delta, l, \mathbf{z}) \cdot 1 + \Pr(\theta_D \mid \delta, l, \mathbf{z}) \cdot p_D^o(\delta, \mathbf{z}) = \tfrac{1}{2}\left(1 + p_D^o(\delta, \mathbf{z})\right) \\ \Pr(t \mid \delta, h, \mathbf{z}) &= 0. \end{aligned}$$

A proof (including a characterisation of δ^*) of this and all other Proposition can be found in Appendix A. The intuition is as follows. Under 'no disclosure' the evaluator never observes the quality of regulatory decision-making. Since D can then mimic any favourable action, pooling behavior is the only possibility. Independent of the cost and ability state, the regulator is as likely to receive a low signal as a high signal. If the evaluator thinks both types *use* their signals, he will expect to observe t as often as g and hence form the same belief following t and g (i.e. substituting for $\sigma_i = (1, 0)$ or $\sigma_i = (0, 1)$ in (2.2) and (2.3) yields $\mu(t) = \mu(g)$). However, since the evaluator retains his priors at information sets off the equilibrium path, he also holds the same belief following t and g when both types *ignore* their signals. Reputational concerns are then irrelevant under any strategy and S and D attempt to make good decisions.

Under 'squawk on tough' the evaluator observes the quality of the regulator's decision if she sets t but, crucially, not if she sets g. If S *ignores* her signals, as above, D will mimic favourable actions when the evaluator thinks she plays a separating strategy, while reputational concerns are again irrelevant under a pooling strategy. The story changes, however, if S elects to *use* her signals.

Suppose that the evaluator believes S and D attempt to make good decisions. Since S makes good (resp. bad) decisions with higher (resp. lower) probability than D, the evaluator believes that the regulator is more likely to be smart following (l, t) than (h, t) (substituting for $\sigma_i = (1, 0)$) in (2.4) and (2.5) yields $\mu(l, t) > \mu(h, t)$). In short, the firm's actions split $\mu(t)$ into a reward for making a good decision and a punishment for making a bad decision. Since the evaluator expects to see a good decision with probability $\frac{1}{2}(\theta_S + \theta_D)$ and a bad decision with probability $\frac{1}{2}(2 - \theta_S - \theta_D)$ and, as already known, holds the same belief following t as g, we have $\mu(g) = \mu(t) = \frac{1}{2}(\theta_S + \theta_D)\mu(l, t) + \frac{1}{2}(2 - \theta_S - \theta_D)\mu(h, t)$.

S knows that she is an above average decision-maker. If she receives $s = l$, she therefore knows that choosing t results in the good decision (l, t) with higher probability (θ_S) than the evaluator expected $(\frac{1}{2}(\theta_S + \theta_D))$ and the bad decision (h, t) with lower probability $(1 - \theta_S)$ than the evaluator expected $(\frac{1}{2}(2 - \theta_S - \theta_D))$. Relishing the opportunity to demonstrate her superior decision-making skills, she attempts to make a good decision. D, however, knows that she is a below average decision-maker and hence prefers to choose g when $s = l$. If reputational concerns are sufficiently important (specifically $\delta > \delta^*$), D therefore deviates from attempting to making good decisions.

Now suppose that the evaluator thinks that S attempts to make good decisions but D plays 'always generous'. Since D *never* sets t the market can be certain that the regulator is smart following either (l, t) or (h, t) (substituting for $\sigma_D = (0, 0)$ in (2.4) and (2.5) yields $\mu(l, t) = \mu(h, t)$). But, given these beliefs, D finds that setting t upon receipt of $s = l$ now yields a higher expected pay-off than setting g. Accordingly, D deviates from playing 'always generous'.

Alternatively, then, suppose that the evaluator thinks that D sets g with positive, but not certain, probability. From (2.3)-(2.5) it is easy to see that the more likely the evaluator thinks D is to set g when $s = l$ (the lower p_D), the lower $\mu(g)$ and the higher both $\mu(l, t)$ or

$\mu(h,t)$ become. Eventually the evaluator's beliefs will be such that D's reputational incentive to set g exactly offsets her policy preference to set t. At this point she will indeed be willing to mix, thereby supporting such an equilibrium.

Exactly the same logic ensures that, if the firm plays 'squawk on generous' and $\delta > \delta^*$, D sets t more often in an attempt to protect her professional reputation. Under 'full disclosure', however, the evaluator observes the quality of the regulator's decision regardless of whether she sets t or g. Suppose D receives the signal $s = l$. If she sets g she will make the good decision (h, g) with lower probability than the bad decision (l, g) and hence she is better off setting t. In short, if S *uses* her signals to make good decisions, D will follow suit since the market treats bad decision-making as evidence of low ability; i.e. reputational concerns *reinforce* the regulator's policy preferences.

Turning to the optimal disclosure rule, it is obvious that the firm would rather see the regulator play 'always generous' than 'follow'. The firm is therefore indifferent between disclosure rules when reputational concerns are of low importance ($\delta \leq \delta^*$), but will play 'squawk on tough' when reputation is of high importance ($\delta > \delta^*$) since this biases regulatory policy in its favour. The conditional probability in parts (i) & (ii)(c) then follows directly from this optimal disclosure rule and the regulator's equilibrium strategies.

Proposition 1 shows that reputational concerns can indeed prove destructive in a regulatory setting. Regulators, motivated by reputational concerns but lacking in confidence in their decision-making skills, are likely take generous decisions too often to keep firms quiet and their professional reputation intact. To facilitate an empirical test and outline policy implications, I now show how this behavior changes with the main parameters of the model.

Proposition 2 (Minimal Squawk Hypothesis). *For any $\delta > \delta^*$, the probability of observing a tough decision conditional on δ, s and $\mathbf{z}$ is: (i) decreasing and strictly convex in δ when $s = l$ and (ii) zero when $s = h$. That is,*

$$\begin{aligned} \frac{\partial \Pr(t|\delta,l,\mathbf{z})}{\partial \delta} &= \frac{\partial p_D^o(\delta,\mathbf{z})}{\partial \delta} < 0, \quad \frac{\partial^2 \Pr(t|\delta,l,\mathbf{z})}{\partial \delta^2} = \frac{\partial^2 p_D^o(\delta,\mathbf{z})}{\partial \delta^2} > 0 \\ \frac{\partial \Pr(t|\delta,h,\mathbf{z})}{\partial \delta} &= 0. \end{aligned}$$

An illustration is given in Figure 2.1. The intuition is as follows. As δ increases above δ^*, D has a stronger reputational incentive to set g when $s = l$. To ensure that D continues to mix, the evaluator must believe that she sets g with higher probability since this decreases her incentive to set g. The equilibrium probability with which D sets t when $s = l$, p_D^o, is therefore decreasing in δ. Since S has a stronger incentive to set t when $s = l$, while both S and D have a stronger incentive to set g when $s = h$, all other equilibrium behavior remains unchanged.

Proposition 3. *Reputational concerns can increase in importance (higher δ) without reducing the probability of a good decision ($\frac{1}{2}(\theta_S + \theta_D p_D^o(\delta,\mathbf{z}) + \frac{1}{2}(1 - p_D^o(\delta,\mathbf{z})))$ if: (i) public service motivation increases (higher W); (ii) the difference in ability decreases (lower Δ_θ).*

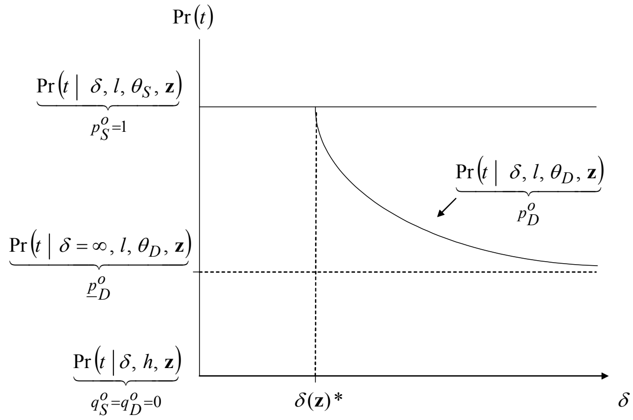

Figure 2.1: The Mininal Squawk Hypothesis (MSH)

As W increases, D has a stronger policy preference incentive to set t when $s = l$, implying that the level of δ necessary to exactly offset this effect - and leave her mixing with the same probability - can also increase. As θ_S increases, S is more likely to make a good decision. Since the evaluator will take a good (bad) decision to be stronger (weaker) evidence that the regulator is smart, D therefore has a stronger reputational incentive to set g when $s = l$. Accordingly, the level of δ necessary to induce her to mix at the same probability decreases with θ_S. An increase in θ_D has two separate effects. Since D is more likely to make a good decision when she follows her signals: (i) the evaluator will take a good (bad) decision to be weaker (stronger) evidence that the regulator is smart giving her a weaker reputational incentive to set g when $s = l$; and (ii) she has a stronger policy preference incentive to set t when $s = l$. These two effects combine to ensure that the level of δ necessary to induce her to mix at the same probability is increasing in θ_D.

3. Squawk or Capture? Evidence From Regulatory Agencies

The 'minimal squawk' model suggests that bureaucrats are driven by a desire to avoid criticism and succumb to an interest group's demands when they lack confidence in their decision-making ability. In stark contrast, proponents of the capture hypothesis, at least in its formal incarnation (Laffont and Tirole 1991), claim that bureaucrats are driven by pecuniary gain and simply 'sell' their policies to the highest bidder. In this Section I attempt to distinguish between these competing theories using matched panel data from US State Public Utility Commissions (PUCs) and investor-owned electric utilities. The aim throughout is to draw out the implications for public organizational design.

The key step in such an undertaking lies in finding an appropriate proxy for the strength of reputational concerns (δ). The variable that I use is a *US State Public Utility Commissioner's* *statutory term of office*. My justification for this choice is two-fold. First, statutory term length is likely to be at least sequentially exogenous conditional on other PUC institutions since it is chosen by State governments rather Commissioners themselves. Second, it is possible to derive an inverse relationship between δ and statutory term length directly from the minimal squawk model.

To see this, suppose that Commissioners serve for a total of T periods, where T varies across PUCs, but that all Commissioners chair their PUC, and hence resolve their policy decision, after t periods in office. Moreover, suppose that Commissioners derive utility u in each remaining of the $T-t$ periods that they are in office (for instance via bonus payments for good decisions or prolonged job satisfaction) and utility μ in each period forever after (think future salary or immutable peer recognition). Applying a discount factor of $\gamma = 1/(1+i)$, the present discounted value of a policy decision in period $t+1$ is then

$$PV = u\left(\frac{1-\gamma^{T+1}}{1-\gamma}\right) + \mu\left(\frac{\gamma^{T+1}}{1-\gamma}\right). \tag{3.1}$$

Equation (3.1) is clearly proportional to $u + \delta\mu$, where

$$\delta(i,T) = \frac{1}{[(1+i)^{T+1} - 1]} \tag{3.2}$$

and immediately reveals that reputational concerns μ should weigh more heavily in a Commissioner's decision problem the shorter her term of office T. More specifically, $\delta_T(i,T) < 0$, $\delta_{TT}(i,T) > 0$, $\delta(i,0) = 1/i$ and $\lim_{T\to\infty} \delta(i,T) = 0$.

The use of US State PUC data anchors the analysis to *rate of return* regulation. Section 3.2 below sets out how the minimal squawk and capture hypotheses can be applied to rate of return regulation and proposes a test that requires estimation of the partial effect of term length on the incidence of formal rate level reviews. Before doing so, however, it will be useful to outline the salient features of PUCs and the rate regulation framework.

3.1. Institutional Background

State PUCs consist of a board of Commissioners and their permanent support staff. Commissioners serve fixed terms under the direction of a chairperson and are jointly responsible for the regulation of the intra-State activities of investor-owned electric, gas, telecommunications and water utilities. They were established by State legislatures over a period of 137 years (from Massachusetts in 1804 to New Mexico in 1941) and, as discussed in Section 3.3 below, differ markedly from State to State, as well as over time.

One institution that PUCs do have in common is their use of rate regulation. As Phillips (1988) notes rate regulation consists of rate level (earnings) and rate structure (price) control. Rate level regulation can be summarized by the formula

$$R = O + rA. \tag{3.3}$$

That is, public utilities are entitled to earn a rate level R (the total revenue requirement) sufficient to cover allowable operating expenses O and earn a 'fair' rate of return r on the asset base $A = (V - D)$, where V is the gross value of tangible and intangible property and D is accrued depreciation. Rate structure regulation is used to ensure that firms set prices that cover R subject to being 'just and reasonable' and showing 'no undue discrimination'.

In sum, then, PUCs are charged with four tasks: (i) to determine allowable operating expenses (opex); (ii) to determine the appropriate valuation of the asset base; (iii) to decide upon a fair rate of return; and (iv) to decide upon the appropriate rate structure given (i)-(iii). These duties are fulfilled via formal rate reviews.[18] The rate review process may be initiated by a firm or PUC and, following Phillips (1988), is summarized below.

A firm or PUC files for a rate change. The PUC suspends the proposed change for a set period and, in many cases, proscribes an interim rate that grants a fraction of the rate requested. The firm, with the PUC's consent, then proposes a 'test year' (typically the latest 12-month period for which complete data are available). The test year is intended to facilitate estimation of O and A. Commissioners are, of course, expected to exercise their judgement rather than simply allow the firm to pass through last year's cost or earn on last year's asset base. For instance, they must decide whether costs determined by the firm (advertising, R&D, charitable contributions) should be passed through to consumers in addition to costs determined by competitive forces (wages, salaries, fuel). Moreover, they must decide whether the relationships between revenue, cost and net investment during the test year will continue to hold into the future. After the test year has been agreed the case is set down on the PUC's docket and customers notified. Before the case is called the firm, PUC and any intervenors prefile 'canned' testimony. The case is subsequently heard by an administrative law judge who makes a recommended decision that is subject to review by the PUC and appeal by the firm. Finally, following the resolution of any appeals, rate structures are adjusted to ensure that the firm earns the agreed rate of return.

3.2. Interpreting the Theory

3.2.1. Squawk

To take the MSH to the data I require a suitable proxy for the action space $a \in \{t, g\}$. A natural candidate suggested by the discussion in Section 3.1 is the PUC-level decision 'file for a rate decrease' ($file = 1$) or 'do nothing' ($file = 0$).

To see this more clearly, suppose that social welfare in period t is given by the loss

[18] There are also informal regulatory proceedings. However, while Federal Commissions use both formal and informal proceedings for rate determination, PUCs only use informal proceedings to deal with customer complaints.

functions

$$SW(review) = -|R_t - (O_t + rA_t)| - C \quad (3.4)$$
$$SW(no\ review) = -|R_{t'} - (O_t + rA_t)| \quad (3.5)$$

where R_t denotes the revenue requirement chosen in the event of a review (initiated either by the firm or PUC) in period t, $R_{t'}$ the prevailing revenue requirement (chosen in period $t' < t$), $O_t + rA_t$ the true revenue revenue requirement in period t and C the administrative deadweight loss arising from the formal review process. Assuming that PUCs view review outcomes as correct in expectation (i.e. $R_t = E[O_t + rA_t]$), in advance of the filing decision, they will anticipate social welfare levels of

$$E[SW(review)] = -C \quad (3.6)$$
$$E[SW(no\ review)] = -|R_{t'} - E[O_t + rA_t]|\,. \quad (3.7)$$

If a PUC elects to file whenever (3.6) minus (3.7) is positive (follow its signal in the parlance of Section 2) it runs the risk of making two mistakes: an inefficient filing for a rate decrease ($R_{t'} - E[O_t + rA_t] > C > R_{t'} - O_t + rA_t$) and an inefficient filing for a rate increase ($E[O_t + rA_t] - R_{t'} > C > O_t + rA_t - R_{t'}$). Since the firm perceives a lower (private) cost of initiating a review, a simple and efficient way to rule out the latter mistake is to let the firm file for rate increases. Consequently, the *effective* choice facing PUCs is whether to file for a rate decrease (play tough) or do nothing (play generous) given that the true state of the world may be either 'low' ($R_{t'} - (O_t + rA_t) > C$) or 'high' ($R_{t'} - (O_t + rA_t) < C$).

This decision problem is a close analogue of the model of Section 2. The optimality of the PUC's choice is state-dependent (tough when the true cost state is 'low' and generous when the true cost state is 'high' are the only good decisions), while firms weakly prefer generous in every cost state. Moreover, as noted in Section 2.1, future employers/peer groups are highly likely to observe the quality of tough, but not generous, decisions. If the PUC does nothing, the firm has no incentive to squawk and third parties will remain none the wiser. However, if the PUC files for a review, test year data and pre-filed canned testimony will necessarily come out in court revealing the quality of the PUCs decision to a wide audience, irrespective of the firm's actions.

Thus, having argued that the formal review process offers a suitable testing ground for the MSH, all that remains is to draw out precise empirical predictions from the theoretical model. A simple way to proceed is to estimate the probability that a PUC initiates a review conditional only on PUC term length (*term*) and a row vector of variables (listed in Section 3.4) likely to be correlated with term length and the incidence of reviews ($\mathbf{z}$). That is, for any $term < term^*$,[19] Proposition 1 part (ii)(c) implies,

$$\Pr(file = 1 \mid term, \mathbf{z}) = \Pr(\theta_S, l \mid term, \mathbf{z}) \cdot 1 + \Pr(\theta_D, l \mid term, \mathbf{z}) \cdot p_D^o(\delta\,(term)\,, \mathbf{z}) \quad (3.8)$$

[19]From (3.2) $term^* = \frac{\log[1+\frac{1}{\delta^*}]}{\log[1+i]} - 1$. Such a term length therefore exists iff $\delta^*(\mathbf{z}) > 1/i$.

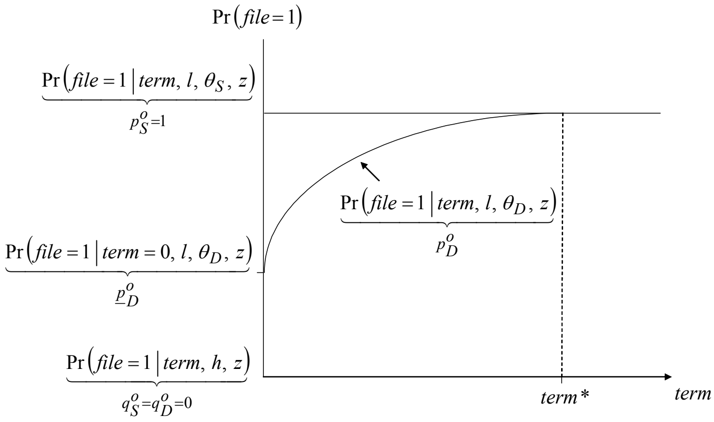

Figure 3.1: The (Estimable) MSH

yielding the potentially estimable equation

$$\Pr(file = 1 \mid term, \mathbf{z}) = \beta term + \mathbf{z}\boldsymbol{\gamma}. \tag{3.9}$$

Equation (3.8) makes it clear that the partial effect of term length, β, estimated by this procedure will depend on $\partial \Pr(\theta, l)/\partial term$ as well as $\partial p_D^o/\partial term$. In Section 2 the probability of a smart regulator was assumed to be independent of term length and, less controversially, the unconditional probability of a low signal. Fortunately, the MSH yields an unambiguous prediction for the *sign* of the partial effect of term length even when this assumption is relaxed. As illustrated in Figure 3.1 (the estimable analogue of Figure 2.1), Proposition 2 implies that β should be positive.[20] True, if less (resp. more) able regulators have a tendency to self-select into PUCs with longer terms of office we should anticipate a higher (resp. lower) partial effect. Nonetheless, in either case, term-length should exert an unambiguously positive impact on the conditional probability of review.

An alternative strategy that offers a more demanding test of the MSH is to attempt to estimate the interaction effect between a PUC's cost signal and term length.[21] I will discuss several proxies for the signal state in Section 3.4 below. Assuming for the moment that a valid proxy exists, Proposition 1 part (ii)(c) implies

$$\begin{aligned} \Pr(file &= 1 \mid term, l, \mathbf{z}) = \Pr(\theta_S \mid term, l, \mathbf{z}) \cdot 1 + \\ &\quad \Pr(\theta_D \mid term, l, \mathbf{z}) \cdot p_D^o(\delta\,(term)\,, \mathbf{z}) && (3.10) \\ \Pr(file &= 1 \mid term, h, \mathbf{z}) = 0. && (3.11) \end{aligned}$$

[20]In Figure 3.1, concavity follows from convexity of p_D^o in δ and of δ in T.

[21]A third possibility, precluded by data limitations, is to estimate a 3-way interaction between tern-length, cost and ability states.

Defining the variable $low = 1$ if the PUC receives a signal that the true cost state is low ($R_{t'} - (O_t + rA_t) > c$) and $low = 0$ otherwise, this yields the potentially estimable equation,

$$\begin{aligned}\Pr(file &= 1 \mid term, low * term, low, \mathbf{z}) = \\ &\alpha_1 term + \alpha_2 low * term + \alpha_3 low + \mathbf{z}\boldsymbol{\zeta}. \qquad (3.12)\end{aligned}$$

Appealing to the same 'self-selection' logic as before, Proposition 2 implies that: (i) α_1 should be zero since term length should have no effect in a high cost signal state; (ii) α_2 should be positive since, averaging over both smart and dumb PUCs, term length should have a positive effect in a low cost signal state resulting in a positive difference in slopes; and (iii) α_3 should be positive since the intercept given a low cost signal should, averaging over both smart and dumb PUCs, be greater than the intercept given a high cost signal. I discuss a variety estimation procedures for (3.9) and (3.12) in Section 3.4.

3.2.2. Capture

Governments certainly give credence to the threat of capture and appear to hold a belief that it can be mitigated by reducing the length of contractual relationships. So much so that, as Tirole (1986) predicts, there has been clear evidence of an 'organizational response' towards short fixed-term contracts in regulatory agencies and frequent job rotation amongst permanent civil servants.

Notwithstanding such organizational changes, to the best of my knowledge, there is no formal model that explains precisely *why* long-term contracts foster regulatory capture. Instead, policy appears to have been shaped by the following more general arguments. First, as Kreps et al (1982) point out, cooperation should increase with the planning horizon because players have a greater incentive to invest in reputation building via cooperation in initial play. Second, as Tirole (1986) suggests, alluding to intuition rather than a formal model, collusion should increase over the course of a contractual relationship as: (i) trust builds up and facilitates higher stakes; and (ii) past collusion offers each side the opportunity to 'blackmail' the other into future collusion.

For the sake of clarity, I now illustrate how a positive relationship between term length and direct collusion arises with two modifications to the model in Section 2. The first change is obvious, the regulator must be willing to accept a bribe from the firm (money and/or post agency employment). The second is that she has private information over her degree of public service motivation but not her decision-making ability. Specifically, W is a random variable commonly known to be uniformly distributed on $[0, 1]$ with realisation w observed only by the regulator, while θ is a known constant.[22] The regulator's objective function is $u(\omega, a) + B(\omega, a)$,

[22] Uncertainty over W ensures continuity of $\Pr(t)$. Since the firm's objective function is sub-modular in B and λ the comparative statics results hold for a general class of distribution functions. Assuming θ is degenerate removes the regulator's reputational concerns and hences keeps the model within the capture paradigm.

where $u(good) = w > u(bad) = 0$ and $B(\omega, a)$ denotes an outcome contingent bribe offered by the firm in place of d in stage 1; the firm's is $v(\omega, a) - (1 + \lambda(term, \mathbf{z}))B(\omega, a)$, where $v(\omega, a)$ is as before and, reflecting the above intuition, $\lambda(term, \mathbf{z})$ denotes the shadow cost of transfers with $\lambda_T < 0$, $\lambda_{TT} > 0$, $\lambda(0) = \infty$ and $\lim_{T\to\infty} \lambda(T, \mathbf{z}) = 0$.

The resulting game between the firm and regulator is straightforward to solve and yields the following equilibrium and comparative statics results.

Proposition 4. *There exists a critical value of λ, $\lambda' > 0$, such that:*

(i) the firm offers the regulator a positive reward for its preferred outcome ($B^o(l, g) > 0$) iff the shadow cost of transfers is sufficiently low ($\lambda \leq \lambda'$);

(ii) a type$-w$ regulator plays 'always generous' ($\sigma^o(0, 0)$) iff $w \leq \frac{\theta B^o(l,g)}{(2\theta-1)}$ and otherwise plays 'follow' ($\sigma^o(1, 0)$);

(iii) the probability of tough decision conditional on term,s and $\mathbf{z}$ is

$$\Pr(t \mid term, l, \mathbf{z}) = 1 - \frac{\theta B^o(l,g,\lambda(term,\mathbf{z}))}{(2\theta-1)} \quad \textit{and} \quad \Pr(t \mid term, h, \mathbf{z}) = 0.$$

The firm designs a menu of non-negative bribes, one for each of the 4 regulatory outcomes in Table 2.1 under uncertainty over the true cost, signal and motivation states and hence weighs up the *expected* cost and benefit of each possible payment. In the absence of side-transfers, every type$-w$ regulator plays 'follow'. Rewarding the outcome (ω, a) therefore has a benefit of $\frac{1}{2}[\theta(H - L) + (1 - \theta)L]$ iff it prompts the type$-w$ regulator to set g when $s = l$. On the other hand, it has a cost of $(1 + \lambda)B(\omega, a)$ in the event of (ω, a) and a further cost of $\frac{1}{2}[(1 - \theta)(H - L) + \theta L]$ if it prompts the regulator to set t when $s = h$. Reasoning along these lines the firm will never choose to reward tough decision-making since at least one type of regulator will set t when $s = h$.

The firm may, however, choose to reward (l, g). This bad decision is the most cost effective way to increase the probability of 'always generous' for two reasons. First, the regulator expects to make a bad decision with higher probability by playing 'always generous' rather than 'follow'. Since the converse is true for a good decision, $B(l, g)$ has a higher marginal benefit than $B(h, g)$. Second, the firm expects to incur the cost $(1+\lambda)B(a, g)$ with (weakly) higher probability when $s = h$ than $s = l$. This gives $B(l, g)$ a lower marginal cost than $B(h, g)$ since the firm faces the higher probability event (pay out for sure) conditional on an incorrect, rather than correct, signal.

Whether the firm actually chooses to set $B^o(l, g) > 0$ depends on λ. If the shadow cost of transfers is too high - specifically $\lambda > \lambda'$ - the firm will be unwilling to attempt to bribe even the lowest type. In any event, given $B^o(h, g) = B^o(\omega, t) = 0$, the regulator plays 'follow' iff her public service motivation is sufficiently high, that is $w > (\theta B^o(l, g)/(2\theta - 1)$.

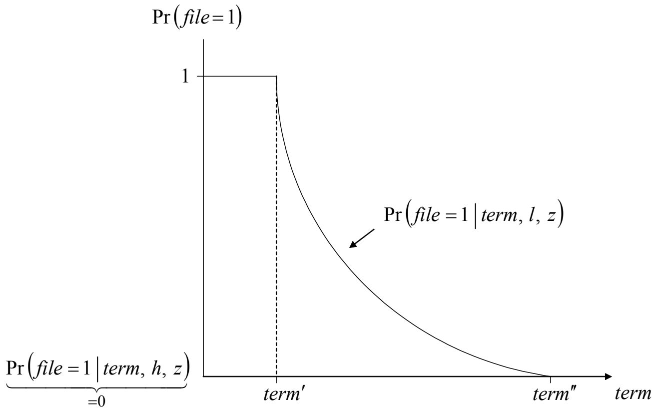

Figure 3.2: The Capture Hypothesis (CH)

Proposition 5 (Capture Hypothesis). *For any* $\lambda \in (\lambda'', \lambda)$, *the firm's equilibrium bribe* $B^o(l, g, \lambda\,(term, \mathbf{z}))$ *is decreasing and strictly concave in PUC term length (term). The probability of observing a tough decision conditional on term,* s *and* z *is therefore: (i) decreasing and strictly convex when* $s = l$ *and (ii) zero when* $s = h$. *That is,*

$$\begin{aligned} \tfrac{\partial \Pr(t|term,l,\mathbf{z})}{\partial term} &< 0, \quad \tfrac{\partial^2 \Pr(t|term,l,\mathbf{z})}{\partial term^2} > 0 \\ \tfrac{\partial \Pr(t|term,h,\mathbf{z})}{\partial term} &= 0. \end{aligned}$$

If the shadow cost of transfers λ is sufficiently low the firm may be willing to bribe the highest type to play 'always generous'.[23] For intermediate values of λ, however, the firm will set $B^o(l, g)$ to capture a fraction of the motivated types. This interior solution $B^o(l, g)$ is clearly decreasing in λ since a higher shadow cost increases the expected cost of rewarding (l, g) but leaves the expected benefit unchanged. Thus, for intermediate values of λ, an increase in PUC term length prompts the firm to increases its equilibrium bribe which, in turn, decreases the ex ante probability that the regulator will take a tough decision (file for a review) upon receipt of a low cost signal. The probability of a review conditional on a high signal is independent of PUC term length for the same reason as in Proposition 2: no (motivation) type of regulator has an incentive to deviate from generous decisions upon receipt of a high cost signal.

There are again two ways to take the theoretical model to the data. From Proposition 3 part (iii), the probability that a PUC initiates a review conditional only on $term$ and $\mathbf{z}$ is given by

$$\Pr(file = 1 \mid term, \mathbf{z}) = \Pr(s = l \mid term, \mathbf{z}) \left[1 - \tfrac{\theta B^o(l, g\lambda(term, \mathbf{z}))}{(2\theta - 1)}\right], \tag{3.13}$$

yielding the estimable equation given in (3.9). Assuming that $\Pr(s = l)$ is independent of

[23] A derivation of this lower bound, λ'', is given in the Appendix. It is straightforward to show that $\lambda'' > 0$ only if H is sufficiently high.

PUC term length, the partial effect of term length depends on $\partial B^o(l, g, \lambda(term, \mathbf{z}))/\partial term$. As Figure 3.2 illustrates, Proposition 4 implies that β should be non-positive.

Similarly, the probability that a PUC initiates a review conditional on $term$, $\mathbf{z}$ and the proxy for PUC's cost signal is given by

$$\Pr(file = 1 \mid term, l, \mathbf{z}) = 1 - \tfrac{\theta B^o(l, g\lambda(term, \mathbf{z}))}{(2\theta - 1)} \tag{3.14}$$

$$\Pr(file = 1 \mid term, h, \mathbf{z}) = 0 \tag{3.15}$$

yielding the estimable equation given in (3.12). Proposition 4 then implies that: (i) α_1 should be zero since term length continues to have no effect in a high cost signal state; (ii) α_2 should now be negative since term length should have a negative effect in a low cost signal state resulting in a negative difference in slopes; and (iii) α_3 should be positive since the intercept given a low cost signal should, again, be greater than under a high cost signal.

3.3. The Data

My dependent variable and proxy for reputational concerns, PUC term length, are taken from the rich, but unfortunately historical, annuals published by the National Association of Regulatory Utility Commissioners (NARUC) between 1974-1990. These yearbooks list a filing date for all ongoing rate cases but, unfortunately, do not consistently report who (firm or PUC) filed. Since the PUCs that provided this information are unlikely to represent a random sample I use all reported reviews and include in $\mathbf{z}$ variables likely to be correlated with a firm's propensity to initiate a review and the variables of interest.[24] For clarity, I refer to this variable as $review_{it}$, where $review_{it} = 1$ if firm i faces a new review in year t and 0 otherwise.

The firm-level data needed to construct a cost-signal proxy is most readily available for the electric industry. The Energy Information Agency (EIA) published financial statistics by major inverstor-owned electric utility and calender year although, unfortunately, not by State served until 1996. To minimise mistakes in attributing cost signals, I focus on the 99 firms that served residential customers in a single State for the 10 years back from 1990.[25] Recalling the earlier claim that a PUC receives a 'low' signal iff $E(O_t + rA_t) < R_{t'} - C$, a simple cost signal proxy is the binary variable neg_{it}, where $neg_{it} = 1$ if firm i's opex has been falling (e.g. $opex_{i,t-1} - opex_{i,t-2} < 0$) and 0 otherwise. Given neg_{it} is a valid proxy only if r and A_t are constant and C is small, I also consider the continuous proxy lagged percentage change in opex, $opexlpch_{it}$. If variation in A_t and the size of C are proportional to firm size, PUCs should be most likely to receive a low signal following large percentage falls in opex and least likely to receive a high signal following large percentage rises in opex. Since all firms are paired with a

[24] As outlined in Section 3.6, I also perform a robustness check by regressing average revenue on PUC term length and a vector of controls.

[25] For convenience, I exclude 10 firms that enter or leave the EIA yearbooks for innocuous reasons between 1980-1990. For details see Table C.1.

single PUC, $term_{it}$ denotes the statutory term length at firm i's PUC recorded in the NARUC yearbook at time t.

[Table 3.1 about here]

As Table 3.1 illustrates, the data set used to estimate (3.9) and (3.12) is a balanced panel of 99 electric utilities serving 39 States between 1982-1990 ($NT = 99 \times 9 = 891$ where $t = 1980, 1981$ are lost in construction of the cost signal proxies). Descriptive statistics for all variables are given in Appendix Tables C.2-C.3.

Before turning to the regression analysis, it is useful to highlight a few key features of the raw data. Figure 3.3(a) depicts sample averages of the incidence of reviews and term lengths using the full series available in the NARUC yearbooks. The average percentage of sample firms exhibits three notable trends: a sharp rise to over 60% prior to the sample period in the late 1970's; a steady decline to around 30% during the first half of the sample period; and finally significant volatility in the aftermath of the oil price collapse in 1986. In contrast, average PUC term-length displays a clear downward time trend throughout.

[Figure 3.3 about here]

Figure 3.3(b) disaggregates average PUC term-length by *switching status*. Of the 39 sample States, only 11 changed their PUC term length between 1974-1990. As Figure 3.3(c) illustrates, there were 6 pre-sample switching (PS) States (CT, MA, LA, KY, NJ, ME affecting 20 PS-firms) and 5 sample switching (S) States (IL, OH, MD, PA, CO affecting 22 S-firms). Three points are worth noting. First, the changes were dispersed evenly over time, suggesting that common macro factors were unlikely to be driving both term length and the incidence of reviews. Second, all increases in term length were short-lived. By 1990, no PUC had experienced a net gain in PUC term length but 7 (including all 5 S-States) had experienced net losses ranging from 1-5 years. Third, with the exception of CT, the net losers came from the pool of PUCs with long (≥ 6) terms. However, since many States with long-terms did *not* switch (19 NS-States had 6 year terms, and 1, NC, had an 8 year term), both PS and S-States ended the sample period with below average terms of office.

Figure 3.3(d) disaggregates the incidence of reviews by switching status. Comparing S and NS-firms there is clear evidence of a positive correlation between term length and the incidence of reviews. Between 1974-1982 S-firms faced longer PUC terms and, with the exception of 1978, more reviews than NS-firms. By 1986, however, the reverse was true; S-firms faced, on average, shorter PUC terms and fewer reviews than NS-firms. A similar, if more mixed, pattern is true of PS and NS-firms. From 1980 onwards NS-firms faced shorter PUC terms and, with the exception of 1985 and 1990, fewer reviews than NS-firms.

[Figure 3.4 about here]

Figure 3.4 disaggregates the incidence of reviews and opex for the S-firm sub-sample (22 firms, 198 obs.) by State. Two points standout. First, echoing the sample average in panel (f), every S-State experienced a period of falling nominal operating costs during the mid 1980's ($neg_{it} = 1$ for 35 of 198 obs. spanning all bar 3 firms). Second, in every State the time averaged incidence of reviews was higher *before* the decrease in term-length. Given PUCs were regulating gas, telecoms and water utilities in addition to electric firms, it is hard to imagine causality running entirely from the incidence of electric reviews to term length. This claim is substantiated by the normalized plot of the incidence of reviews for S and PS-firms shown in Figure 3.5. The incidence of reviews fails to show any significant decline before term length decreases (the slope of the regression line is $-.495$ with a $p-value$ of .57). Rather, the downward shift *after* term length decreases is suggestive of causality running from term length (and/or variables correlated with term length) to the incidence of reviews.

[Figure 3.5 about here]

3.4. Estimation

The apparent correlation between PUC term length and the incidence of reviews in Figures 3.3 and 3.5 may, of course, be driven (or muted) by other factors. This section outlines three regression techniques intended to control for such omitted variable bias.

Static Unobserved Effects Models (UEMs) I begin by allowing for a row vector of controls $\mathbf{z}_{it}$ (firm, PUC and State socioeconomic/political controls and region dummies), year effects c_t and an unobserved firm level effect c_i. The latter could, for instance, reflect the ever presence of confrontational managers/regulators who enjoy reviews or good regulatory relationships that stave off formal reviews. Letting $\mathbf{x}_{it}$ denote the row vector of all explanatory variables, these models require strict exogeneity of $\mathbf{x}_{it}$ conditional on c_i for consistency. Adopting the notation $\mathbf{x}_i \equiv (\mathbf{x}_{i1}, \mathbf{x}_{i2}, ..., \mathbf{x}_{iT})$, the estimable analogues of (3.9) and (3.12) are therefore

$$\begin{aligned} \Pr(review_{it} &= 1 \mid \mathbf{x}_i, c_i) = \Pr(review_{it} = 1 \mid \mathbf{x}_{it}, c_i) \\ &= G(\beta term_{it} + \mathbf{z}_{it}\boldsymbol{\gamma} + c_i + c_t), \end{aligned} \tag{3.16}$$

and

$$\begin{aligned} \Pr(review_{it} &= 1 \mid \mathbf{x}_i, c_i) = \Pr(review_{it} = 1 \mid \mathbf{x}_{it}, c_i) \\ &= G(\alpha_1 term_{it} + \alpha_2 low * term_{it} + \mathbf{z}_{it}\boldsymbol{\zeta} + c_i + c_t), \end{aligned} \tag{3.17}$$

for $t = 1982, ..., 1990$. The parameters of interest are β, α_1 and α_2.[26]

To exploit the variation in term length between firms, I first estimate Random Effects (RE) Linear Probability and Probit Models. The RE LPM takes G to be the index function and

[26] A proxy for low_{it} is always included in included $\mathbf{z}_{it}$ but, since cost conditions may influence both firms and PUCs, I make no attempt to interpret α_3.

requires the zero conditional mean assumption $E(c_i \mid \mathbf{x}_i) = E(c_i) = 0$ for consistency. The RE Probit Model restricts fitted values to the unit interval by taking G to be the standard Normal cdf but requires the stronger assumption that $c_i \mid \mathbf{x}_i \sim N(0, \sigma_c^2)$ together with the assumption that $review_{i1982}, ..., review_{i1990}$ are independent conditional on $\mathbf{x}_i$ and c_i for consistency.

To relax the assumption that c_i is uncorrelated with $\mathbf{x}_{it}$, I also consider Fixed Effects (FE) Linear Probability and Logit models. When G is linear, a time-demeaning transformation can be used to remove the c_i from the estimating equation. The FE LPM then yields unbiased estimates under strict exogeneity. When G is non-linear such a transformation is no longer possible. An alternative strategy is to take G to be the Logistic cdf and maximise the log likelihood conditional on $\mathbf{x}_i$, c_i and $\Sigma_{t=1982}^{T} y_{it}$ since this conditional distribution does not depend on c_i (see, for instance, Honoré 2002). The downside of this approach is that it also requires conditional independence of $\{review_{it}\}$ in addition to strict exogeneity and, since the distribution of c_i is left unrestricted, fails to deliver estimates of the average partial effect of term length.

Dynamic Pooled Probit Omitting lags of the dependent variable is undesirable since the probability of review in year t is highly likely to depend on the incidence of past reviews. For instance, firms or PUCs that have recently incurred the administrative burden of a review may be less willing to initiate the process afresh. Alternatively, firms or PUCs may learn by doing resulting in a positive, cumulative effect of past reviews. The simplest way to allow for such path dependence is to estimate the dynamic pooled Probit Models,

$$\Pr(review_{it} = 1 \mid review_{i,t-1}, \mathbf{x}_{it}) = \Phi(\rho review_{i,t-1} + \beta term_{it} + \mathbf{z}_{it}\boldsymbol{\gamma} + c_t) \tag{3.18}$$

and

$$\begin{aligned} \Pr(review_{it} &= 1 \mid review_{i,t-1}, \mathbf{x}_{it}) \\ &= \Phi(\rho review_{i,t-1} + \alpha_1 term_{it} + \alpha_2 low * term_{it} + \mathbf{z}_{it}\boldsymbol{\zeta} + c_t) \end{aligned} \tag{3.19}$$

for $t = 1982, ..., 1990$. In the absence of unobserved effects, partial maximum likelihood estimation yields consistent estimates without the need for an assumption of strict exogeneity (see Wooldridge 2002, Ch. 13). In particular, feedback from past reviews into current PUC terms of office is perfectly admissible.

Linear Dynamic Panel Data Models (Linear DPDMs) Allowing for dynamics and unobserved effects in a non-linear model with additional explanatory variables is possible but involved (see Honoré 2002). For this reason I check the robustness of my dynamic pooled Probit results using linear DPDMs. In error component form, these models are given by

$$review_{it} = \rho review_{i,t-1} + \beta term_{it} + \mathbf{z}_{it}\boldsymbol{\gamma} + (c_i + c_t + v_{it}) \tag{3.20}$$

and

$$review_{it} = \rho review_{i,t-1} + \alpha_1 term_{it} + \alpha_2 low * term_{it} + \mathbf{z}_{it}\boldsymbol{\zeta} + (c_i + c_t + v_{it}), \tag{3.21}$$

for $t = 1983, ..., 1990$, where v_{it} is an idiosyncratic error term.[27]

It will be helpful to review why pooled OLS, RE and FE estimation of (3.20) and (3.21) is inappropriate. First, $review_{i,t-1}$ is necessarily positively correlated with c_i having previously been on the LHS of (3.20). This precludes a RE analysis and implies that a pooled OLS approach will produce inconsistent parameter estimates.[28] Second, v_{it} is necessarily correlated with future values of the lagged dependent variable. Thus, while the Within (fixed effects) transformation successfully removes c_i, failure of strict exogeneity results in estimates of ρ that are biased downwards, at least for small T (see Bond 2002).

Consistent estimation of β, α_1 and α_2 therefore requires a transformation to remove c_i and instrumentation for pre-determined and endogenous explanatory variables. I follow Arellano and Bond (1991) in first differencing to remove c_i and, assuming that $\{v_{it}\}$ is serially uncorrelated, using lagged levels as instruments in a GMM procedure. Taking (3.20) as an example, first differencing yields

$$\Delta review_{it} = \rho \Delta review_{i,t-1} + \beta \Delta term_{it} + \Delta \mathbf{z}_{it}\boldsymbol{\gamma} + \Delta c_t + \Delta v_{it} \tag{3.22}$$

for $t = 1984, ...1990$. A valid instrument for $\Delta review_{i,t-1}$ must be correlated with $\Delta review_{i,t-1}$ and orthogonal to Δv_{it}. Providing that $review_{i1}$ is pre-determined and $\{v_{it}\}$ is serially uncorrelated, I can exploit the moment condition $E(review_{is}\Delta v_{it}) = 0$ for $s = 1, 2, ..., t-2$ and hence, at time t, use up to $t-2$ instruments for $\Delta review_{i,t-1}$. Different instruments are available for $\Delta term_{it}$ and $\Delta \mathbf{z}_{it}$ depending on their correlation with v_{it}. I take a parsimonious approach and allow for contemporaneous correlation.

Since first-differencing controls for unobserved firm-level effects and contemporaneous correlation is admissible, I drop $\mathbf{z}_{it}$. Despite this, the relatively long series for $review_{it}$ still gives rise to a large number of over-identifying restrictions. Given GMM estimators using many overidentifying restrictions are known to have poor finite sample properties (see Wooldridge 2002, Ch. 11), I focus on instrument sets that use lagged levels no earlier than $t-3$. One-step estimates with robust standard errors are used for inference but two-step results are used to conduct a Sargan test of the validity of the moment conditions (see Bond 2002). I also test the key identifying assumption of no serial correlation in $\{v_{it}\}$.

[27]The Stata command for linear dynamic panel data (xtabond) drops $t = 1982$ when constructing the lagged dependent variable. To facilitate a comparison across models, I drop observations for 1982 when estimating the static LPMs (see Tables 3.2-3.5).

[28]If $review_{i,t-1}$ alone is correlated with c_i pooled OLS estimates of ρ should be biased upwards. Standard results for omitted variables bias imply that $\boldsymbol{\beta}$ is also likely to be inconsistently estimated.

3.5. Results

Providing that my proxies for reputational concerns and the signal state are valid, it is straightforward to test between the MSH and CH: a finding that $\beta > 0$ and/or $\alpha_2 > 0$ ($\alpha_2 < 0$ if $opexlpch_{it}$ is used in place of neg_{it}) permits a rejection of the CH in favour of the MSH and vice versa. Throughout this Section I focus on statistical tests of these coefficients, postponing a discussion of their economic significance and any policy implications to Section 4.

Linear Probability Models (Tables 3.2-3.4) Table 3.2 reports static and dynamic LPM estimates of β. It is useful to begin by comparing the difference between the Static OLS and FE estimates, with and without the vector of 'full controls' $\mathbf{z}_{it}$.[29] In the absence of controls, columns (a),(b), the difference is small but with controls, columns (c),(d) OLS and FE yield practically identical estimates, while, as noted in note 1, RE collapses back to OLS. These findings suggest that $\mathbf{z}_{it}$ does a reasonable job of mopping up unobserved firm-level effects. Further evidence is apparent in the OLS residuals. The column (a) residuals exhibit second order, but no obvious first order, serial correlation, while the column (c) residuals exhibit no second order, but significant *negative* first order, serial correlation. Again, this suggests that $\mathbf{z}_{it}$ removes a positively autocorrelated component from the error term.

[Table 3.2 about here]

The existence of negative serial correlation suggests that a dynamic specification may be more appropriate. Columns (f)-(j) report dynamic OLS, FE and Diff GMM estimates of β and ρ with year effects but without full controls. Two results confirm that the Diff GMM models in columns (h)-(j) are well-specified. First, the Diff GMM estimates of ρ lie between the OLS and FE estimates as the theory predicts. In fact, the OLS estimate of ρ in column (f) is biased upwards to zero and hence preserves the estimate of β and lack of first order serial correlation from column (a). Second, the first differenced residuals exhibit significant first, but not second, order serial correlation as required by the key identifying assumption of no serial correlation in $\{v_{it}\}$.

Columns (h)-(j) consider different instrument sets. The increase in the Sargan statistic moving from column (h) to (i) provides some evidence that PUC term length is not *strictly* exogenous (conditional only on c_i and year effects). However, a difference Sargan test of the Sargan statistics in columns (i) and (j) fails to reject the null hypothesis that $term_{it}$ is predetermined rather than endogenous. By way of comparison, column (e) reports dynamic OLS

[29] The vector of controls includes: (i) factors likely to affect a firm's propensity to initiate rate reviews (lagged Δopex, fuel costs as a proportion of opex, lagged profit and, as a proxy for scale effects, log sales to residential customers); (ii) other PUC institutions; (iii) PUC practice and workload (adjustment mechanisms, valuation standards, test years and the number of regulated utilities); (iii) State socioeconomic/political controls; and (iv) for OLS, region effects. Table C.5 gives details of the coefficients for selected regressions (TO BE INSERTED).

estimates with full controls. If one buys the assertions that $\mathbf{z}_{it}$ mops up c_i and that $term_{it}$ is at least sequentially exogenous, then this simple specification should yield a consistent estimate of β. The estimates in columns (e) and (i) are very similar (as are the implications of the serial correlation tests), while the lower standard errors (reflecting the efficiency of pooled OLS in the absence of c_i) ensure that the positive coefficient on β is significant at 1% against a two-tailed test.

In light of this discussion, columns (e) and (i) are my preferred specifications. Allowing for unobserved effects and dynamics, as well as instrumenting for the potential endogeneity of term length does little to change the story in Figure 3.5. Consistent with the MSH but not the CH, the partial effect of PUC term length β is consistently positive and significant, although only weakly so in the case of the GMM specification.

Tables 3.3 and 3.4 repeat this exercise including the binary and continuous cost signal proxies. Beginning with Table 3.3 (binary proxy), Static OLS and FE with full controls, columns (c)-(d), again yield similar estimates, while there is (weak) evidence that the OLS errors exhibit negative first order serial correlation. Similarly, the Diff GMM estimates of ρ in columns (h)-(k) lie between the OLS and FE estimates, while the first and second order test statistics for serial correlation are consistent with no correlation in $\{v_{it}\}$.

The Sargan statistics suggest that $term_{it}$ is best modelled as pre-determined as before but that neg_{it}, and hence $neg{*}term_{it}$, are best modelled as endogenous. Dynamic OLS with full controls, column (e), yields similar estimates to Diff GMM with a pre-determined instrument set, column (h). However, the differences between columns (e) and (i) suggests that neg_{it} is also endogenous conditional on z_{it}. Interestingly, this correlation actually appears to mute the interaction effect, with α_2 almost trebling in the presence of instruments for neg_{it}. Column (i) is my preferred specification. Consistent with the MSH but not the CH, there is a statistically significant positive interaction effect; the partial effect of term length on the probability of review is positive when a firm's PUC is likely to have received a low cost signal ($neg_{it} = 1$) and zero when a firm's PUC is likely to have received a high cost signal ($neg_{it} = 0$) exactly as the theory predicts.

[Table 3.3 and 3.4 about here]

Table 3.4 (continuous proxy) tell a broadly similar story. The main difference is that a difference Sargan for columns (i) and (j) fails to reject the null hypothesis that $opexlpch_{it}$ and $opexlpch * term_{it}$ (as well as $term_{it}$) are pre-determined rather than endogenous. For this reason, columns (e) and (i) are my preferred specifications. Both yield similar estimates of α_1 and α_2. Consistent with the MSH but not CH, the partial effect of term length when $opexlpch_{it}$ is zero - plausibly still a low cost signal - is positive and significant at 5% against a two tailed test. More importantly, $opexlpch_{it}$ exerts a statistically significant negative effect on the partial effect of term length; term length has a smaller positive impact on the probability of review as a firm's lagged percentage change in operating expenses rises.

Non-linear Models (Tables 3.5-3.7) The non-linear results tell a very similar story to the LPM results. The static pooled Probit estimates in columns (b) are identical to RE Probit but both specifications are dynamically incomplete invalidating usual inference procedures. The FE logit estimates in columns (c) and (d) are also similar to the FE LPM results; the mean effect of term length (β) is positive, while the signs of the interaction terms are consistent with the MSH but are insignificant. Turning to the dynamic pooled Probit estimates in columns (e) and (f), the vector of controls z_{it} again reduces the upwards bias of ρ. Since term length should be at least sequentially exogenous conditional on z_{it} (given the LPM results) and every dynamic specification is dynamically complete, column (f) in Table 3.5 and 3.7 offer reasonably reliable estimates of β and α_2.[30] In contrast, the apparent endogeneity of neg_{it} suggests that column (f) in Table 3.6 is likely to *understate* the magnitude of the interaction effect. As discussed in Section 4.1, the additional controls $npuc_{i,t-1}$ and $ppuc_{it-1}$ are included as a proxy for PUC experience. Interestingly, they actually serve to strengthen the interaction effect.

[Tables 3.5-3.7 about here]

3.6. A Robustness Check: Revenue Regressions

An obvious concern is that firm-side responses to PUC term length (or variables correlated with PUC term length) are driving the above results. I explore this possibility using average revenue data. If firm-side responses (more reviews to increase R_t') are the dominant effect, then PUC term length should have a *positive* partial effect on a firm's average revenue ($pres_{it}$). Since unobserved firm-level, rather than dynamic, effects are likely to be important in determining a firm's average revenue, I estimate Static UEMs. In error component form, the estimating equation is

$$pres_{it} = \phi term_{it} + \mathbf{z}_{it}\boldsymbol{\xi} + (c_i + v_{it})$$

for $t = 1982, ..., 1990$. The parameter of interest is ϕ: a finding that $\phi < 0$ suggests that PUC-side, rather than firm-side, responses likely to be driving the previous results.

[Table 3.8 about here]

The first two columns in Table 3.8 report pooled OLS estimates of ϕ with and without PUC and State-level controls. In both cases ϕ is negative and significant at 5%. However, as expected, the OLS residuals exhibit strong correlation ($corr(\hat{u}_{i,t}, \hat{u}_{i,t-1}) = 0.92$) that is persistent over time indicating the presence of unobserved firm-level heterogeneity. The RE estimate of ϕ in column (iii) is also negative and significant at 5%, while the FE estimate in column (iv) is very similar but only significant at 10%. The RE estimates in column (iii) are

[30] All models are dynamically complete - i.e $\hat{u}_{i,t-1} \equiv review_{it} - \Phi(\hat{\rho} review_{i,t-1} + \hat{\beta} term_{it} + \mathbf{z}_{it}\hat{\gamma})$ is insignificant in the auxiliary pooled probit of $review_{it}$ on $\mathbf{x}_{it}$ and $\hat{u}_{i,t-1}$ - ensuring that standard inference procedures are valid (see Wooldridge 2002, Ch. 15).

preferred since the Hausman test fails to reject the null hypothesis of no correlation between $\mathbf{x}_{it}$ and c_i ($p = .37$). Accordingly, it seems reasonable to conclude that firm-side responses are unlikely to be driving the results in Section 3.5.

4. Discussion

4.1. Squawk, Capture or Learning Effects?

The results reported above tell a consistent story. PUC term length *never* exerts a negative effect on the probability of review. As such, it seems fair to reject the (pure) capture hypothesis. Longer PUC terms of office do not appear to be associated with softer regulatory decision-making.

A far thornier question is whether the empirical analysis has really unearthed any evidence of minimal squawk behavior. The data are certainly *consistent* with the minimal squawk hypothesis. The mean effect of term length (β) on the probability of review is positive and significant in all bar one Diff GMM specification (Table 3.2 column (g)). There is also evidence of a positive and significant interaction effect between term length and falling operating costs. The effect of term length when $neg_{it} = 1$ (α_2) is positive and significant in all bar the static FE analysis. Moreover, the effect of term length when $neg_{it} = 0$ (α_1) disappears to zero, as predicted, once the apparent endogeneity of neg_{it} is accounted for (Table 3.3 column (i)).

The obvious concern, however, is that these effects are entirely due to learning. It may take time for a new Commissioner to 'learn the ropes'. If such a period of familiarization checks a PUC's ability or willingness to initiate rate reviews, then a positive correlation between term length and rate reviews could be due to lower Commissioner turnover. Moreover, Commissioners may 'learn by doing'. If the marginal cost (pecuniary and/or psychic) of filing for review decreases with past reviews, then a positive correlation between term length and rate reviews could be due to scale effects.

The cleanest solution to this problem is to track individual decision-makers over time and identify β and α_2 off variation in time left in office, holding experience (time/cases already served) constant. The construction of such an individual-level data set is beyond the scope of this paper and is therefore left for future research. In the meantime, I highlight two observations that suggest that both learning and minimal squawk behavior may be important.

Holding the percentage of firms reviewed in period $t-1$ ($ppuc_{i,t-1}$) constant (to account for the negative serial correlation apparent in Figure 3.4), the absolute number of firms reviewed in period $t-1$ ($npuc_{i,t-1}$) should act as a crude proxy for experience. That is, reviewing 3 of 6 firms gives greater scope for learning than reviewing 1 of 2. As expected, in column (i) in Tables 3.5-3.7 $ppuc_{i,t-1}$ is negative and $npuc_{i,t-1}$ is positive. More importantly, the inclusion of a proxy for experience decreases the mean effect of term length (compare (f) and (i) in Table 3.5) but increases the interaction effect (compare (f) and (i) in Tables 3.6 and 3.7).

This suggests that learning effects, or at least factors correlated with experience, increase the incidence of reviews in high signal states and hence obscure the observation of minimal squawk behavior.

Further evidence is apparent in Figure 3.5. In steady-state PUCs with shorter terms of office should display stronger reputational concerns and weaker learning effects. Immediately after a decrease in term length, however, only the former should matter; Commissioners will immediately face more imminent unemployment but will not have suddenly lost experience. Clearly, if learning is all that matters, it is hard to explain why the incidence of reviews *shifts* rather than trends downwards (the slope of the 'after' regression line is $-.729$ with a $p-value$ of .37).

4.2. Economic Significance and Implications for Regulatory Agencies

Of course, establishing exactly why longer PUC terms of office are associated with fewer rate reviews and lower prices is irrelevant if the effect is *economically* insignificant. Both the Diff GMM and dynamic pooled Probit models have their disadvantages. The obvious problem with the LPM estimates is the assumed linearity of the coefficients. Since firm-level effects appear unimportant after controlling for $\mathbf{z}_{it}$, I focus on the dynamic pooled Probit estimates.

[Table 3.9 about here]

Table 3.9 reports impact effects on the predicted probability of formal review as PUC term length increases, other things equal, around the sample mean from 5 to 6 years using the estimates dynamic pooled Probit estimates in column (i) in Table 3.7. There is clear evidence of an economically, as well as statistically, significant interaction effect. Moving from 5 to 6 year terms of office has a surprisingly large impact (.1244) at the bottom percentile of $opexlpch_{it}$ but *no* effect at the top percentile. Averaging over the distribution of $opexlpch_{it}$ the effect is .0634. Moreover, such behavior appears to have had a real impact on residential customers. Other things equal, an additional statutory year of office increases average revenue from residential customers by .0666 cents per kwh. Between 1980-1990 average US household electricity consumption was 105 million BTU, implying that a one year reduction in PUC term length cost the average family an extra \$20.50 per year.[31]

One policy implication is therefore clear cut: US States currently using short contracts (≤ 5 years) should consider raising their PUC terms of office. It is important to stress that this is not the advocation for "jobs for life for our premier watchdogs" that some have reported.[32] The data appear to reject one motivational extreme (bribable, no reputational concerns). They cannot, however, distinguish between the other extreme (not bribable, reputational concerns)

[31] 1kwh = 3412 BTU. Figures taken from the EIA's Annual Energy Review 2002, available at www.eia.doe.gov/emu/aer/pdf/pages/sec2.pdf

[32] The Guardian, March 27, 2002.

and a world where both motives are present but, given the prevailing institutions, firms found it optimal to 'squawk' rather than 'capture'. When both motives are present the relationship between the probability of review and PUC term length is likely to be non-monotonic. Thus, absent further analysis, it would be just as naive to optimistically proscribe long-term contracts as it was of the proponents of the capture hypothesis to argue in the other direction.

If the interaction effect identified in the data is indicative of minimal squawk behavior then the policy implications of this analysis widen to other institutions. It would be churlish to suggest that reformers should stifle reputational concerns across the board. However, in settings where there is limited scope for incentive effects (e.g. effort to improve signal accuracy) it may be desirable to hire fewer "professionals" (Wilson 1989) with a high outward focus (high δ). A related point, suggested by Proposition 3, is to staff regulatory agencies with older commissioners (lower δ) drawn from a homogenous, but possibly less able, recruiting pool (lower Δ_θ). Such a policy would decrease 'market' uncertainty over ability and hence prompt less able regulators to take tough decisions more often (higher p_D^o).

4.3. Application to Other Government Agencies

The analysis has so far been couched in terms of utility regulation. I now briefly discuss whether other government agencies are likely to be susceptible to minimal squawk behavior. To be completed.

5. Concluding Remarks

To be completed.

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Appendix

A. Proofs

To prove Proposition 1 it will be helpful to first state a series a Lemmas characterising equilibrium behavior in the four sub-games between the regulator and evaluator induced by the firm's choice of disclosure rule.

Lemma 1. *When the firm plays 'no disclosure', for any δ, there exists a unique pooling sub-game equilibrium with $\sigma_S^o = \sigma_D^o = (1, 0)$.*

Proof. Under 'no disclosure' the evaluator observes either t or g. The regulator's problem is therefore given by

$$\max_{p_i, q_i} \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right) W + \delta\left[\tfrac{1}{2}(p_i + q_i)\mu(t) + \tfrac{1}{2}(2 - p_i - q_i)\mu(g)\right], \tag{A.1}$$

where $\mu(t)$ and $\mu(g)$ are given in (2.2) and (2.3). Differentiating (A.1) wrt to p_i and q_i yields

$$\frac{\partial E[U_i]}{\partial p_i} = (\theta_i - \tfrac{1}{2})W + \delta\left[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}\mu(g)\right] \tag{A.2}$$

$$\frac{\partial E[U_i]}{\partial q_i} = (\tfrac{1}{2} - \theta_i)W + \delta\left[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}\mu(g)\right]. \tag{A.3}$$

and

$$\frac{\partial E[U_S]}{\partial p_S} - \frac{\partial E[U_D]}{\partial p_D} = \frac{\partial E[U_D]}{\partial q_D} - \frac{\partial E[U_S]}{\partial q_S} = \Delta_\theta W > 0. \tag{A.4}$$

Existence. Suppose $\mu(t) = \mu(g) = \frac{1}{2}$. Since $(\theta_i - \frac{1}{2})W > 0\ \forall i$, (A.2) is strictly positive and (A.3) strictly negative $\forall i$ and hence (A.1) has a unique solution characterised by $p_i^o = 1, q_i^o = 0\ \forall i$. Substituting for these strategies in (2.2) and (2.3) the evaluator's beliefs are as stated and hence such an equilibrium exists.

Uniqueness. Suppose that $\mu(t) > \mu(g)$. From (2.2) and (2.3) we require $\widetilde{p}_S + \widetilde{q}_S > \widetilde{p}_D + \widetilde{q}_D$. Given these beliefs, (A.2) is strictly positive $\forall i$ implying $p_S^o = p_D^o = 1$. However, (A.4) is also strictly positive implying $q_D^o \geq q_S^o$. Thus $p_S^o + q_S^o \leq p_D^o + q_D^o$ inducing a contradiction. Analogous reasoning rules out $\mu(t) < \mu(g)$. Alternatively, suppose $\mu(t) = \mu(g)$. If these beliefs have been derived from Bayes' Rule then, from (2.2) and (2.3), we require $\widetilde{p}_S = \widetilde{p}_D$, $\widetilde{q}_S = \widetilde{q}_D$ and $2 > \widetilde{p}_S + \widetilde{q}_S > 0$.which implies that $\mu(t) = \mu(g) = \frac{1}{2}$. Thus, given passive beliefs, $\mu(t) = \mu(g) = \frac{1}{2}$ for any $\widetilde{p}_S = \widetilde{p}_D$, $\widetilde{q}_S = \widetilde{q}_D$. But then we know from above that $p_i^o = 1, q_i^o = 0\ \forall i = S, D$ is the unique solution to (A.1) given these beliefs. ■

Lemma 2. *When the firm plays 'squawk on tough' there exists a critical value of δ, $\delta^* > 0$, such that:*

(i) iff $\delta \leq \delta^*$ then there exists a pooling sub-game equilibrium with $\sigma_S^o = \sigma_D^o = (1, 0)$;

(ii) iff $\delta > \delta^*$ then there exists a hybrid sub-game equilibrium with $\sigma_S^o = (1,0)$ and $\sigma_D^o = (p_D^o, 0)$ for some $p_D^o > 0$.

Proof. Under 'squawk on tough' the regulator's decision problem is given by (2.6) and the evaluator's beliefs by (2.3)-(2.5). Differentiating (2.6) wrt to p_i and q_i yields

$$\begin{aligned}
\tfrac{\partial E[U_i]}{\partial p_i} &= (\theta_i - \tfrac{1}{2})W + \delta\left[\tfrac{1}{2}\theta_i\mu(l,t) + \tfrac{1}{2}(1-\theta_i)\mu(h,t)\tfrac{1}{2} - \mu(g)\right] && \text{(A.5)}\\
\tfrac{\partial E[U_i]}{\partial q_i} &= (\tfrac{1}{2} - \theta_i)W + \delta\left[\tfrac{1}{2}(1-\theta_i)\mu(l,t) + \tfrac{1}{2}\theta_i\mu(h,t)\tfrac{1}{2} - \mu(g)\right] && \text{(A.6)}\\
\tfrac{\partial E[U_i]}{\partial p_i} - \tfrac{\partial E[U_j]}{\partial qj} &= (\theta_i + \theta_j - 1)W + \delta\left[\tfrac{1}{2}(\theta_i + \theta_j - 1)(\mu(l,t) - \mu(h,t))\right] && \text{(A.7)}
\end{aligned}$$

for $i, j = S, D$ and

$$\begin{aligned}
\tfrac{\partial E[U_S]}{\partial p_S} - \tfrac{\partial E[U_D]}{\partial p_D} &= \tfrac{\partial E[U_D]}{\partial q_D} - \tfrac{\partial E[U_S]}{\partial q_S}\\
&= \Delta_\theta W + \delta\left[\tfrac{1}{2}\Delta_\theta(\mu(l,t) - \mu(h,t))\right]. && \text{(A.8)}
\end{aligned}$$

Existence (pooling). Suppose that the evaluator's beliefs are given by

$$\mu(g) = \tfrac{1}{2},\ \mu(l,t) = \frac{\theta_S}{\theta_S + \theta_D} \text{ and } \mu(h,g) = \frac{1-\theta_S}{2 - \theta_S - \theta_D} \qquad \text{(A.9)}$$

and $\delta \leq \delta^*$, where

$$\delta^* = (\theta_i - \tfrac{1}{2})W\left(\frac{4(2-\theta_S-\theta_D)(\theta_S+\theta_D)}{(\theta_S-\theta_D)^2}\right).$$

Substituting for (A.9) in (A.5) yields,

$$\tfrac{\partial E[U_S]}{\partial p_S} = (\theta_S - \tfrac{1}{2})W + \delta\left[\frac{(\theta_S-\theta_D)^2}{4(2-\theta_S-\theta_D)(\theta_S+\theta_D)}\right] > 0$$

and

$$\tfrac{\partial E[U_D]}{\partial p_D} = (\theta_D - \tfrac{1}{2})W + \delta\left[\frac{(\theta_S-\theta_D)^2}{4(2-\theta_S-\theta_D)(\theta_S+\theta_D)}\right]$$

which may be positive or negative depending on δ. Similarly, substituting for (A.9) in (A.6) yields,

$$\tfrac{\partial E[U_S]}{\partial q_S} = (\tfrac{1}{2} - \theta_S)W + \delta\left[\frac{(\theta_S-\theta_D)(3\theta_S+\theta_D-2)}{4(2-\theta_S-\theta_D)(\theta_S+\theta_D)}\right] < 0$$

and

$$\tfrac{\partial E[U_D]}{\partial q_D} = (\tfrac{1}{2} - \theta_S)W + \delta\left[\frac{(\theta_S-\theta_D)(\theta_S+3\theta_D-2)}{4(2-\theta_S-\theta_D)(\theta_S+\theta_D)}\right] < 0.$$

Given $\delta \leq \delta^*$, it follows that $p_i^o = 1, q_i^o = 0\ \forall i$.is a solution to (2.6). From (2.3)-(2.5) the evaluator's beliefs are indeed as stated and hence such an equilibrium exists.

Existence (hybrid). Suppose that the evaluator's beliefs are given by

$$\begin{aligned} \mu(g) &= \frac{1}{3-\widetilde{p}_D},\ \mu(l,t)=\frac{\theta_S}{\theta_S+\widetilde{p}_D\theta_D} \\ \text{and } \mu(h,g) &= \frac{1-\theta_S}{(1-\theta_S)+\widetilde{p}_D(1-\theta_D)}, \end{aligned} \tag{A.10}$$

and $\delta > \delta^*$.

When $\widetilde{p}_D = 1$ (A.10) is the same as (A.9). So, from above, given $\delta > \delta^*$, $\frac{\partial E[U_D]}{\partial p_D} < 0$ implying $p_D = 0$. In contrast, when $\widetilde{p}_D = 0$, $\mu(l,t) = \mu(h,t) = 1$ and $\mu(g) = \frac{1}{3}$. Substituting for these beliefs in (A.5) yields $\frac{\partial E[U_D]}{\partial p_D} > 0$ implying $p_D = 1$. It is straightfoward to show that

$$\frac{\partial^2 E[U_D]}{\partial p_D \partial \widetilde{p}_D} < 0,$$

(i.e. D's incentive to choose g following $s = l$ decreases the more likely the market thinks she is to play 'always generous'). Thus there must exist a unique value of $\widetilde{p}_D$, $\widetilde{p}_D^*(\delta, \mathbf{z})$ such that

$$\frac{\partial E[U_D]}{\partial p_D}\,|_{\widetilde{p}_D^*} = 0$$

thereby supporting $p_D^o = \widetilde{p}_D$. Note that $\widetilde{p}_D^* \in (\underline{\widetilde{p}}_D, 1)$ where $\underline{\widetilde{p}}_D$ solves

$$\mu(g) = \theta_D \mu(l,t) + (1-\theta_D)\mu(h,g).$$

Given the beliefs in (A.10) we have

$$\mu(l,t) - \mu(h,t) = \frac{\widetilde{p}_D \Delta_\theta}{(\theta_S + \widetilde{p}_D\theta_D)(1-\theta_S+\widetilde{p}_D(1-\theta_D))}$$

which is strictly positive for any $\widetilde{p}_D \in [0,1)$. Thus, using the definition of $\widetilde{p}_D^*$, it follows from (A.8) that (A.5) must strictly positive for $i = S$ supporting $p_S^o = 1$. Similarly, it follows from (A.7) that (A.6) must be strictly negative for $i = D$ and hence from (A.8) that (A.6) strictly negative for $i = S$ supporting $q_S^o = q_D^o = 0$. From (2.3)-(2.5) the evaluator's beliefs are therefore as stated and hence such an equilibrium exists. ■

Lemma 3. *When the firm plays 'squawk on generous' there exists a critical value of δ, $\delta^* > 0$, such that:*

(i) iff $\delta \le \delta^*$ then there exists a pooling sub-game equilibrium with $\sigma_S^o = \sigma_D^o = (1,0)$;

(ii) iff $\delta > \delta^*$ then there exists a hybrid sub-game equilibrium with $\sigma_S^o = (1,0)$ and $\sigma_D^o = (1, q_D^o)$ for some $q_D^o < 1$.

Proof. This is exactly analogous to the proof of Lemma 2. ■

Lemma 4. *When the firm plays 'full disclosure', for any δ, there exists a pooling sub-game equilibrium with $\sigma_S^o = \sigma_D^o = (1,0)$.*

Proof of Lemma 4. Under 'full disclosure' the evaluator may observe an of the four regulatory outcomes. The regulator's problem is therefore given by

$$\max_{p_i,q_i} \tfrac{1}{2}\left(1+p_i(2\theta_i-1)+q_i(1-2\theta_i)\right)W+$$
$$\delta\left[\begin{array}{c} \frac{1}{2}\left(q_i+(p_i-q_i)\theta_i\right)\mu(l,t)+\frac{1}{2}\left(p_i-(p_i-q_i)\theta_i\right)\mu(h,t)+ \\ \frac{1}{2}\left(1-q_i-(p_i-q_i)\theta_i\right)\mu(l,g)+\frac{1}{2}\left(1-p_i+(p_i-q_i)\theta_i\right)\mu(h,g) \end{array}\right] \tag{A.11}$$

where the evaluator's beliefs are given in (2.4) and (2.5) and by Bayes' Rule,

$$\mu(l,g)=\frac{(1-\widetilde{p}_S)\theta_S+(1-\widetilde{q}_S)(1-\theta_S)}{(1-\widetilde{p}_S)\theta_S+(1-\widetilde{q}_S)(1-\theta_S)+(1-\widetilde{p}_D)\theta_D+(1-\widetilde{q}_D)(1-\theta_D)} \tag{A.12}$$

and

$$\mu(h,g)=\frac{(1-\widetilde{p}_S)(1-\theta_S)+(1-\widetilde{q}_S)\theta_S}{(1-\widetilde{p}_S)(1-\theta_S)+(1-\widetilde{q}_S)\theta_S+(1-\widetilde{p}_D)(1-\theta_D)+(1-\widetilde{q}_D)\theta_D}. \tag{A.13}$$

Differentiating (A.11) wrt to p_i and q_i yields

$$\frac{\partial E[U_i]}{\partial p_i}=(\theta_i-\tfrac{1}{2})W+\delta\left[\begin{array}{c} \frac{1}{2}\theta_i\mu(l,t)+\frac{1}{2}(1-\theta_i)\mu(h,t) \\ -\frac{1}{2}\theta_i\mu(l,g)-\frac{1}{2}(1-\theta_i)\mu(h,g) \end{array}\right] \tag{A.14}$$

$$\frac{\partial E[U_i]}{\partial q_i}=(\tfrac{1}{2}-\theta_i)W+\delta\left[\begin{array}{c} \frac{1}{2}(1-\theta_i)\mu(l,t)+\frac{1}{2}\theta_i\mu(h,t) \\ -\frac{1}{2}(1-\theta_i)\mu(l,g)-\frac{1}{2}\theta_i\mu(h,g) \end{array}\right]. \tag{A.15}$$

Suppose that

$$\begin{aligned} \mu(l,t) &= \mu(h,g)=\frac{\theta_S}{\theta_S+\theta_D} \text{ and} \\ \mu(l,g) &= \mu(h,t)=\frac{1-\theta_S}{2-\theta_S-\theta_D}. \end{aligned} \tag{A.16}$$

Substituting for (A.16) in (A.14) yields

$$\frac{\partial E[U_i]}{\partial pi}=(\theta_i-\tfrac{1}{2})H_r+\delta\left[\frac{(2\theta_i-1)(\theta_S-\theta_D)}{2(2-\theta_S-\theta_D)(\theta_S+\theta_D)}\right]>0\ \forall i.$$

Similarly substituting for (A.16) in (A.15) yields

$$\frac{\partial E[U_i]}{\partial q_i}=(\tfrac{1}{2}-\theta_i)H_r-\delta\left[\frac{(2\theta_i-1)(\theta_S-\theta_D)}{2(2-\theta_S-\theta_D)(\theta_S+\theta_D)}\right]<0\ \forall i.$$

It therefore follows that, for any δ, $p_i^o=1, q_i^o$ is a solution to (A.11). From (2.4), (2.5), (A.12) and (A.13) the evaluator's beliefs are as stated and hence such an equilibrium exists.

Having characterised equilibrium behavior in the four sub-games, all that remains is to solve for the firm's optimal choice of disclosure rule.

Proof of Proposition 1. The firm's problem can be written as

$$\max_d E[v(\omega, a(d, \theta_i)] = \sum_{i=S,D} \Pr(\theta_i) \left[\sum_{\omega,a} \Pr(\omega, a \mid \theta_i, \sigma_i(d)) \, v(\omega, a) \right].$$

Suppose that $\sigma_S^o = \sigma_D^o = (1, 0)$. Then $E[v(l, a)] = \frac{1}{2}(\theta_S + \theta_D)L + \frac{1}{2}(2 - \theta_S - \theta_D)H$ and $E[v(h, a)] = \frac{1}{2}(\theta_S + \theta_D)L$. W.l.o.g, let $H = 2L$, yielding $E[v(\omega, a)] = L$. Now suppose that $\sigma_S^o = (1, 0)$ and $\sigma_D^o = (1, 1)$. Given $E[v(\omega, a) \mid \theta_D] = \frac{1}{2}L$ we have $E[v(\omega, a)] = \frac{3}{4}L$. Thus when $\sigma_S^o = (1, 0)$ and $\sigma_D^o = (1, q_D^o)$ $E[v(\omega, a)] \in (\frac{3}{4}L, L)$. Analogously, when $\sigma_S^o = (1, 0)$ and $\sigma_D^o = (p_D^o, 1)$ $E[v(\omega, a)] \in (L, \frac{3}{2}L)$. Given Lemmas 1- 4, the firm will be indifferent between disclosure rules when $\delta \leq \delta^*$ but will play 'squawk on tough' when $\delta > \delta^*$, since this disclosure rule biases regulatory policy in its favour. ■

Proof of Proposition 2. Let the function $\delta_{mix\ p}(\theta_S, \theta_D, W, \widetilde{p}_D)$ denote the values of δ such that D is willing to mix on $s = l$, given $\widetilde{p}_S = 1$ and $\widetilde{q}_S = \widetilde{q}_D = 0$. Note $\delta^* = \delta_{mix\ p}(\theta_S, \theta_D, W, 1)$, implying that δ^* gives the value of δ beyond which D mixes on $s = l$. First note from Lemma 2 that S has no reputational incentive to deviate from setting t when $s = l$ for any $\widetilde{p}_D$. From above, for D to mix on $s = l$, we require

$$\tfrac{\partial E[U_D]}{\partial p_D} = (\theta_D - \tfrac{1}{2})W + \delta \left[\tfrac{1}{2}\theta_D \mu(l, t) + \tfrac{1}{2}(1 - \theta_D)\mu(h, t) - \tfrac{1}{2}\mu(g) \right] = 0.$$

Define the function

$$Z(\theta_S, \theta_D, \widetilde{p}_D) = \mu(g) - \theta_D \mu(l, t) - (1 - \theta_D)\mu(h, t).$$

Substituting for the market's beliefs when $\widetilde{\sigma}_S = (1, 0)$ and $\widetilde{\sigma}_D = (\widetilde{p}_D, 0))$ yields

$$Z = \frac{1}{(3 - \widetilde{p}_D)} - \frac{(1 - \theta_S)(1 - \theta_D)}{(1 - \theta_S - \widetilde{p}_D(1 - \theta_D))} - \frac{\theta_S \theta_D}{(\theta_S + \widetilde{p}_D \theta_D)}.$$

Differentiating Z wrt to $\widetilde{p}_D$ gives

$$\tfrac{\partial Z}{\partial \widetilde{p}_D} = \frac{1}{(3 - \widetilde{p}_D)^2} + \frac{(1 - \theta_S)(1 - \theta_D)^2}{(1 - \theta_S - \widetilde{p}_D(1 - \theta_D))^2} + \frac{\theta_S {\theta_D}^2}{(\theta_S + \widetilde{p}_D \theta_D)^2} > 0.$$

Given the definition of $\delta_{mix\ p}$ we have

$$\delta_{mix\ p} = \frac{(2\theta_D - 1)W}{Z(\theta_S, \theta_D, \widetilde{p}_D)}$$

implying $\delta_{mix\ p}$ must be decreasing in $\widetilde{p}_D$. Thus $\widetilde{p}_D$ - and hence the probability that the unable regulator plays 'follow' - decreases as δ increases. ■

Proof of Proposition 3. Let $\underline{\widetilde{p}}_D$ solve $\mu(g) = \theta_D \mu(l, t) + (1 - \theta_D)\mu(h, t))$ when $\widetilde{\sigma}_S = (1, 0)$ and $\widetilde{\sigma}_D = (\widetilde{p}_D, 0)$. It then follows that Z must be strictly positive for any $\widetilde{p}_D \in (\ \underline{\widetilde{p}}_D, 1]$ and hence that $\delta_{mix\ p}$ is increasing in W as stated. Differentiating Z wrt to θ_S yields, after some re-arrangement,

$$\frac{\partial Z}{\partial \theta_S} = \frac{\widetilde{p}_D(\theta_S - \theta_D)(\theta_S + \theta_D - 2\theta_S\theta_D + 2\widetilde{p}_D(1-\theta_D)\theta_D)}{(\theta_S + \widetilde{p}_D\theta_D)^2((1-\theta_S + \widetilde{p}_D(1-\theta_D))^2}$$

which by inspection is strictly positive for any $\widetilde{p}_D \in (0,1]$. Thus $\delta_{mix\ p}$ must be decreasing in θ_S. Differentiating Z wrt to θ_D yields, after some re-arrangement,

$$\frac{\partial Z}{\partial \theta_D} = \frac{\widetilde{p}_D(\theta_S - \theta_D)(\widetilde{p}_D(2\theta_S\theta_D - \theta_S - \theta_D) - 2(1-\theta_S)\theta_S)}{(\theta_S + \widetilde{p}_D\theta_D)^2((1-\theta_S + \widetilde{p}_D(1-\theta_D))^2}$$

which by inspection is strictly negative for any $\widetilde{p}_D \in (0,1]$. Thus, given the definition of $\delta_{mix\ p}$, it follows that $\delta_{mix\ p}$ is increasing in θ_D. ■

Proof of Proposition 4. Since the firm has no incentive to reward the regulator for taking tough decisions it must set $B(l,t) = B(h,t) = 0$. Denoting the remaining bribes by $B_l \equiv B(l,g)$ and $B_h \equiv B(h,g)$, a type W regulator then solves

$$\begin{aligned} \max_{p,q} \Pr(s &= l)\left\{p\theta W + (1-p)\left[\theta B_l + (1-\theta)\left(W + B_h\right)\right]\right\} + \\ \Pr(s &= h)\left\{q(1-\theta)W + (1-q)\left[\theta\left(W + B_h\right) + (1-\theta)B_l\right]\right\} \end{aligned} \tag{A.17}$$

and hence plays 'always generous' ($p = q = 0$) iff $W \leq \frac{\theta B_l + (1-\theta)B_h}{2\theta - 1}$ and 'follow' ($p = 1$, $q = 0$) otherwise.

Anticipating the regulator's strategy, the firm expects a generous decision with probability

$$\Pr(g \mid s = l, \theta, B_l, B_h) = F\left(\frac{\theta B_l + (1-\theta)B_h}{2\theta - 1}\right) = \frac{\theta B_l + (1-\theta)B_h}{2\theta - 1} \tag{A.18}$$

$$\Pr(g \mid s = h, \theta, B_l, B_h) = 1 \tag{A.19}$$

where the last equality follows from the fact that F is uniform on $[0,1]$. The firm's problem can therefore be expressed as

$$\begin{aligned} \max_{B_l,\, B_h} E[V] = {} & \Pr(\omega = l)\underbrace{\left[\theta\left(\frac{\theta B_l + (1-\theta)B_h}{(2\theta-1)}\right) + (1-\theta)\right]}_{\Pr(l,g)}\left[H - (1+\lambda)B_l\right] + \\ & \Pr(\omega = l)\underbrace{\left[\theta\left(1 - \frac{\theta B_l + (1-\theta)B_h}{(2\theta-1)}\right)\right]}_{\Pr(l,t)} L + \\ & \Pr(\omega = h)\underbrace{\left[\theta + (1-\theta)\left(\frac{\theta B_l + (1-\theta)B_h}{(2\theta-1)}\right)\right]}_{\Pr(h,g)}\left[L - (1+\lambda)B_h\right] \end{aligned} \tag{A.20}$$

subject to the constraints non-negativity constraints $B_l \geq 0$ and $B_h \geq 0$ and the inequality constraint $\frac{\theta B_l + (1-\theta)B_h}{2\theta - 1} \leq 1$.

This problem yields three Kuhn-Tucker necessary conditions for a maximum

$$\begin{aligned}
\tfrac{\theta[\theta(H-L)+(1-\theta)L-(\theta B_l+(1-\theta)B_h)2(1+\lambda)]}{2(2\theta-1)}-\tfrac{(1-\theta)(1+\lambda)}{2} &\leq \tfrac{\gamma\theta}{2\theta-1} \text{ and } B_l \geq 0 && \text{(A.21)}\\
\tfrac{(1-\theta)[\theta(H-L)+(1-\theta)L-(\theta B_l+(1-\theta)B_h)2(1+\lambda)]}{2(2\theta-1)}-\tfrac{\theta(1+\lambda)}{2} &\leq \tfrac{\gamma(1-\theta)}{2\theta-1} \text{ and } B_h \geq 0 && \text{(A.22)}\\
\tfrac{\theta B_l+(1-\theta)B_h}{2\theta-1} &\leq 1 \text{ and } \gamma \geq 0 && \text{(A.23)}
\end{aligned}$$

each with complementary slackness, where γ denotes the Lagrange multiplier on the inequality constraint. It is straightforward to rule out any candidate optimum with $B_h > 0$ (the LHS of (A.22) is always lower than LHS of (A.21)), while $B_l = B_h = 0$ and $\gamma > 0$ clearly violates (A.23). This leaves three possibilities: (i) $B_l = B_h = \gamma = 0$; (ii) $B_l > B_h = \gamma = 0$; and (iii) $B_l > 0$, $B_h = 0$ and $\gamma > 0$. Candidate (i) satisfies (A.21)-(A.23) if

$$\tfrac{\theta[\theta(H-L)+(1-\theta)L]}{2(2\theta-1)}-\tfrac{(1-\theta)(1+\lambda)}{2} \leq 0 \Leftrightarrow \lambda \geq \tfrac{1+\theta^2(2+H-2L)+\theta(L-3)}{3\theta+2\theta^2-1} \equiv \lambda'. \tag{A.24}$$

Candidate (ii) $B_l > B_h = \gamma = 0$ satisfies (A.21)-(A.23) if

$$B_l = \tfrac{1+\lambda+\theta^2(H+2(1+\lambda-L))+\theta(L-3(1+\lambda)}{2\theta^2(1+\lambda)} \leq \tfrac{2\theta-1}{\theta} \Leftrightarrow \lambda \geq \tfrac{1+\theta[\theta(H-2)-(2\theta-1)L-1]}{2\theta^2+\theta-1} \equiv \lambda'', \tag{A.25}$$

where $\lambda'' < \lambda'$ given $\theta > \frac{1}{2}$ and $H \geq L$. Finally, Candidate (iii) satisfies (A.21)-(A.23) if

$$\begin{aligned}
B_l &= \tfrac{2\theta-1}{\theta} \text{ and} && \text{(A.26)}\\
\gamma &= \tfrac{1+\lambda+\theta^2(H-2(1+\lambda+L)+\theta(L-(1+\lambda))}{2\theta} > 0 \Leftrightarrow \lambda < \lambda''. && \text{(A.27)}
\end{aligned}$$

The firm's equilibrium bribes are therefore given by

$$\begin{aligned}
B^o(h,t) &= B^o(l,t) = B^o(h,g) = 0\\
B^o(l,g) &= \begin{cases} 0 \text{ if } \lambda \geq \lambda' \\ \frac{1+\lambda+\theta^2(H+2(1+\lambda-L))+\theta(L-3(1+\lambda)}{2\theta^2(1+\lambda)} \text{ if } \lambda \in [\lambda'', \lambda') \\ \frac{2\theta-1}{\theta} \text{ if } \lambda < \lambda''. \end{cases}
\end{aligned}$$

Thus, from (A.17), a type W regulator's equilibrium strategy is given by

$$\begin{aligned}
p^o &= \begin{cases} 1 \text{ if } W > \frac{\theta B^o(l,g)}{2\theta-1} \\ 0 \text{ if } W \leq \frac{\theta B^o(l,g)}{2\theta-1} \end{cases}\\
q^o &= 0 \text{ for any } W
\end{aligned}$$

which completes the proof. ■

Proof of Proposition 5. Differentiating $B^o(l,g)$ wrt λ yields

$$\begin{aligned}
\frac{\partial B^o(l,g)}{\partial \lambda} &= \begin{cases} 0 \text{ if } \lambda \geq \lambda' \text{ or } \lambda < \lambda'' \\ -\frac{H\theta-(2\theta-1)L}{2\theta(1+\lambda)^2} < 0 \text{ if } \lambda \in [\lambda'', \lambda') \end{cases} \quad \text{and}\\
\frac{\partial^2 B^o(l,g)}{\partial \lambda^2} &= \begin{cases} 0 \text{ if } \lambda \geq \lambda' \text{ or } \lambda < \lambda'' \\ \frac{H\theta-(2\theta-1)L}{2\theta(1+\lambda)^3} > 0 \text{ if } \lambda \in [\lambda'', \lambda'). \end{cases}
\end{aligned}$$

Thus $B^o(l, g)$ is weakly decreasing in λ and, given $\lambda_1 < 0$, is weakly increasing in *term* as stated. Now recall that

$$\begin{aligned}
\Pr(file &= 1 \mid s = l, \theta, B^o(l, g)) = 1 - F\left(\tfrac{\theta B^o(l,g)}{2\theta - 1}\right) \\
\Pr(file &= 1 \mid s = h, \theta, B^o(l, g)) = 0.
\end{aligned}$$

Accordingly, the ex ante probability that a regulator will file for a review conditional on receiving: (i) a high cost signal is decreasing in *term* and (ii) a low cost signal is independent of *term*. ■

B. Data

All PUC variables were obtained from *Annual Report on Utility and Carrier Regulation of the National Association of Regulatory Utility Commissioners*, (K. Bauer ed.), Washington: NARUC (1982-1990), except for $staffpc_{it}$ which, along with $land_{it}$, was taken from *The Book of the States, (*Council of State Governments), Washington (1982/3-1990/1).

All firm variables were taken from the EIA yearbooks (DOE/EIA-0437), published under a number of titles, most recently "*Financial Statistics of Major US Investor Owned Electric Utilities*" until the series was discontinued in 1996. For more details see http://www.eia.doe.gov/cneaf/electricity/invest/invest_sum.html.

Finally, the state variables $stpop_{it}$ and $stdpcy_{it}$ were taken from the Bureau of Economic Analysis Regional Accounts Data available at http://www.bea.doc.gov/bea/regional/spi.

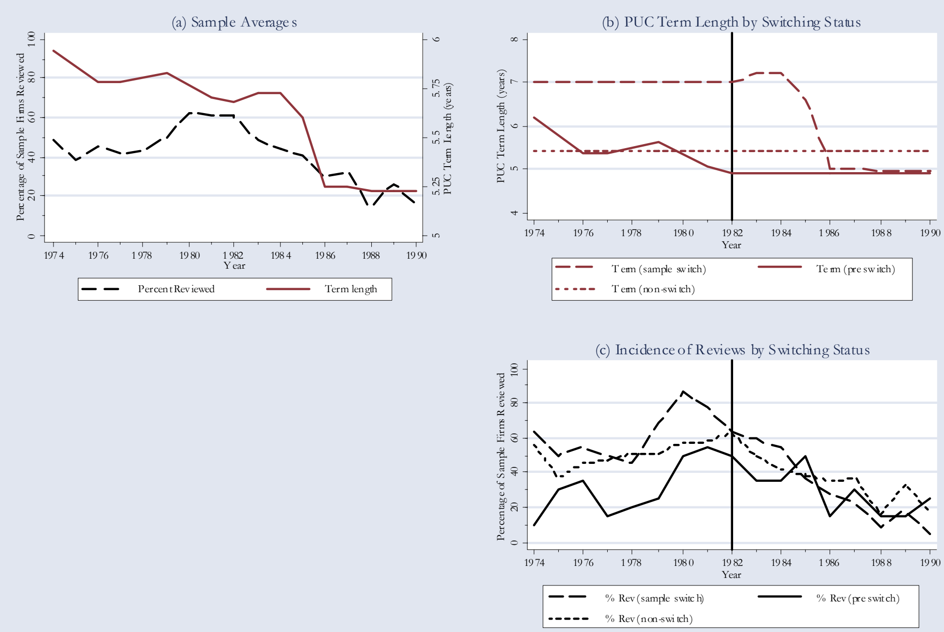
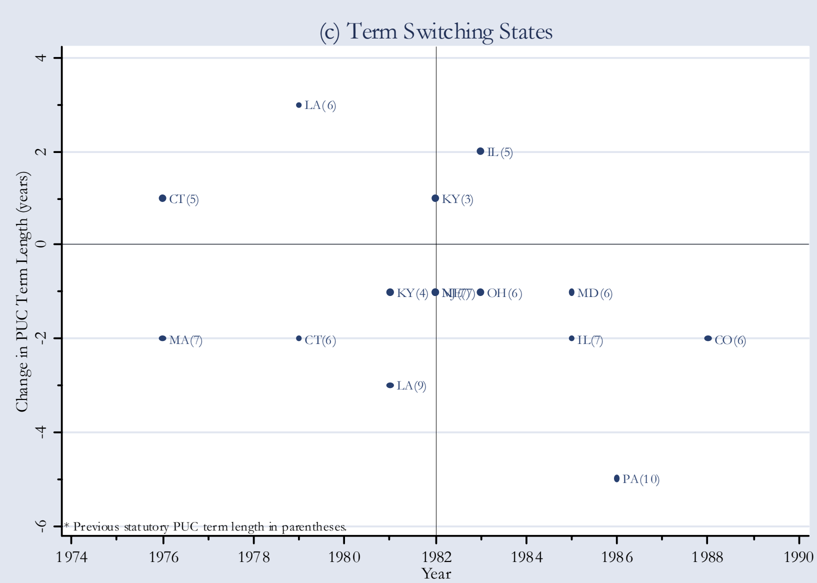


Figure 3.3: Rate Reviews and PUC Term Length (Full Series, 1974-90)



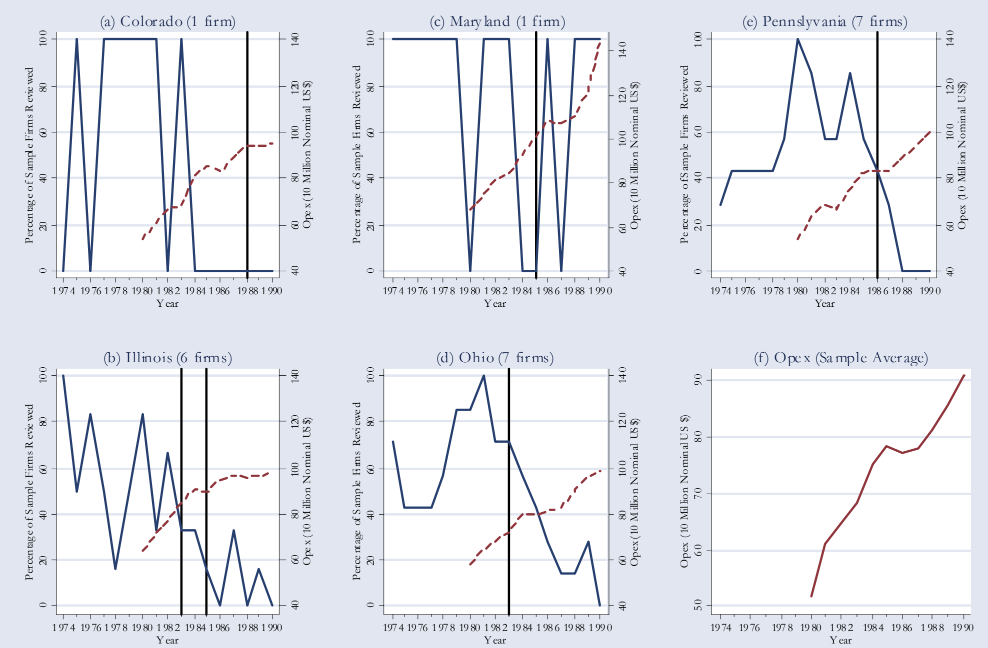


Figure 3.4: Rate Reviews and Opex (Full Series, Sample Switchers)

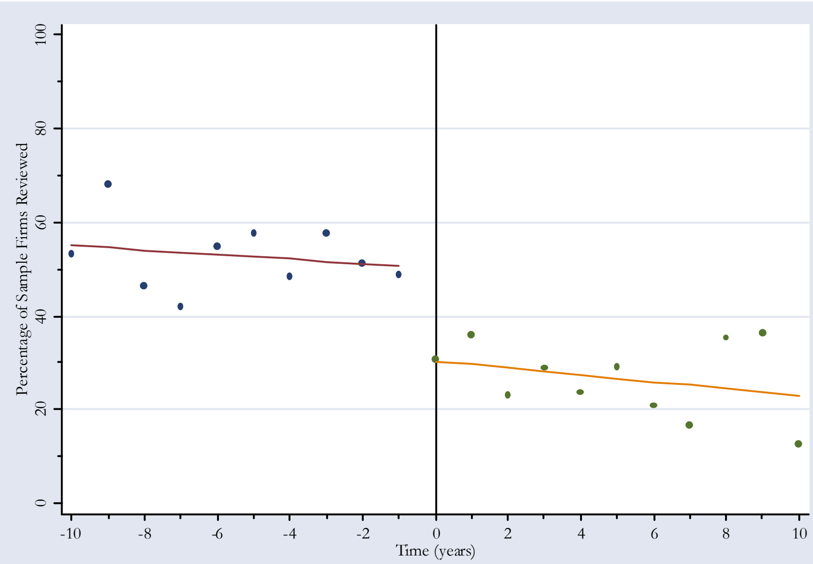


Figure 3.5: Rate Reviews Before/After Decrease in Term Length

Table 3.1: Number of Sample Firms and Observations per State

Frequency	State	Number of States	Number of Firms	Number of Obs.
0	AR, DC, DE, HI, ID, MT, ND, UT, VA, WY[1]	10	0	0
1	AL, CO, MD, MN, MO, NC, NH, NM, NV, OK, OR, SD, TN, VT, WA, WV	16	16	144
2	AZ, CT, GA, IA, KS, MS, RI, SC,	8	16	144
3	CA, KY, LA, ME, NJ, TX, WI	7	21	189
4	FL, IN	2	8	72
5	MI	1	5	45
6	IL, MA	2	12	108
7	NY, OH, PA,	3	21	189
		49[2]	**99**	**891**

Notes:
1 States excluded from sample.
2 No investor-owned electric utilities serve NE and the sample excludes AK.

Table 3.2: Linear Probability Models of Formal Rate Review (No Interaction)

Dependent Variable: 1 if firm *i* faced a new review in year *t*; 0 otherwise ($review_{it}$)

	Static Year Effects		Static Controls		Dynamic Controls	Dynamic Year Effects				
	OLS Lev (a)	Within (b)	OLS[1] Lev (c)	Within (d)	OLS Lev (e)	OLS Lev (f)	Within (g)	GMM Dif (h)	GMM Dif (i)	GMM Dif (j)
PUC term of office, yrs ($term_{it}$)	**.0471***** **(.0173)**	**.0626***** **(.0229)**	**.0829***** **(.0207)**	**.0861***** **(.0280)**	**.0876***** **(.0215)**	**.0459***** **(.0168)**	**.0716***** **(.0216)**	**.0227** **(.0452)**	**.0545*** **(.0317)**	**.0557*** **(.0329)**
Lagged dependent variable ($review_{i,t-1}$)					-.0811** (.0339)	.0379 (.0385)	-.2103*** (.0355)	-.0952** (.0484)	-.1013** (.0472)	-.0986** (.0472)
Year effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full Controls?	No	No	Yes	Yes	Yes	No	No	No	No	No
m_1 (p-value)	1.72 (.09)	-7.50 (0)	-2.02 (.04)	-7.37 (0)	.99 (.32)	1.75 (.08)	-8.18 (0)	-8.28 (0)	-8.26 (0)	-8.32 (0)
m_2 (p-value)	3.39 (0)	1.64 (.10)	1.20 (.23)	1.57 (.12)	.86 (.39	3.43 (0)	-1.62 (.10)	.72 (.47)	.53 (60)	.55 (.58)
Sargan Test (p-value)								*chi (12)* 11.35 (.50)	*chi2(31)* 17.67 (.97)	*chi2 (24)* 15.25 (.91)
Instruments[2] $\Delta review_{i,t-1}$								*t-2, t-3*	*t-2, t-3*	*t-2, t-3*
$\Delta term_{it}$									*t-1,…,t-3*	*t-2, t-3*
Number of Firms	99	99	99	99	99	99	99	99	99	99
No. of Observations	792	792	772	772	772	792	792	693	693	693

Notes:

All regressions include a constant, with ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

m_1 and m_2 are tests for first-order and second-order serial correlation. These test the levels residuals for OLS Lev and first differenced residuals for Within Goups and GMM Dif.

OLS Lev: robust standard errors adjusted for clustering by firm in parentheses.

GMM Dif: one-step estimates with robust standard errors in parentheses. The Sargan test statistic, m_1 and m_2 are from two-step estimation.

All coefficients, standard errors and test statistics were obtained using Stata 8 (xtabond for GMM Dif), except for OLS Lev m_1 and m_2 which were obtained using DPD98 for Gauss, for details see Arellano and Bond (1991).

1. Random effects collapses back to pooled OLS in the presence of full controls (*rho = 0*). This precludes the use of a Hausman Test.

2. Instruments are lagged levels as listed, e.g. the instrument set used in column (h) is

$$Z_i = \left[diag\left(review_{i,t-2}, review_{i,t-3}, term_{i,t-2}, term_{i,t-3}\right)\right] \quad t = 1984,\ldots,1990$$

Table 3.3: Linear Probability Models of Formal Rate Review (Interaction 1)

Dependent Variable: 1 if firm *i* faced a new review in year *t*; 0 otherwise ($review_{it}$)

	Static Year Effects		Static Controls		Dynamic Controls	Dynamic Year Effects					
	OLS Lev (a)	Within (b)	OLS Lev (c)	Within (d)	OLS Lev (e)	OLS Lev (f)	Within (g)	GMM Dif (h)	GMM Dif (i)	GMM Dif (j)	GMM Dif (k)
PUC term of office, yrs ($term_{it}$)	**.0384***	**.0527***	**.0760*****	**.0790*****	**.0808*****	**.0370***	**.0624*****	**.0148**	**.0488**	**.0225**	**.0259**
	(.0201)	**(.0239)**	**(.0178)**	**(.0287)**	**(.0228)**	**(.0197)**	**(.0216)**	**(.0430)**	**(.0309)**	**(.0375)**	**(.0309)**
Interaction effect 1 ($neg* term_{it}$)	**.0341**	**.0390**	**.0310**	**.0296**	**.0303**	**.0344**	**.0360**	**.0586***	**.0512***	**.1925****	**.1889****
	(.0252)	**(.0305)**	**(.0281)**	**(.0310)**	**(.0279)**	**(.0284)**	**(.0298)**	**(.0348)**	**(.0309)**	**(.0861)**	**(.0863)**
1 if lagged Δopex < 0; 0 otherwise (neg_{it})	-.1894	-.1613	-.1447	-.1067	-.1425	-.1892*	-.1449	-.2960	-.2350	-.9799**	-.9694**
	(.1378)	(.1679)	(.1537)	(.1699)	(.1522)	(.1513)	(.1639)	(.1928)	(.1728)	(.4844)	(.4814)
Lagged dependent variable ($review_{i,t-1}$)					-.0796**	.0381	-.2096***	-.0935*	-.1134**	-.0979**	-.0963**
					(.0338)	(.0383)	(.0355)	(.0486)	(.0460)	(.0492)	(.0492)
Year effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full Controls?	No	No	Yes	Yes	Yes	No	No	No	No	No	No
m_1 (*p*-value)	1.78 (.08)	-7.52 (0)	-1.87 (.06)	-7.38 (0)	1.20 (.23)	1.85 (.06)	-8.13 (0)	-8.30 (0)	-7.90 (0)	-8.04(0)	-8.01 (0)
m_2 (*p*-value)	3.46 (0)	1.73 (.08)	1.29 (.20)	1.64 (.10)	.95 (.34)	3.51 (0)	-1.61 (.11)	.94 (.35)	.75 (.46)	1.32 (.18)	1.35 (.18)
Sargan Test (*p*-value)								*chi2(12)* 12.31 (.42)	*chi2(69)* 67.22 (.54)	*chi2(55)* 41.26 (.92)	*chi2*(48) 39.33 (.81)
Inst. $\Delta review_{i,t-1}$								*t-2, t-3*	*t-2, t-3*	*t-2, t-3*	*t-2, t-3*
Inst. $\Delta term_{it}$									*t-1,…,t-3*	*t-1,…,t-3*	*t-2, t-3*
Inst. $\Delta neg*term_{it}$									*t-1,…,t-3*	*t-2, t-3*	*t-2, t-3*
Inst. Δneg_{it}									*t-1,…,t-3*	*t-2, t-3*	*t-2, t-3*
Number of Firms	99	99	99	99	99	99	99	99	99	99	99
No. of Observations	792	792	772	772	772	792	792	693	693	693	693

Notes: See Table 3.2 above.

Table 3.4: Linear Probability Models of Formal Rate Review (Interaction 2)

Dependent Variable: 1 if firm *i* faced a new review in year *t*; 0 otherwise ($review_{it}$)

	Static Year Effects		Static Controls		Dynamic Controls	Dynamic Year Effects					
	OLS Lev (a)	Within (b)	OLS Lev (c)	Within (d)	OLS Lev (e)	OLS Lev (f)	Within (g)	GMM Dif (h)	GMM Dif (i)	GMM Dif (j)	GMM Dif (k)
PUC term of office, yrs ($term_{it}$)	**.0632*****	**.0759*****	**.0996*****	**.0962*****	**.1048*****	**.0617*****	**.0846*****	**.0597**	**.0941*****	**.0963****	**.1032****
	(.0173)	**(.0252)**	**(.0228)**	**(.0284)**	**(.0233)**	**(.0168)**	**(.0247)**	**(.0453)**	**(.0307)**	**(.0399)**	**(.0309)**
Interaction effect 2 ($opexlpch * term_{it}$)	**-.0026***	**-.0020**	**-.0024**	**-.0015**	**-.0024***	**-.0026***	**-.0019**	**-.0035****	**-.0033****	**-.0037**	**-.0040**
	(.0014)	**(.0015)**	**(.0015)**	**(.0015)**	**(.0014)**	**(.0014)**	**(.0015)**	**(.0016)**	**(.0016)**	**(.0035)**	**(.0036)**
Lagged % change in opex ($opexlpch_{it}$)	.0144*	.0090	.0112	.0064	.0114	.0143*	.0083	.0186**	.0160*	.0186	.0204
	(.0075)	(.0083)	(.0079)	(.0084)	(.0077)	(.0075)	(.0081)	(.0091)	(.1728)	(.0210)	(.0218)
Lagged dependent variable ($review_{i,t-1}$)					-.0822**	.0369	-.2117***	-.0971**	-.1163***	-.1129**	-.1116**
					(.0338)	(.0382)	(.0355)	(.0479)	(.0460)	(.0463)	(.0463)
Year effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full Controls?	No	No	Yes	Yes	Yes	No	No	No	No	No	No
m_1 (p-value)	1.81 (.07)	-7.48 (0)	-1.90 (.06)	-7.34 (0)	1.37 (.17)	2.04 (.04)	-5.90 (0)	-8.22 (0)	-7.48 (0)	-7.70 (0)	-7.69 (0)
m_2 (p-value)	3.43 (0)	1.64 (.10)	1.22 (.22)	1.60 (.11)	.87 (.39)	3.46 (0)	-1.42 (.16)	.72 (.47)	-.01 (.99)	-.21 (.83)	-.19 (.85)
Sargan Test (p-value)								*chi2(12)* 12.31 (.42)	*chi2(69)* 71.25 (.40)	*chi2(55)* 57.92 (.37)	*chi2*(48) 55.13 (.22)
Inst.[2] $\Delta review_{i,t-1}$								*t-2, t-3*	*t-2, t-3*	*t-2, t-3*	*t-2, t-3*
$\Delta term_{it}$									*t-1,…,t-3*	*t-1,…,t-3*	*t-2, t-3*
$\Delta opexlpch * term_{it}$									*t-1,…,t-3*	*t-2, t-3*	*t-2, t-3*
$\Delta opexlpch_{it}$									*t-1,…,t-3*	*t-2, t-3*	*t-2, t-3*
Number of Firms	99	99	99	99	99	99	99	99	99	99	99
No. of Observations	792	792	772	772	772	792	792	693	693	693	693

Notes: See Table 3.2 above.

Table 3.5: Non-Linear Models of the Probability of Formal Rate Review (No Interaction)

Dependent Variable: 1 if firm *i* faced a new review in year *t*; 0 otherwise ($review_{it}$)	Static Pooled Probit		Static FE Logit		Dynamic Pooled Probit				
	(a)	(b)[1]	(c)	(d)	(e)	(f)	(g)	(h)	(i)
PUC term of office, yrs ($term_{it}$)	**.1002**** **(.0436)**	**1791***** **(.0515)**	**.3260**** **(.1463)**	**.4068**** **(.1741)**	**.0997**** **(.0437)**	**.1950***** **(.0544)**	**.1454***** **(.0511)**	**.1890***** **(.0536)**	**.1355***** **(.0510)**
Lagged dependent variable ($review_{i,t-1}$)					-.0127 (.1040)	-.3046*** (.0971)	-.5297*** (.1239)	-3.989*** (.1448)	-.3964*** (.1456)
Lagged # reviews by PUC, ($npuc_{i,t-1}$)							.2022*** (.0470)		.3040*** (.0580)
Lagged % reviews by PUC, ($npuc_{i,t-1}$)								.0024 (.0022)	-.0062** (.0027)
Year effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full Controls?	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
$\hat{u}_{i,t-1}$	.1138 (.1107)	-.3004*** (.1142)			-2.690 (2.039)	.7381 (.5597)			
Log Likelihood	-528.942	-.465.798	-.318.647	-291.502	-528.933	-461.829	-454.587	-461.254	-452.498
R^2	.079	.0165			.079	.172	.185	.173	.189
Number of Firms	99	99	94	93	99	99	99	99	99
No. of Observations	891	868	846	818	891	868	868	868	868

Notes:

All regressions include a constant. ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Pooled Probit: robust standard errors adjusted for clustering by firm in parentheses.

The variable $\hat{u}_{i,t-1} \equiv review_{it} - \Phi\left(\hat{\rho} review_{i,t-1} + \hat{\beta} term_{it} + \mathbf{z}_{it}\hat{\boldsymbol{\gamma}}\right)$ is included in an auxiliary regression of $review_{it}$ on $\mathbf{x}_{it}$ to test for dynamic completeness.

1. RE Probit estimates collapse back to Pooled Probit (*rho = 0*).

Table 3.6: Non-Linear Models of the Probability of Formal Rate Review (Interaction 1)

Dependent Variable: 1 if firm *i* faced a new review in year *t*; 0 otherwise ($review_{it}$)	Static Pooled Probit		Static FE Logit		Dynamic Pooled Probit				
	(a)	(b)[1]	(c)	(d)	(e)	(f)	(g)	(h)	(i)
PUC term of office, yrs	**.0711**	**1499*****	**.2830***	**.3691**	**.0705**	**.1662*****	**.1116****	**.1601*****	**.0993***
($term_{it}$)	**(.0458)**	**(.0515)**	**(.1511)**	**(.1773)**	**(.0459)**	**(.0545)**	**(.0514)**	**(.0537)**	**(.0513)**
Interaction effect 1	**.1502***	**.1755****	**.2519**	**.2368**	**.1504***	**.1726****	**.1933****	**.1726****	**.2026****
(neg* $term_{it}$)	**(.0832)**	**(.0852)**	**(.1754)**	**(.1855)**	**(.0832)**	**(.0859)**	**(.0865)**	**(.0861)**	**(.0858)**
1 if lagged Δopex < 0;	-.8275	-.8716	-1.068	-.9294	-.8280	-.8575*	-.9777	-.8626*	-1.018**
0 otherwise (neg_{it})	(.4668)	(.4892)	(.9723)	(1.022)	(.4670)	(.4928)	(.4960)	(.4934)	(.4946)
Lagged dependent					-.0145	-.2957***	-.5319***	-3.9722***	-.3943***
variable ($review_{i,t-1}$)					(.1034)	(.0966)	(.1220)	(.1442)	(.1456)
Lagged # reviews by PUC,							.2104***		.3152***
($npuc_{i,t-1}$)							(.0469)		(.0580)
Lagged % reviews by PUC,								.0025	-.0063**
($npuc_{i,t-1}$)								(.0022)	(.0027)
Year effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full Controls?	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
$\hat{u}_{i,t-1}$	.1156	-.2904***			-1.068	.8676			
	(.1099)	(.1141)			(1.255)	(.5546)			
Log Likelihood	-527.627	-464.688	-316.703	-290.268	-527.616	-460.945	-453.121	-460.290	-450.927
R^2	.082	.167			.082	.173	.188	.175	.191
Number of Firms	99	99	94	99	99	99	99	99	99
No. of Observations	891	868	846	868	891	868	868	868	868

Notes: see Table 3.5 above.

Table 3.7: Non-Linear Models of the Probability of Formal Rate Review (Interaction 2)

Dependent Variable: 1 if firm *i* faced a new review in year *t*; 0 otherwise ($review_{it}$)

	Static Pooled Probit		Static FE Logit		Dynamic Pooled Probit				
	(a)	(b)[1]	(c)	(d)	(e)	(f)	(g)	(h)	(i)
PUC term of office, yrs	**.1499*****	**2359*****	**.3756****	**.4396****	**.1495*****	**.2578*****	**.2185*****	**.2531*****	**.2100*****
($term_{it}$)	**(.0487)**	**(.0515)**	**(.1583)**	**(.1840)**	**(.0485)**	**(.0594)**	**(.0578)**	**(.0594)**	**(.0571)**
Interaction effect 2	**-.0059****	**-.0061****	**-.0053**	**-.0037**	**-.0059****	**-.0067****	**-.0082*****	**-.0069****	**-.0084*****
($opexlpch * term_{it}$)	**(.0026)**	**(.0028)**	**(.0062)**	**(.0065)**	**(.0026)**	**(.0028)**	**(.0028)**	**(.0028)**	**(.0028)**
Lagged % change in	.0325**	.0266	.0184	.0071	.0325**	.0289*	.0385**	.0306*	.0387**
opex ($opexlpch_{it}$)	(.0157)	(.0177)	(.0349)	(.0367)	(.0156)	(.0176)	(.0171)	(.0174)	(.0170)
Lagged dependent					.0073	-.3137***	-.5525***	-.4158***	-.4160***
variable ($review_{i,t-1}$)					(.1032)	(.0963)	(.1228)	(.1442)	(.1451)
Lagged # reviews by PUC,							.2130***		.3177***
($npuc_{i,t-1}$)							(.0475)		(.0594)
Lagged % reviews by PUC,								.0025	-.0064
($npuc_{i,t-1}$)								(.0022)	(.0027)
Year effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full Controls?	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
$\hat{u}_{i,t-1}$	.1059	-.3080***			-1.934*	.6181			
	(.1103)	(.1151)			(.9971)	(.5501)			
Log Likelihood	-527.608	-464.521	-317.791	-291.343	-527.605	-460.330	-452.391	-460.665	-450.927
R^2	.082	.167			.082	.175	.189	.176	.191
Number of Firms	99	99	94	99	99	99	99	99	99
No. of Observations	891	868	846	868	891	868	868	868	868

Notes: see Table 3.5 above.

Table 3.8: Estimation of Residential 'Prices' (Average Revenue)

Dependent Variable: Average revenue from residential customers received by firm *i* in year *t*, cents per kwh ($pres_{it}$)

	Pooled OLS (i)		Pooled OLS (ii)		RE (iii)		FE (iv)	
PUC term of office, yrs ($term_{it}$)	**-.1833****	**(.0810)**	**-.1549****	**(.0724)**	**-.0666****	**(.0311)**	**-.0532***	**(.0321)**
Firm-level controls								
Opex, mill$ ($opex_{it}$)	.0229***	(.0040)	.0516***	(.0080)	.0455***	(.0035)	.0464***	(.0041)
Quadratic: $opex_{it}^2$			5.6e^{-05***}	(1.3e^{-05})	3.2e^{-05***}	(5.1e^{-06})	3.3e^{-05***}	(5.8e^{-06})
Sales to residential customers, megawatt hours ($sres_{it}$)	-.3595***	(.1010)	-.8944***	(.1428)	-.8120***	(.0670)	-.8929***	(.1034)
Quadratic: $sres_{it}^2$			.0169***	(.0034)	.0109***	(.0016)	.0119***	(.0021)
PUC and State-level controls								
# Commissioners ($numcom_{it}$)			-.1427	(.1049)	-.0148	(.0558)	.0161	(.0630)
Total commission staff ($staff_{it}$)			.0003	(.0012)	-.0002	(.0005)	-.0003	(.0005)
1 if comm. appointed ($appoint_{it}$)			-.6655	(.4615)	-.1220	(.4918)	n/a	
1 if time restrictions ($postoc_{it}$)			.9905***	(.2791)	.1591	(.1613)	.0076	(.1810)
1 if qualifications needed ($qual_{it}$)			.3889*	(.2167)	.1804	(.1386)	.0659	(.1634)
1 if terms staggered ($stag_{it}$)			-.1479	(.3900)	-.1349	(.2160)	-.0220	(.2725)
1 if minority political representation ($minrep_{it}$)			.1210	(.3011)	-.0205	(.2628)	-.3459	(.4892)
Log commissioners'. salary, 000$ log($salcom_{it}$)			.1180	(.4951)	.0152	(.2344)	-.0746	(.2464)
1 if automatic fuel mech (aam_{it})			.5116**	(.2012)	.1825	(.1047)	.0867	(.1208)
1 if 'original cost' ($valst_{it}$)			-.0608	(.2002)	.0208	(.1141)	.0366	(.1217)
1 if 'historic' test year ($test_{it}$)			.8500**	(.3853)	.1634	(.2505)	.2674	(.3215)
# regulated entities ($ntreg_{it}$)			-.0007	(.0032)	-.0031	(.0025)	-.0023	(.0031)
# private electric utilities ($nelpr_{it}$)			-.0413	(.0255)	-.0023	(.0107)	.0037	(.0112)
State population, mil ($stpop_{it}$)			-.0813	(.1046)	.0054	(.0777)	-.2937	(.2392)
Quadratic: $stpop_{it}^2$			.0061*	(.0035)	.0026	(.0024)	.0075	(.0047)
Log State disposable income per capita log($stdpcy_{it}$)			1.341	(1.335)	.6109	(.7761)	.5412	(.8569)
1 if Governor is a Democrat ($govparty_{it}$)			-.2675*	(.1529)	-.0757	(.0598)	-.0750	(.0620)
% Democrats in State House of Representatives ($demhse_{it}$)			.7628	(.9437)	-.1501	(.4908)	-.3887	(.5388)
Year effects?	Yes		Yes		Yes		Yes	
Region effects?	Yes		Yes		Yes		n/a	
Fraction of variance due to c_i					.829		.926	
Hausman Test (*p-value*)					31.97 (p = 0.369)			
R^2 (overall)	.579		.697		.651		.195	
Number of firms	99		99		99		99	
Number of Observations	891		868		868		868	

Notes:
All regressions include a constant. Regressions (a) and (b) robust standard errors, adjusted for clustering by firm in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Table 3.9: The Partial Effect of Term Length on the Probability of Review

		Predicted probability of review $term_{it} = 5$	$term_{it} = 6$	Partial Effect
Lagged % change in opex ($opexlpch_{it}$)	Top 1% (34.59)	.4098	.3791	-.0307
	Top 10% (17.29)	.4312	.4569	.0257*
	Mean (6.051)	.4452	.5086	.0634*
	Bottom 10% (-4.085)	.4579	.5551	.0972*
	Bottom 1% (-12.41)	.4684	.5928	.1244*

Notes:

1 Coefficients are from the Dynamic pooled Probit regression (i) reported in Table 3.7.

2 The predicted probability of review is evaluated at the sample mean value of all non-binary variables. The remaining variables are as follows: $opex\_lpch_{it}$ as stated, $appoint_{it}$ = 1 $postoc_{it}$ = 1, $qual_{it}$ = 0, $stag_{it}$ = 1, $minrep_{it}$ = 1, aam_{it} = 0, $valst_{it}$ = 1, $test_{it}$ = 0, $party_{it}$ =1, $year_{it}$ = 1986, $region_{it}$ = South Atlantic (5).

3 * denotes that the coefficient on $term_{it}$ is significant at 1% in an auxiliary regression in which the interaction term ($opexlpch_{it}$* $term_{it}$) has been replaced with ($opexlpch_{it}$ – quantile) x $term_{it}$. Thus term length does not exert a statistically significant effect on the probability of review at the top percentile of lagged % change in opex.

Table C.1: New Entrants and Attrition (10 firms)

State	Firm	Years in sample	Reason
HI	Maui Electric Co. Ltd.	1985-90	Missing data
IA	Iowa Southern Utilities	1983-90	No residential customers pre 1983
MA	Commonwealth Electric Co.	1981-90	Missing data
RI	Newport Electric Corp.	1985-90	Reclassified major utility
TX	Texas Utilities Electric Co.	1984, 1987-90	Not in existence pre 1983
TX	West Texas Utilities Co.	1983-90	Missing data
FL	Florida Public Utilities Co.	1980-87	Exempted, determined by FERC
HI	Hawaiian Electric Co. Inc.	1980-87, 90	Missing data
OR	CP National	1980-84	Reclassified non-major utility
WI	Consolidated Water Pwr Co.	1980-88	No longer serving res. customers

Table C.2: Descriptive Statistics (All Sample Firms, 1982-1990)

Variable	Overall Mean	Overall Std Dev	Min	Max	No. of Obs (*NT, N*)
Incidence of Rate Reviews					
1 if firm *i* faces a new review in year *t* ($review_{it}$)	.3457	.4759	0	1	891, 99
Absolute no. of reviews by firm *i*'s PUC in year *t* ($npuc_{it}$)	1.376	1.590	0	6	891, 99
Fraction of sample firms reviewed by firm *i*'s PUC in year *t* ($ppuc_{it}$)[1]	.3457	.3434	0	1	891, 99
Firm-level Financial Statistics					
Electric operating expenses, million $ ($opex_{it}$)	776.7	974.8	5.210	5830	891, 99
Lagged percentage change in operating expenses[2] ($opexlpch_{it}$)	6.051	9.112	-17.90	64.46	891, 99
Negative lagged % change in opex	-4.491	3.790	-17.90	-.0043	206, 89
Positive lagged % change in opex	9.221	7.759	.0136	64.46	685, 99
Fuel costs as a percentage of electric operating costs ($fuelop_{it}$)	25.98	17.74	-.0184	93.67	891, 99
Net electric operating revenue, million $ ($profit_{it}$)	175.4	230.9	-31.39	1502	891, 99
Revenue from residential customers, million $ ($rrev_{it}$)	337.6	426.0	1.838	2683	890,[3] 99
Sales to residential customers, million megawatt hours ($sres_{it}$)	4.153	4.866	.0330	33.49	890, 99
Average revenue from residential customers, cents per kwh[4] ($pres_{it}$)	7.888	1.953	2.929	16.50	890, 99
Number of residential customers, thousands ($nres_{it}$)	513.4	656.8	4.308	3604	890, 99
State-Level Variables[5]					
Total no. of regulated entities ($ntreg_{it}$)	33.72	54.59	4	368	885, 99
Total no. of private electric utilities[6] ($nelpr_{it}$)	7.42	3.700	1	17	887, 99
State population, millions ($stpop_{it}$)	8.035	5.917	.5191	29.95	891, 99
State disposable income per capita, thousand $ ($stdpcy_{it}$)	13.46	2.808	7.524	23.28	891, 99
1 if State governor is a Democrat, 0 otherwise ($govparty_{it}$)	.5960	.4910	0	1	891, 99
1 if majority in State House of Representatives is Democratic ($house_{it}$)	.8620	.3451	0	1	891, 99
Percentage of Democratic seats in State House of Representatives ($demhse_{it}$)	.6173	.1375	.1857	.9508	891, 99

Notes:

1 Note that $review_{it} \equiv npucrev_{it} \equiv ppucrev_{it}$ for the 16 sample firms serving single sample firm States (see Table 3.1).

2 The variable 'lagged percentage change in electric operating expenses' was constructed as follows: $opex\_lpch_{it} = [(opex_{i,t-1} - opex_{i,t-2}) / opex_{i,t-2}] \times 100$.

3. Missing $rres_{it}$, $sres_{it}$ and $pres_{it}$ for Penn Power Co 1987.

4 The variable 'average revenue from residential customers, cents per kwh' was constructed as follows:

$pres_{it} = (rres_{it} / sres_{it}) \times 1/10$.

5 PUC institutional variables are listed separately in Table C.3.

6 Includes major and non-major electric utilities.

Table C.3: Overall and Within-State Variation in PUC Institutions (All Sample Firms 1982-90)

Variable	Overall Mean	Overall Std Dev	Min, Max	No. Obs (N, n)	Within-State Variation Increase	Decrease	Firms
PUC term length, yrs ($term_{it}$)	5.431	1.239	4, 10	891, 99	1983: IL(5-7)	1983: OH(6-5); 1985: IL (7-5), MD (6-5) 1986: PA(10-5); 1988: CO (6-4)	22
No. of commissioners ($numcom_{it}$)	4.279	1.420	1, 7	891, 99	1983: IN (3-5), NV (3-5); OH (3-5) 1985: IL (5-7); 1986: OR (1-3) 1988: SC (6-7)	1987: SC (7-6); 1990: NY (7-5)	28
Total commission staff ($staff_{it}$)	273.8	221.8	17, 1024	891, 99	CT, GA, MD, NH, NV, PA, TN, WI	SC, VT	99
Commissioners' salary, 000$ ($salcom_{it}$)	57.70	13.328	15, 90	891, 99	All States except LA	1989: IN (72202-52780)	98
1 if commissioners appointed, 0 other wise ($appoint_{it}$)	.8687	.3379	0, 1	891, 99	No State	No State	0
1 if time restrictions on industry employment, 0 other wise ($postoc_{it}$)	.7616	.4263	0, 1	881, 99	1983: IL, NM; 1985; MN; 1987: OR; 1989: WV	No State	10
1 if qualifications needed, 0 otherwise ($qual_{it}$)	.4770	.4998	0, 1	891, 99	1983: OH; 1990: PA	1984: AL	15
1 if term staggered, 0 otherwise ($stag_{it}$)	.9080	.2892	0, 1	891, 99	1983: OR; 1988: SC	1987: SC; 1989; SC	3
1 if minority political representation, 0 otherwise ($minrep_{it}$)	.5410	.4986	0, 1	891, 99	1986: OR	No State	1
1 if automatic fuel adjustment mechanism, 0 otherwise (aam_{it})	.4583	.4985	0, 1	888, 99	1983: RI; 1985: NJ; 1987: NM	1983: LA, TX, WI; 1987: FL; 1988: NJ, VT	20
1 if PUC uses an 'orginal cost' valuation standard, 0 otherwise ($valst_{it}$)	.7856	.4123	0, 1	891, 99	1983: KY, OK; 1985: IL; 1986: MI; 1987: NM	No State	16
1 if PUC uses a 'historic test year', 0 otherwise ($test_{it}$)	.4590	.4986	0, 1	891, 99	No State	1984: RI	2

Table C.4: Cross-Tabulations of Formal Rate Reviews (All sample firms 1982-1990)

			Lagged Percentage Change in Firm Operating Expenses		
			Negative	Positive	Total
PUC Term Length	Short (5 years or less)[1]	No. of Reviews (y_{it} = 1)	20	88	108
		No. of Observations	95	299	394
		% Reviewed	21.1%	29.4%	27.4%
	Long (6 years or more)	No. of Reviews (y_{it} = 1)	40	160	200
		Number of Observations	111	386	497
		% Reviewed	36.0%	41.5%	40.2%
	Total	No. of Reviews (y_{it} = 1)	60	248	308
		No. of Observations	206	685	891
		% Reviewed	29.1%	36.2%	34.6%

Notes: The data is cut at the overall mean term-length (see Table C.4).