Bureaucratic Minimal Squawk Behaviour: Theory and Evidence from US Regulatory Policy*

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Abstract

Regulators appointed on finite contracts have an incentive to signal their worth to the job market. This paper shows that, if contracts are sufficiently short, this can result in 'minimal squawk' behaviour. That is, regulated firms publicise the quality of unfavourable decisions, aware that regulators then set favourable policies more often to keep their professional reputation intact. Terms of office vary across US states, prompting an empirical test using firm-level data from the regulation of the US electric industry. Consistent with the theory, we find that shorter terms are associated with fewer rate of return reviews and higher residential electricity prices.

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1. Introduction

The role of an industry watchdog is a high profile one. In the US sustained media coverage of regulation began in the 1970's, as spiralling energy prices made headline news. In Europe intense interest in the merits of privatisation has kept regulation firmly in the media spotlight. As a result, policy changes rarely pass unnoticed and mistakes, when they come to light, create substantial controversy.

Few of us like being shown to have made a mistake, particularly in public. Introspection therefore suggests that our regulators may be motivated, at least in part, by a desire to avoid being cast in a bad light. Indeed, given such exposure, it would be a remarkable public servant that did *not* take her reputation into account when making policy decisions.

One might, initially, think that this is all to the good: reputational concerns will prompt regulators to try even harder not to make a mistake. However, such a conclusion overlooks the fact that regulated firms are often better placed to judge their regulator's performance than the public at large. For example, firms may have private information pertinent to a decision to cut cost pass-through, or superior knowledge of the financial implications of new environmental legislation. In short, the very nature of regulation ensures that regulated firms are in a position to influence their regulator's reputation. Given firms have an incentive to use this channel of influence to secure more lenient policies, it therefore seems more likely that reputational concerns will actually bias regulatory policy away from the social optimum.

To date government policy appears to have been driven by other considerations. In particular, the spectre of regulatory capture (i.e. the risk that regulators will 'go native' if they stay in the job too long) has led to the widespread use of fixed short-term contracts. For instance, when replacing the Office of the National Lottery with the National Lottery Commission, where the post of chairperson is held for just one year, the UK government explicitly stated 'its introduction will reduce the risk, actual or perceived, of conflicts of interest and regulatory capture'.[1] Indeed, fixed short-term contracts are the norm, with terms of office for US State public utility commissioners currently ranging from 3 to 8 years.[2]

However, fixed short-term contracts raise the importance of reputational concerns. Regulators face the prospect of having to find alternative employment and may reasonably anticipate that desirable job offers will hinge on the reputation they earn while in office. In sum, finite contracts imbue regulators with a pecuniary, or *career concern*, motive to maintain a favourable reputation. Given our observation that reputational concerns may bias regulatory polices, this paper investigates the wisdom of current policy towards regulatory appointments.

[1] Taken from a statement made by the Secretary of State for Culture, Media and Sport, Chris Smith MP. Source: Hansard Written Answers, 1st April 1998, available at http://www.parliament.the-stationary-office.co.uk. For a theoretical argument why long contracts may result in regulatory capture see Tirole (1986).

[2] Figures taken from the websites of individual State Public Utility Commissions, links are provided at http://www.naruc.org.

We begin by presenting a simple model that shows career concerns can indeed result in sub-optimal policies. The desire to maintain a favourable reputation results in what we shall term 'minimal squawk' behaviour: regulators set policies that are too soft on firms to keep them quiet and hence their own professional reputation intact.

Comparative statics of this model suggest that the greater the weight regulators attach to maintaining a favourable reputation, relative to social welfare, the greater the inefficiency. The statutory length of a regulator's term of office seems a natural indicator of the strength of her career concerns (i.e. shorter contracts tend to focus employees' attention on finding another job).[3] If 'minimal squawk' behaviour is the predominant force we should therefore see softer policies in regimes where regulators are appointed for shorter periods of time. Accordingly, our analysis concludes with a test of this prediction that exploits variation in statutory terms of office across US State Public Utility Commissions (PUCs).

The potential for regulator career concerns to create distortions was actually first recognised 30 years ago. Noting that regulators' terms of office were limited, but generally longer than those of the politicians that appointed them, Hilton (1972) argued that regulators would deem re-appointment unlikely and hence set policy with an eye on the job market. Specifically, he conjectured that regulators would pacify firms in an attempt to land a job in the regulated industry, first coining the phrase 'minimal squawk' to describe such behaviour. Today, however, legislation has largely closed the 'revolving door' between regulatory office and industry job suggesting a direct *quid pro quo* between regulators and firms is implausible.[4] In contrast to Hilton, we therefore explore how the need to secure even a non-industry job can bias regulatory behaviour.

We model the regulatory environment as one of 'career concerns for experts' (see, for instance, Scharfstein and Stein (1990)). Regulators must decide on the level of exogenous operating costs firms can pass through to consumers. Since firms shave on socially desirable investment if they cannot pass through high costs, the optimal policy depends on the cost state of the world. Regulators differ in their innate decision-making ability, with more able regulators receiving more accurate cost signals. Finally, decision-making skills are deemed relevant in the private sector, ensuring regulators' future wage offers depend on the reputation they acquire while in office.

Given such a set up, we show that career concerns can bias regulatory behaviour under

[3] Specifically, we assume that, at any point in time, regulators on shorter contracts attach more weight to maintaining a favourable reputation. As a justification, think of the two extremes: a regulator appointed on a 'permanent' contract has no need to worry about finding another job, while a regulator appointed on a 'spot' contract may well think of little else.

[4] In the UK former public servants must seek clearance before joining private companies for two years after leaving office. See the reports of The Committee for Standards in Public Life, available at http://www.public-standards.gov.uk/. The annual reports published by the National Association of Regulatory Utility Commissioners list similar restrictions for the US.

two relatively weak assumptions over the information structure. First, that decision-making ability is private information. Second, that all parties can observe regulatory decisions but that regulated firms are better informed about their input costs and hence the *quality* of these decisions.

The intuition is as follows. Suppose that a firm threatens to squawk (disclose decision-making quality) if its regulator is tough (permits a low level of cost pass through) but to stay silent if she is generous (permits a high level of cost pass through). As long as the job market believes able regulators 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 regulators relish the opportunity such selective disclosure gives them to demonstrate their superior decision-making skills. In contrast, less able regulators recognise that tough policies expose their poor decision-making to the market's scrutiny. Less able regulators therefore have an incentive to hide behind generous policies to ensure their professional reputation remains intact.

Of course, if the job market believes that less able regulators are *always* generous it will simply treat tough policies as evidence that the regulator is able. But then less able regulators have an incentive to be tough. Accordingly, we establish that regulators will strike a balance between these two effects. Formally, a hybrid equilibrium exists in which able regulators try to make good decisions but less able regulators mix between attempting to make good decisions and simply being generous. Given less able regulators hide behind tough policies when the firm threatens to squawk on generous but attempt to make good decisions if the firm threatens to always squawk or always stay silent, squawking on tough is indeed optimal for the firm ensuring that, in equilibrium, generous policies are set too often.

Performing comparative statics we find that less able regulators set generous policies more often as career concerns increase in importance relative to social welfare. To test this prediction using variation in terms of office across US State PUCs, we follow Joskow (1974) in equating tough policies with the initiation of formal rate of return reviews, generous policies with doing nothing and cost signals with lagged changes in operating expenses ($\Delta opex$). This allows us to formulate three testable hypotheses: (i) rate reviews should be less likely the shorter PUC terms of office; (ii) rate reviews should be less likely the lower $\Delta opex$; and (iii) the effect of term-length should be greater when operating expenses have been falling (negative $\Delta opex$) rather than rising (positive $\Delta opex$). One might also expect 'minimal squawk' behaviour to feed through into prices (i.e. if PUCs fail to reduce revenue allowances, firms should earn higher average revenue). Our final hypothesis (iv) is therefore that firms should charge higher prices in States with shorter PUC terms of office.

Estimating Logit, and Conditional Logit, models of the probability that a firm faces a rate review and Least Squares Dummy Variable price regressions using firm-level panel data from the regulation of the US electric industry 1980-1990, we find evidence in favour of all four hypotheses. In particular, controlling for firm-level fixed effects, firms are significantly less likely to face a rate review and set significantly higher prices when their regulators serve for shorter terms. We therefore conclude that appointing regulators on short fixed-term contracts may not be not be the panacea that some have hoped for. Rather, in using such contracts, governments may be replacing one source of political failure (i.e. regulatory capture) with another in the shape of 'minimal squawk' behaviour.

The remainder of the paper is organised as follows. The next section discusses related theoretical and empirical approaches. Section 3 sets out the theoretical model, characterises equilibrium behaviour and performs comparative statics. Section 4 outlines the empirical hypotheses that follow from the theory, the econometric models used to test them and presents our empirical results. Section 5 offers a discussion and Section 6 concludes.

2. Related Literature

This paper relates to two strands of literature: theoretical papers that examine how career concerns influence actions in public and private organisations and empirical studies that investigate the role political institutions play in determining regulatory outcomes.

An excellent summary of the career concern literature is given in Prat (2001). Three approaches can be distinguished depending on whether 'the agent's type is seen as ability to exert effort, congruence of preference with the principal, or ability to observe a signal about the state of the world' (Prat (2001), pp. 5). To date, studies of career concerns in public organisations have taken the first approach originally developed by Holmström (1982, 1999) (see Dewatripont et al (1999), Le Borgne and Lockwood (2001), Persson and Tabellini (2000, Chp. 4)). In these papers agents (bureaucrats or politicians) are, *ex ante*, unaware of their ability and career concerns are found to foster effort. In this paper we adopt the third 'career concerns for experts' approach developed by Sharfstein and Stein (1990).

Scharfstein and Stein (1990) study managers taking sequential investment decisions. Managers are unaware of their type and the job market can observe the quality of all decisions. They show that career concerns can prompt managers to ignore their signals and simply mimic earlier decisions - a phenomenon termed 'herd behaviour'. A number of papers have built on this basic set up (see, for instance, Prendergast and Stole (1996), Levy (2000), Prat (2001), Fingleton and Raith (2001)). Closest to this paper is Levy (2000), who focuses on managers who are perfectly informed of their own ability and able to consult others for advice. When managers cannot consult (analogous to our case of full disclosure), all types attempt to make good decisions. In the presence of advice, however, career concerns produce 'anti-herding': able managers contradict their signals to demonstrate they are a better source of information.

This paper also asks whether experts with career concerns and private information over ability will attempt to make good decisions. Motivated by our regulatory setting, however, we endogenise the market's ability to judge decision-making quality by adding a third player with a vested interest in actions. In doing so we highlight an alternative reason why career concerns can bias decision-making. Under selective disclosure, less able regulators attempt to hide their poor decision-making from the market by ignoring their signals with positive probability.

Turning to the empirical literature, the benefits of using State PUC data have certainly not gone unnoticed. By far the most popular question has been whether electing rather than appointing PUC commissioners results in lower utility prices (see, for instance, Besley and Coate (2001) who provide a comprehensive review of earlier papers). Alternative regulatory outcomes studied include the cost of capital, rates of return (both prescribed and actual), regulatory climate, percentage of rate requests granted and systematic risk. To our knowledge, however, this paper is the first to investigate the impact of political institutions on the incidence of rate reviews.

Until recently, these studies were cross-sectional and there was little evidence to suggest that institutions mattered. Noting that these findings are sensitive to the chosen year / set of controls, as well as to unobservable heterogeneity, Besley and Coate (2001) take a panel data approach. Allowing for State fixed effects, they find strong evidence that electricity prices respond more to cost shocks in electing States but that other PUC institutions, including term-length, exert no significant effect. This paper also takes a panel data approach. However, to allow us to exploit the significant variation in operating expenses across firms, as well as to control for unobserved heterogeneity in the relationship between firms and their regulators, we use firm-level data. In contrast to previous work we find that, controlling for firm-level fixed effects, statutory term-length can indeed exert a significant effect on regulatory policy.

3. Theory

3.1. The Model

The model is the simplest needed to show that career concerns can bias regulatory policy: all choice sets are binary, state variables are binary and occur with equal probability. The implications of key assumptions are discussed at the end of the next section.

Description There are three players: a firm, its regulator and future private sector employers subsumed into a single player called the job market.

The firm faces input costs 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 can choose a policy that is 'tough', allowing the firm to pass through the lower level of costs, or one that is 'generous', allowing the firm to pass through the higher level. This action is denoted by $a \in \{t, g\}$. The optimal action depends on the cost state of the world. A tough policy is optimal if input costs are low but, if input costs are high, the regulator must be generous to ensure firms maintain socially desirable investment. The four possible outcomes

Table 3.1: The Four Regulatory Outcomes

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

are defined in Table 3.1. It is common knowledge that (l, t) and (h, g) are good decisions and (h, t) and (l, g) are bad decisions.

To guide her in her policy choice, the regulator can conduct an experiment which generates an informative private cost signal $s \in \{l, h\}$. The accuracy of this signal is termed the regulator's 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. In contrast, the firm and the market 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 $\frac{1}{2} < \theta_D < \theta_S < 1$.[5]

The regulator derives utility from two sources: directly from her policy choice (her *policy preferences)*, as well as from the effect this decision has on her future job prospects (her *career concerns)*[6]. Ceterus paribus, the regulator likes to make good decisions, receiving W from doing so. Her policy preferences are therefore 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. It is assumed that ability affects future productivity and that the job market responds by offering a future wage equal to its posterior beliefs μ over ability. The regulator's career concerns are therefore captured by μ. Adopting a simple additive specification, her objective function is given by $u(\omega, a) + \delta\mu$, where $\delta > 0$ is a weighting term that reflects the relative importance of career concerns.

The firm weakly prefers a generous policy in all cost states, receiving H if the regulator mistakenly sets a generous policy when its costs are low, L if she makes a good decision and nothing if she mistakenly sets a tough policy 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 policy a in cost state ω.

The firm attempts to persuade the regulator to be generous by strategically announcing the quality of her decisions (equivalently firm costs ω).[7] Specifically, the firm takes the first

[5] The upper bound ensures incorrect signals are received with positive probability and hence reduces the number occasions on which information sets are off the equilibrium path.

[6] In keeping with standard economic models, we view μ as a purely pecuniary motive (i.e. career concerns). Another possibility is that the regulator cares *directly* about what her peers think of her. For recent survey evidence supporting both interpretations see Schofield (2001).

[7] To enable us to focus on the effect of career concerns, we assume that the firm cannot offer the regulator

Table 3.2: A Typical Disclosure Rule ('squawk on tough')

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

move and publicly commits to a disclosure rule d which states how it will behave following each regulatory outcomes. It is assumed that ω is hard information and hence that the firm can either commit to 'squawk' (costlessly revealing the true state ω) or to stay silent. This action is denoted by $r \in \{\omega, \emptyset\}$. A typical strategy d is given Table 3.2.

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. To allow us to focus on whether each ability type attempts to make a good decision, let $\sigma_i = (p_i, q_i)$ denote the probability that a regulator with ability θ_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, we can then define four pure 'strategies' for each ability type: 'follow' ($\sigma_i = (1, 0)$, 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 we 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_i.[8]

Stage 2. Observing d, θ_i 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 market offers the regulator a wage equal to its posterior beliefs μ over θ_i.

The solution concept we use 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^o solves (2). Since the market's action is completely characterised by its beliefs we solve for such a PBE by backwards induction.

bribes (including offers of future employment) to influence policy.

[8] 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.

Discussion of Assumptions Assuming the regulator derives utility from making good decisions enables us to pin down equilibria when the market pays the same wage for any policy choice. We offer two possible justifications. First, the government (but not the market) might learn the quality of the regulator's decision-making and hence offer her a wage contract which pays a bonus in the event of a good decision. Alternatively, one could take a more traditional view and assume that regulators attach some weight to maximising social welfare.

An observable disclosure rule ensures that the firm's actions induce proper sub-games, thereby enabling us to focus on the sub-games between the regulator and job market, taking the firm's action as given. Under a private disclosure rule the market's beliefs must be derived from the firm's, as well as the regulator's, strategy. Since 'minimal squawk' behaviour is part of an equilibrium in both cases, we adopt the former approach.

Costless revelation eases notation, while ensuring that our existence, although not uniqueness, results are robust to the firm's ability to commit.[9] The presence of a media eager for regulatory news suggests such costs may be low. Our results would go through up to a well defined positive cost of revelation. However, in this case, the firm's ability to commit is crucial; 'minimal squawk' behaviour could only be sustained if firms were keen to establish a reputation for credibility (see Lizzeri (1999) for a related discussion).

Finally, assuming that the quality of the regulator's decision making (i.e. ω) is hard information, greatly reduces the firm's strategy space. This, however, suggests that it may be possible to find a contractual solution to the regulatory problem. By abstracting from the possibility of mechanism design, we aim to draw attention to the fact that common place regulatory institutions such as short appointments combined with price caps or rate reviews may foster alternative sources of capture.

3.2. Analysis

Our aim is to establish whether the firm can use the presence of career concerns to bias regulatory policy in its favour. As a benchmark, we begin by characterising the regulator's behaviour when she is motivated solely by her policy preferences.

3.2.1. 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 $\Pr(\omega = s \mid s) = \theta_i$. Upon receipt of $s = l$, the regulator therefore 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

[9] Note that commitment is therefore (weakly) in the firm's interest; i.e. it guarantees that the regulator plays the firm's preferred strategy.

$\Pr(h, g \mid h, \theta_i, \sigma_i) = (1 - q_i)\theta_i$. By the Law of Total Probability $\Pr(s = l) = \Pr(s = h) = \frac{1}{2}$, implying

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

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 career concerns, both smart and dumb regulators play 'follow' since this maximises the probability of making a good decision. Hereafter, we describe this (socially optimal) benchmark behaviour 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).

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

In games of hard information revelation, saying nothing can often be informative. Here such unraveling allows us to partition the set of possible disclosure rules 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 market 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, we make two simplifications. First, we assume that it is common knowledge that the market retains its prior beliefs at information sets off the equilibrium path.[10] Second, we ignore equilibria in which smart regulators try to signal their ability by attempting to make *bad* decisions.[11]

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 market believes the regulator is playing. Since the market observes the regulator's actions, it 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

[10] In doing so we remove the possibility that both S and D ignore their signals. Given such equilibria are a possibility under any disclosure rule this does not change the essence of our results.

[11] Since dumb regulators also engage in 'minimal squawk' behaviour in these 'bad' equilibria, this does not affect the qualitative nature of our results. For a full characterisation of these equilibria see Leaver (2001).

action, Bayes' Rule implies that its beliefs must satisfy

$$\begin{aligned} \mu(t) &= \frac{\Pr(t \mid \theta_S, \widetilde{\sigma}_S) \cdot \Pr(\theta_S)}{\Pr(t)} \\ &= \frac{\widetilde{p}_S + \widetilde{q}_S}{\widetilde{p}_S + \widetilde{q}_S + \widetilde{p}_D + \widetilde{q}_D} \end{aligned} \tag{2}$$

and

$$\mu(g) = \frac{2 - \widetilde{p}_S - \widetilde{q}_S}{4 - \widetilde{p}_S - \widetilde{q}_S - \widetilde{p}_D - \widetilde{q}_D}. \tag{3}$$

Under 'squawk on tough' the market also learns the quality of the regulator's decision making if she chooses t. Since the market can deduce that $\Pr(l, t \mid \theta_i, \widetilde{\sigma}) = \frac{1}{2}(\widetilde{p}_i\theta_i + \widetilde{q}_i(1 - \theta_i))$ (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 $\Pr(h, t \mid \theta_i, \widetilde{\sigma}) = \frac{1}{2}(\widetilde{p}_i(1 - \theta_i) + \widetilde{q}_i\theta_i)$, its posterior beliefs at the information sets (l, t) and (h, t) are given by

$$\mu(l, t) = \frac{\widetilde{p}_S\theta_S + \widetilde{q}_S(1 - \theta_S)}{\widetilde{p}_S\theta_S + \widetilde{q}_S(1 - \theta_S) + \widetilde{p}_D\theta_D + \widetilde{q}_D(1 - \theta_D)} \tag{4}$$

and

$$\mu(h, t) = \frac{\widetilde{p}_S(1 - \theta_S) + \widetilde{q}_S\theta_S}{\widetilde{p}_S(1 - \theta_S) + \widetilde{q}_S\theta_S + \widetilde{p}_D(1 - \theta_D) + \widetilde{q}_D\theta_D}. \tag{5}$$

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 (1), the regulator's problem is given by

$$\max_{p_i, q_i} \frac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right) W + \delta \left[\begin{array}{c} \frac{1}{2}(p_i\theta_i + q_i(1 - \theta_i))\mu(l, t) + \\ \frac{1}{2}(p_i(1 - \theta_i) + q_i\theta_i)\mu(h, t) + \frac{1}{2}(2 - p_i - q_i)\mu(g) \end{array} \right]. \tag{6}$$

To establish all the sub-game equilibria when the firm plays 'squawk on tough' we simply need to solve (6) for every set of beliefs defined by (3)-(5).

Repeating the above procedure for the three remaining sub-games and then solving for the firm's optimal choice of disclosure rule yields our first result.

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

(i) if career concerns are of low importance ($\delta \leq \delta^*$), then

a) smart and dumb regulators both attempt to make good decisions ($\sigma_S^o = \sigma_D^o = (1,0)$)

b) the firm plays any disclosure rule

c) the ex ante probability of a good decision is $\frac{1}{2}(\theta_S + \theta_D)$;

(ii) if career concerns are of high importance ($\delta > \delta^*$), then

a) smart regulators attempt to make good decisions ($\sigma_S^o = (1,0)$) but dumb regulators mix into always being generous ($\sigma_D^o = (p_D^o, 0)$ for some $p_D^o > 0$)

b) the firm plays 'squawk on tough'

c) the ex ante probability of a good decision is $\frac{1}{2}\left(\theta_S + \theta_D p_D^o + \frac{1}{2}(1 - p_D^o)\right)$.

A proof (including a characterisation of δ^*) is given in Appendix A. The intuition is as follows. Under 'no disclosure' the market never observes the quality of regulatory decision-making. Since D can then mimic any favourable action, pooling behaviour 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 market thinks both types *use* their signals, it will expect to observe t as often as g and hence offers the same wage following t and g (i.e. substituting for $\sigma_i = (1,0)$ or $\sigma_i = (0,1)$ in (2) and (3) yields $\mu(t) = \mu(g)$). However, since the market retains its priors at information sets off the equilibrium path, it also offers the same wage following t and g when both types *ignore* their signals. Career concerns are then irrelevant under any strategy and S and D attempt to make good decisions.

Under 'squawk on tough' the market 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 market thinks she plays a separating strategy, while career concerns are again irrelevant under a pooling strategy. The story changes, however, if S elects to *use* her signals.

Suppose that the market believes S and D attempt to make good decisions. Since S makes good (resp. bad) decisions with higher (resp. lower) probability than D, the market believes that the regulator is more likely to be smart following (l,t) than (h,t) (substituting for $\sigma_i = (1,0)$) in (4) and (5) yields $\mu(l,t) > \mu(h,t)$). In short, the firm's actions split the wage offer $\mu(t)$ into a reward for making a good decision and a punishment for making a bad decision. Since the market 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 we already know, offers the same wage 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 market expected $(\frac{1}{2}(\theta_S + \theta_D))$ and the bad decision (h, t) with lower probability $(1 - \theta_S)$ than the market expected $(\frac{1}{2}(2 - \theta_S - \theta_D))$. Relishing the opportunity to demonstrate her superior decision-making skills, she therefore 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 career concerns are sufficiently important (specifically $\delta > \delta^*$), D therefore deviates from attempting to making good decisions.

Now suppose that the market 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 (4) and (5) yields $\mu(l, t) = \mu(h, t)$). But, given these new wage offers, D finds that setting t upon receipt of $s = l$ now yields a higher expected wage than setting g. Accordingly, D deviates from playing 'always generous'.

Alternatively, then, suppose that the market thinks that D sets g with positive, but not certain, probability. From (3)-(5) it is easy to see that the more likely the market 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 market's beliefs will be such that D's *career concern* 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 play 'squawk on generous' and $\delta > \delta^*$, D sets t more often in an attempt to protect her professional reputation. Under 'full disclosure', however, the market 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. career concerns *reinforce* the regulator's incentive to attempt to make good decisions.

Turning to the optimal disclosure rule, it should be obvious that firm would rather see the regulator play 'always generous' than 'follow'. Given the above discussion, while the firm is indifferent between disclosure rules when career concerns are of low importance ($\delta \leq \delta^*$), it will commit to 'squawk on tough' when reputation is more important ($\delta > \delta^*$) since this biases regulatory policy in its favour.

Finally, the *ex ante* probability of a good decision follows from our discussion in Section 3.2.1. When S and D attempt to make good decisions, the probability of a good decision is simply the average decision-making ability $\frac{1}{2}(\theta_S + \theta_D)$. Recall that p_D^o denotes the probability with which D sets t when $s = l$. The lower p_D^o, the more often D plays 'always generous' and thus the closer she is to making good decisions with probability $\frac{1}{2}$. The *ex ante* probability of a good decision must therefore be given by $\frac{1}{2}\left(\theta_S + \theta_D p_D^o + \frac{1}{2}(1 - p_D^o)\right)$.

Proposition 1 therefore confirms our initial conjecture that reputational concerns can bias regulatory policy away from the social optimum: less able regulators engage in 'minimal squawk' behaviour, setting generous policies more often to keep the firm quiet and their professional reputation intact. To allow us to test this hypothesis against the available data and outline policy implications, we now ask how this incentive changes as we vary our main parameters.

Proposition 2 (Comparative Statics). *(i) The ex ante probability of a good decision is (weakly) decreasing in the weight attached to career concerns (δ); (ii) career concerns can increase in importance (higher δ) without reducing the probability of a good decision if the direct utility derived from making good decisions increases (higher W); the ability of the least able increases (higher θ_D); or the ability of the most able decreases (lower θ_S).*

As δ increases above δ^*, D has a stronger career concern incentive to set g when $s = l$. To ensure that D continues to mix, the market 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^o_D, 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 behaviour remains unchanged. It is then easy to see from the statement of Proposition 1 that the *ex ante* probability of a good decision must be (weakly) decreasing in δ.

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 market will take a good (bad) decision to be stronger (weaker) evidence that the regulator is smart, D therefore has a stronger career concern 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 market will take a good (bad) decision to be weaker (stronger) evidence that the regulator is smart giving her a weaker career concern 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.

4. Evidence

Our theoretical results suggest that regulatory policies may be shaped by the level of importance regulators attach to their reputation. Statutory terms of office seem a natural (and as we discuss below arguably exogenous) indicator of the importance of career concerns (i.e. shorter contracts tend to focus employees' attention on finding another a job). If our 'minimal squawk' hypothesis is correct, we should therefore see softer policies in regimes where regulators are appointed for shorter periods of time. In this section we undertake an empirical test of this prediction by exploiting variation in statutory terms of office across US State Public Utility Commissions (PUCs).

4.1. Hypotheses

Joskow (1974) suggests that regulatory agencies seek to minimise conflict and do nothing in the absence of complaints. He therefore conjectures that formal rate of return reviews will be triggered by firms attempting to raise the level of their rates and hence that 'during periods of falling average cost, we should expect to observe virtually no regulatory rate of return reviews' (Joskow (1974), pp. 299). In this paper we offer a micro-foundation for *why* regulators might seek to minimise conflict: regulators keep firms quiet to ensure their professional reputation remains intact. Joskow's work therefore suggests that, if such 'minimal squawk' behaviour exists, it should be reflected in the relationship between cost conditions and the incidence of formal rate reviews.

To derive more precise predictions we need to outline the basic features of the US 'rate of return' framework. Rate regulation has two aspects: regulation of the rate level (earnings) and control of the rate structure (prices). As Phillips (1988) notes, rate level regulation can be summarised by the formula $R = O + Ar$. That is, public utilities are entitled to earn a level of revenue R, sufficient to cover allowable operating costs O and earn a "fair" rate of return r on the asset base A. Crucially, given the context of this paper, either the firm *or* the PUC can file for a rate review if R proves too tight or too loose.

The rate of return system therefore gives firms the motive and opportunity to file for a rate review to increase R when input costs are rising, but an incentive to stay silent when they are falling. Given formal reviews expend valuable PUC resources, it is efficient for regulators to restrict attention to the possibility that input costs are falling or constant. These observations allow us to interpret our theoretical model as follows. PUC commissioners either receive a signal that O has been falling (a low cost signal) or one that suggests that O has remained roughly constant (a high cost signal) and must subsequently decide whether to file for a formal review to decrease R (be tough) or do nothing (be generous). Since it is also socially wasteful for R to exceed O, filing when costs are falling (l, t) and doing nothing when costs are constant (h, g) are the only good decisions.

In light of this discussion, it should be clear that the relevant dependent variable is the incidence of formal rate reviews *initiated by PUCs*. Unfortunately, data limitations mean our empirical framework must admit the possibility that an observed review could have been initiated by the PUC or the firm (see Section 4.2 below). Given this constraint, Propositions 1 and 2 yield the following testable hypotheses.

Hypothesis 1. *Firms should be less likely to face rate reviews the shorter the statutory terms of office for their PUC commissioners (the marginal effect of term-length on reviews).*

The shorter statutory terms of office, the greater the weight one would expect PUC commissioners to place on maintaining a favourable reputation and hence, from Proposition 2, the fewer reviews they should initiate (i.e. the higher δ the more often regulators play generous). Hypothesis 1 then follows from the reasonable assumption that the number of reviews firms initiate is independent of term-length.

Hypothesis 2. *Firms should be less likely to face rate reviews the lower the lagged change in their operating expenses (the marginal effect of $\Delta opex$).*

Assuming lagged changes in firm-level operating expenses ($\Delta opex$) are a reasonable proxy for a PUC's cost signal, small drops (or rises) in a firm's operating expenses ($\Delta opex$ close to zero) should effectively signal that its input costs are constant. Similarly, large drops in a firm's operating expenses (strongly negative $\Delta opex$) should signal that a firm's input costs are falling. Thus, from Proposition 1, the more negative is $\Delta opex$, the less likely the PUC should be to initiate a review. Recall that we have assumed that the regulator's signal is positively correlated with the true cost state. Thus, the more positive is $\Delta opex$, the more likely the firm should be to initiate a review, hence Hypothesis 2.

Hypothesis 3. *The effect of term-length should be greater when the lagged change in operating expenses is negative rather than positive (the interaction effect of $\Delta opex$).*

Recall that regulators can (efficiently) rely upon firms to initiate reviews when input costs are rising. Consequently, career concerns should only bite (and hence foster 'minimal squawk' behaviour) when input costs are falling. From Proposition 1 and 2, the effect of term-length should therefore be greater conditional on a drop in operating expenses than a rise.

Hypothesis 4. *Firms should charge higher prices the shorter statutory terms of office for their PUC commissioners (the marginal effect of term-length on prices).*

Other things equal, firms should earn higher average revenue when their PUC commissioners fail to initiate rate reviews. If Hypothesis 1 is correct firms should therefore earn higher average revenue (equivalently charge higher prices[12]) the shorter the term of office facing their PUC commissioners. Put simply, the longer their term of office, the more likely PUC commissioners are to initiate a review to reduce the allowable *rate level* which should be reflected in the *rate structure* as lower prices.

4.2. Data

Until 1990 the National Association of Regulatory Utility Commissioners (NARUC) provided a summary of ongoing utility rate cases in its annual reports. Although these yearbooks record

[12] The rate structures set by firms often allow for quantity discounts and thus calculating prices from revenue and sales may not always reflect the price per kwh paid by all customers.

the requests and outcomes of rate cases by PUC and utility and, crucially, list the date filed, they do not consistently report whether it was the PUC or the firm that initiated each rate case. The available dependent variable is therefore the incidence of all formal rate reviews.

Our first independent variable of interest is the proxy for cost signals $\Delta opex$. Since PUCs only have jurisdiction over the rates of investor-owned utilities we restrict attention to these firms. Until 1996 the Energy Information Agency (EIA) published an annual digest of firm-level financial information from the US electric industry, including a breakdown of each firm's total electric operating expenses together with a list of States served, sales and total revenue. We use these yearbooks to construct $\Delta opex$ for the 162 major investor-owned electric utilities serving at least one State during our sample period 1980-90.

Our second independent variable of interest is the statutory term of office for PUC commissioners in the 48 States and District of Columbia served by at least one major investor-owned utility.[13] PUC term-lengths are available from a variety sources. Since the NARUC yearbooks report annually and provide the information for the other volumes, our term-length variables, together with all PUC controls, are taken from this source.

4.3. The Incidence of Rate Reviews

4.3.1. Estimation

As Table 4.3 shows, individual firms faced very different input cost conditions over our sample period. To enable us to exploit this important source of variation, as well as to control for firm-level unobservable heterogeneity, we take a firm-level panel data approach. Since our sample includes firms that serve more than one State (and all but four states are served by more than one firm) we could potentially include both firm and State fixed effects. However, this would mean dropping over half the available data. Instead, we elect to treat *firm-State pairs* as the unit of analysis and hence effectively control for the possibility that some 'regulatory relationships' are more difficult than others. For more details see Table 4.1.

Given this approach our dependent variable, y_{it}, is binary, taking the value 1 if firm-State pair i faces at least one new review in year t and 0 otherwise, where $i = 1, .., N = 236$ and $t = 1, ...T$ where $T \leq 9$ for some i. As is standard in the case of discrete dependent variables, we posit the existence of an underlying model

$$y_{it}^{*} = \boldsymbol{\beta}'\mathbf{x}_{it} + u_{it} \tag{7}$$

where $\mathbf{x}_{it}$ is a vector of k regressors and a constant α, $\boldsymbol{\beta}$ is a vector of $k+1$ coefficients, u_{it} is an error term and y_{it}^{*} is defined such that we observe $y_{it} = 1$ if $y_{it}^{*} > 0$ and 0 otherwise. Given our data set contains the entire population of major investor-owned electric utilities, we assume that individual effects are fixed across firms, implying $u_{it} = \alpha_i + \upsilon_{it}$ where α_i is a constant and $\upsilon_{it} \sim IID(0, \sigma_{\upsilon}^2)$.

[13] Alaska is not recorded in the EIA yearbooks and Nebraska is not served by an investor-owned utility.

When u_{it} follows a Logistic distribution the probability that firm-State pair i faces a review in year t is given by

$$\Pr[y_{it} = 1] = F(\alpha_i + \boldsymbol{\beta}'\mathbf{x}_{it}) = \frac{\exp(\alpha_i + \boldsymbol{\beta}'\mathbf{x}_{it})}{1 + \exp(\alpha_i + \boldsymbol{\beta}'\mathbf{x}_{it})}. \tag{8}$$

But for the addition of N fixed effects (α_i), this is a standard Logit model, implying that we can obtain estimates of the vector of coefficients $\boldsymbol{\beta}$ by maximum likelihood estimation (MLE). However, for large N and fixed T, MLE produces inconsistent estimates of α_i. More worringly, under MLE, this results in inconsistent estimates of $\boldsymbol{\beta}$ (for a simple illustration see, for instance, Hsaio (1986)). To resolve this 'incidental parameter problem', we follow Chamberlain (1980)'s suggestion and also maximise the likelihood function conditional on $\sum_{t=1}^{T} y_{it}$ (i.e. we condition the likelihood for each set of T_i observations on the number of reviews in this set).

Hypotheses 1-3 suggest the following structural form for the underlying model given in (7)

$$\begin{aligned} y_{it}^{*} &= \alpha + \alpha_i + \beta_1 term_{it} + \beta_2 \Delta opex_{it} + \beta_3 D_{it} \cdot term_{it} + \\ &\quad \beta_4 t + \boldsymbol{\gamma}'\mathbf{z}_{it} + \upsilon_{it}, \end{aligned} \tag{9}$$

where α is a constant term, $\mathbf{z}_{it}$ is a vector of PUC controls and all variables are defined in Table 4.2. From Hypotheses 1 and 2, β_1 and β_2 should be positive since they capture the marginal effects of term-length and $\Delta opex$, respectively. Hypotheses 3 suggests that the coefficient on the interaction term $D_{it} \cdot term_{it}$, β_3, should be positive, since longer terms should exert a greater positive effect on the probability of a review when costs are falling ($D_{it} = 1$) than when costs are rising ($D_{it} = 0$).

This specification controls for unobservable heterogeneity via the inclusion of firm-State fixed effects α_i and for the fact that both the number of reviews and term-length follow a downward trend during our sample period via the inclusion of a simple time trend t (see Figure 4.1). Besides term-length, PUCs vary in a number of other ways that might plausibly be expected to affect the probability of review. Given our aim is to test Hypotheses 1-3, these institutional variables are 'nuisance parameters' and hence we include the vector $\mathbf{z}_{it}$ simply to isolate the role played by $\Delta opex_{it}$, $term_{it}$ and $D_{it} \cdot term_{it}$.

4.3.2. Results

A natural starting point is to ask whether Hypotheses 1-3 are borne out in the raw data. Table 4.4 reports cross-tabulations of the number of reviews ($\sum_{i=1}^{N} \sum_{t=1}^{T} y_{it}$) between 1982 and 1990 by lagged change in firm operating expenses and the statutory PUC terms of office. Cutting the data in this way offers broad support for theoretical model. First, consistent with Hypothesis 1, the percentage of firm-State pairs facing a review in any given year is lower in States where the statutory term of office is strictly less than the sample mean of 6 years

(25.3% relative to 30.7%). Second, consistent with Hypothesis 2, the percentage of firms-State pairs facing a review in any given year is lower when input costs have been falling, and hence cost expectations are low, (23.2% relative to 30.4%). Finally, consistent with Hypothesis 3, the effect of term-length on the incidence of reviews is greater when input costs are falling. Specifically, while 18.5% of firm-State pairs with falling inputs costs and *short* terms face a review in any given year, 26% of firms-state pairs with falling input costs face a review when terms are *long* - an increase of 40.5%. In contrast, when input cost are rising, moving from short to long terms only increases the fraction of firms facing a review by 16% (i.e. 27.4% to 31.8%).

Turning to the regression analysis, Table 4.5 reports the results from the Logit estimation of the probability of formal review. Simply controlling for a time trend does little to alter the story from the raw data (Regression (i)); $term_{it}$ and $\Delta opex_{it}$ are positive and significant at 5% respectively, while $D_{it} \cdot term_{it}$ is positive, although not significant at conventional inference levels. In line with previous studies, introducing PUC controls $\mathbf{z}_{it}$ renders $term_{it}$ insignificant (Regression (ii)). However, if we exploit the unique feature of our data set and allow for firm-level fixed effects, the significance of $\Delta opex_{it}$ drops markedly, while $term_{it}$ is once again significant at the 5% level and $D_{it} \cdot term_{it}$ is insignificant at standard levels but retains the correct sign (Regression (iii)). Finally, if we re-introduce PUC controls , $term_{it}$ remains significant at 5% while $\Delta opex_{it}$ and $D_{it} \cdot term_{it}$ remain insignificant but retain the correct signs (Regression (iv)).

We interpret these results as follows. Consistent with our theoretical results, firms are more likely to face a formal review the longer the term of office served by their regulators and the greater the lagged rise in their input costs. The fact that the latter effect is insignificant following the introduction of firm-level effects is unsurprising given $\Delta opex_{it}$ is, itself, highly firm idiosyncratic (see Table 4.3). Moreover, we also find weak evidence of an interaction effect between our proxies for career concerns and cost signals. That this interaction effect is insignificant, in addition to the level effects, is also unsurprising given the relative small size of our sample.

The results of the Conditional Logit estimation of the probability of formal review are given in Table 4.6. Regressions (iii) and (iv) show that the (qualitative) results reported above are robust to conditioning on the total number of reviews; $term_{it}$ is positive as predicted and drops in significance following the introduction of PUC controls, while $\Delta opex_{it}$ and $D_{it} \cdot term_{it}$ are positive as predicted but insignificant at standard levels.

Table 4.6 also reports robustness checks. Repeating Regression (iv) in the absence of $D_{it} \cdot term_{it}$ confirms that the significance of $term_{it}$ is not driven by the inclusion of the interaction term; $term_{it}$ is now significant at 5%. Running Regression (iv) on the subset of single-state firms confirms that our results are not driven by our decision to use firm-State effects rather than firm dummies to control for unobservable heterogeneity. Similarly, repeating Regression

(iv) for the subset of appointing states we obtain similar results, suggesting Hilton (1972) was indeed correct to conjecture that *appointed* regulators engage in 'minimal squawk' behaviour.

4.4. Prices

Since the EIA yearbooks list sales and revenue by head-office state we do not have a breakdown of prices in each State served. To control for the possibility that PUC institutions in other States affect this measure of average revenue we therefore restrict attention to the 109 firms that serve customers in their 'head-office', *but no other*, State. Assuming that prices are (linearly) determined by three groups of variables: PUC institutions, supply-side factors and demand-side factors, we have the following model

$$p_{it} = \alpha + \alpha_i + \alpha_t + \beta_1 term_{it} + \boldsymbol{\varphi}^{'}\mathbf{s}_{it} + \boldsymbol{\psi}^{'}\mathbf{d}_{it} + \boldsymbol{\gamma}^{'}\mathbf{z}_{it} + \upsilon_{it}, \tag{10}$$

where definitions of the elements of the vectors $\mathbf{s}_{it}$, $\mathbf{d}_{it}$ and $\mathbf{z}_{it}$, are given in Table 4.7. Hypothesis 1 suggests that the coefficient β_1 should be negative.

The model given in (10) maintains the assumption that firm effects are fixed but also introduces a year effect to control for inflation and year specific shocks. The error term u_{it} is therefore decomposed into two constants, α_i and α_t, in addition to the random variable $\upsilon_{it} \sim IID(0, \sigma_\upsilon)$. On the supply-side we include $avopex_{it}$ as a proxy for per unit costs, $land_{it}$ to reflect possible scale economies associated with serving larger states and census region dummies to isolate geographic factors such as terrain or climate. We also include $stpop_{it}$ and $stdpcy_{it}$ to control for inter and intra-State variation in the demand for electricity. As in (8) above, the number of parameters to be estimated in (10) increases with N. In contrast to MLE of (8), however, ordinary least squares (OLS) yields estimates of $\boldsymbol{\beta}$ that are efficient and consistent, even for fixed T.

These estimates are reported for residential prices in Table 4.8. Prior to controlling for variation in PUC institutions and firm-State effects, $term_{it}$ displays the correct sign but is highly insignificant (Regression (i)). Introducing the vector of PUC controls (Regression (ii)), reduces the significance of $term_{it}$. Again, fixed effects overturn these results: in Regressions (iii) and (iv) $term_{it}$ is negative and significant at 5%. These results therefore suggest that firms do indeed charge higher prices when regulated by commissioners serving shorter terms.

5. Discussion

Our theoretical model has shown that the career concerns stemming from fixed short-term contracts can indeed bias regulatory behaviour. Regulators set generous policies more often than is socially optimal to keep firms quiet and their professional reputation intact, with this inefficiency increasing the stronger career concerns are relative to social welfare.

This finding echoes Prendergast's (2000) observation that bureaucrats accede to consumer demands to avoid the possibility of complaints. In both papers, bureaucracies are inefficient because third parties observe the quality of a sub-set of bureaucratic decisions. Here, however, we provide a micro-foundation for this bias by introducing an explicit model of career concerns (for bureaucratic experts). We also show how such an information structure can be derived endogenously by modelling the recipients of bureaucratic decisions as formal players in the game.

This approach suggests a link with the literature on special interest politics. Epstein and O'Halloran (1995) claim that regulatory agencies accede to interest groups to limit their 'fire alarms' and hence the possibility of congressional veto. Here, we highlight that career concerns, rather than policy preferences, may offer bureaucrats an incentive to silence possible critics. Dal Bó and Di Tella (1999) present a reduced form model of 'capture by threat'. In this paper we micro-found this phenomenon, describing how interest groups can threaten policy-makers into concessions by exploiting their concerns for a future career. In doing so we add a subtle, and perfectly legal, channel of influence to the now standard models of political contributions and provision of policy relevant information.

Given the natural experiment proffered by variation in term-length across US States, we have also been able to test our theoretical model. We found evidence consistent with career concerns prompting regulators to set lenient policies. Controlling for firm-level fixed effects, US investor-owned electric utilities were significantly less likely to face a formal rate review, and set significantly higher prices, the shorter the statutory term of office served by their PUC commissioners.

Before drawing policy conclusions, we discuss two possible criticisms of our empirical approach. First, one might question our choice of proxy for the strength of career concerns. Clearly, at any point in time, a regulator's *actual* term left to serve is a better indicator of the strength of her career concerns than *statutory* PUC term-length. Notwithstanding the complications in constructing such a variable from data on individual regulators, the fact that PUC commissioners are free to leave mid-term suggests such a measure could easily be endogenous. In contrast, statutory PUC terms of office are set by State governments and are uniform across all regulated sectors and hence firms, suggesting they are far more likely to be exogenous.

Second, one might wonder whether our results are biased by regulators self-selecting into PUC commissions according to their terms of office. Our theoretical model predicts that below average ability regulators will play a mixed strategy, implying that they should be indifferent between PUCs with different terms of office. In contrast, above average regulators should select into States with shorter terms of office (i.e. this increases the utility they derive from attempting to make good decisions) but then this suggests that, if self selection exists, it should actually weaken, rather than strengthen, our results.

With these considerations in mind, we conclude that fixed short-term contracts may not be the panacea that some have hoped for. Rather than removing the threat of regulatory capture, governments may actually be replacing one source of political failure with another. All is not entirely lost, however, since our comparative statics results suggest that it may be possible to alleviate this trade-off. 'Minimal squawk' behaviour can be limited by (i) an increase the regulator's *ex ante* desire to make a good decision and (ii) an increase in the ability of the least able regulators and/or a decrease in the ability of the most able. While we leave a formal analysis to future research, this suggests that shorter terms of office might be desirable if accompanied by explicit incentive schemes or by changes in the composition of the regulatory pool.

Aside from confirming our central 'minimal squawk' conjecture, our empirical results also highlight that unobservable firm-level heterogeneity may play an important role in shaping regulatory outcomes. It is possible to test for the presence of such heterogeneity (i.e. $\alpha_i \neq \alpha$) in our rate regressions via a Likelihood Ratio test. With Regression (iii) in Table 4.5 as the unrestricted model and Regression (i) the restricted model $\chi^2(192) = 264.80$ ($p = 0.0004$). Similarly, with Regression (iv) as the unrestricted model and Regression (ii) the restricted model (i.e. with PUC controls), $\chi^2(191) = 234.58$ ($p = 0.0173$).[14] These critical values are significant at 5%, allowing us to reject the null hypothesis of homogeneity. Similarly, joint significance tests on the fixed effects in the price regressions in Table 4.8 yield strongly significant F-statistics of 72.23 and 54.80, for Regressions (iii) and (iv) respectively.

It is perhaps unsurprising, then, that previous *state-level* panel data studies such as Besley and Coate (2001), have concluded that term length is not important. Indeed, we find that term-length exerts a significant positive effect on the probability of rate review, and a significant negative effect on prices, only in the presence firm-state dummies. Moreover, our results also suggest that previous papers may have over-stated the importance of other PUC institutions such as the method of commissioner selection. For instance, taking a cross-sectional approach, Crain and McCormick (1984), Primeaux and Mann (1986) and Smart (1994) find weak evidence that consumers in electing states face lower utility prices, while Besley and Coate (2001) take a state-level panel data approach and find strong evidence of such an effect. In contrast, controlling for firm-level unobservable heterogeneity we find little evidence that selection methods matter.

6. Conclusion

This paper has proposed that regulated firms keep quiet when their regulators set favourable policies but squawk in the event of a mistake that hurts the firm. Such behaviour seems entirely natural and could be put down to firms attempting to get bad decisions overturned. We have shown, however, that this may not be the only explanation. Regulators appointed on fixed short-term contracts will be keen to avoid any negative publicity that could hurt their future

[14] In both cases the restricted regressions were run for the estimation sub-sample from the unrestricted regression to maintain parity in sample sizes.

job prospects. If it is known *ex ante* that firms will publicise unfavourable mistakes, regulators engage in what we have termed 'minimal squawk' behaviour, setting favourable policies more often than is socially optimal to keep firms silent and their own professional reputation intact.

Thus, rather than encouraging good decision-making, career concerns may actually bias regulatory behaviour away from the social optimum. Given this inefficiency should increase as reputation becomes more important relative to social welfare, we have tested this hypothesis using variation in terms of office across state PUCs. Consistent with our theoretical model, we have found evidence that investor-owned US electric utilities were significantly less likely to face a rate review and also earned more per kwh from residential customers, the shorter the term of office served by their regulators. Accordingly, we have suggested that governments need to strike a balance between different sources of capture by appointing their regulators on longer, if not permanent, contracts.

In concluding we note that 'minimal squawk' behaviour is only one possible reason why short terms of office result in softer policies. Longer terms could be associated with learning effects, while career concerns might prompt regulators to substitute effort from attempting to make good decisions into networking activities. Although beyond the scope of this paper, an interesting extension would therefore be to undertake an empirical investigation of regulatory career concerns using data on individual regulators in an attempt to identify between these competing theories.

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Appendix

A. Proofs

To prove Proposition 1 we first state a series a Lemmas characterising equilibrium behaviour in the four different sub-games between the regulator and the job market 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 market observes either t or g. The regulator's problem is therefore given by

$$\max_{p_i, q_i} \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right) W + \delta\left[\tfrac{1}{2}(p_i + q_i)\mu(t) + \tfrac{1}{2}(2 - p_i - q_i)\mu(g)\right], \quad \text{(A1)}$$

where the market's beliefs $\mu(t)$ and $\mu(g)$ are given in (2) and (3). Differentiating (A1) wrt to p_i and q_i yields

$$\frac{\partial E[U_i]}{\partial p_i} = (\theta_i - \tfrac{1}{2})W + \delta\left[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}\mu(g)\right] \quad \text{(A2)}$$

$$\frac{\partial E[U_i]}{\partial q_i} = (\tfrac{1}{2} - \theta_i)W + \delta\left[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}\mu(g)\right] \quad \text{(A3)}$$

and

$$\begin{aligned} \frac{\partial E[U_S]}{\partial p_S} - \frac{\partial E[U_D]}{\partial p_D} &= \frac{\partial E[U_D]}{\partial q_D} - \frac{\partial E[U_S]}{\partial q_S} \\ &= (\theta_S - \theta_D)W > 0. \end{aligned} \quad \text{(A4)}$$

(a) Existence. Suppose the market's beliefs are $\mu(t) = \mu(g) = \frac{1}{2}$. Since $(\theta_i - \frac{1}{2})W > 0\ \forall i$, (A2) is strictly positive and (A3) is strictly negative $\forall i = S, D$ implying that (A1) has a unique solution characterised by $\sigma_S^o = \sigma_D^o = (1,0)$. Substituting for these strategies in (2) and (3) the market's beliefs are as stated, implying that such an equilibrium exists.

(b) Uniqueness. Suppose that $\mu(t) > \mu(g)$. From (2) and (3) we require $\widetilde{p}_S + \widetilde{q}_S > \widetilde{p}_D + \widetilde{q}_D$. Given these beliefs, (A2) is strictly positive, implying $p_S^o = p_D^o = 1$. However, (A4) 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, (2) and (3) imply that $\widetilde{p}_S = \widetilde{p}_D$, $\widetilde{q}_S = \widetilde{q}_D$ and $2 > \widetilde{p}_S + \widetilde{q}_S > 0$. Moreover $\mu(t) = \mu(g) = \frac{1}{2}$. Recall that the market is assumed to retain its prior belief $\Pr(\theta_S) = \frac{1}{2}$ at information sets off the equilibrium path. Thus $\mu(t) = \mu(g) = \frac{1}{2}$ for any $\widetilde{p}_S = \widetilde{p}_D$, $\widetilde{q}_S = \widetilde{q}_D$. However we know from Part (a) that, given these beliefs, $\sigma_S^o = \sigma_D^o = (1,0)$ is the unique solution to (A1). ■

Under the three remaining disclosure rules 'bad' equilibria (i.e. with S playing 'contradict') exist alongside 'good' equilibria (i.e. with S playing 'follow') if δ is sufficiently high. For brevity, we focus only on the existence of 'good' equilibria. For a full characterisation of all 'bad' equilibria and a proof that no other sub-game equilibria exist for any δ see Leaver (2001).

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. Recall that under 'squawk on tough' the regulator's problem is given by (6) and the market's beliefs are given by (3)-(5). Differentiating (6) yields

$$\frac{\partial E[U_i]}{\partial p_i} = (\theta_i - \tfrac{1}{2})W + \delta\left[\tfrac{1}{2}\theta_i\mu(l,t) + \tfrac{1}{2}(1-\theta_i)\mu(h,t) - \tfrac{1}{2}\mu(g)\right] \tag{A5}$$

$$\frac{\partial E[U_i]}{\partial q_i} = (\tfrac{1}{2} - \theta_i)W + \delta\left[\tfrac{1}{2}(1-\theta_i)\mu(l,t) + \tfrac{1}{2}\theta_i\mu(h,t) - \tfrac{1}{2}\mu(g)\right] \tag{A6}$$

$$\frac{\partial E[U_i]}{\partial p_i} - \frac{\partial E[U_j]}{\partial qj} = (\theta_i + \theta_j - 1)W + \delta\left[\tfrac{1}{2}(\theta_i + \theta_j - 1)(\mu(l,t) - \mu(h,t))\right] \tag{A7}$$

for $i, j = S, D$ and

$$\begin{aligned} \frac{\partial E[U_S]}{\partial p_S} - \frac{\partial E[U_D]}{\partial p_D} &= \frac{\partial E[U_D]}{\partial q_D} - \frac{\partial E[U_S]}{\partial q_S} \\ &= (\theta_S - \theta_D)W + \delta\left[\tfrac{1}{2}(\theta_S - \theta_D)(\mu(l,t) - \mu(h,t))\right]. \end{aligned} \tag{A8}$$

(a) Existence of the pooling sub-game equilibrium. Suppose that the market's beliefs are given by

$$\mu(g) = \tfrac{1}{2},\ \mu(l,t) = \frac{\theta_S}{\theta_S + \theta_D} \text{ and } \mu(h,t) = \frac{1-\theta_S}{2-\theta_S-\theta_D} \tag{A9}$$

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

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

Substituting for (A9) in (A5) yields,

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

and

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

which may be positive or negative depending on δ. Similarly, substituting for (A9) in (A6) yields,

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

and

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

Given $\delta \leq \delta^*$, it follows that $\sigma_S^o = \sigma_D^o = (1, 0)$ is a solution to (6). From (3)-(5) the market's beliefs are indeed as stated and hence such an equilibrium exists.

(b) Existence of the hybrid sub-game equilibrium. Suppose that the market's beliefs are given by

$$\begin{aligned} \mu(g) &= \frac{1}{3 - \widetilde{p}_D},\ \mu(l,t) = \frac{\theta_S}{\theta_S + \widetilde{p}_D\theta_D} \\ \text{and } \mu(h,t) &= \frac{1 - \theta_S}{(1 - \theta_S) + \widetilde{p}_D(1 - \theta_D)}, \end{aligned} \tag{A10}$$

and $\delta > \delta^*$.

If $\widetilde{p}_D = 1$, the market's beliefs given in (A9) and (A10) are equivalent. Given $\delta > \delta^*$, it therefore follows from Part (a) that (A5) is strictly negative for $i = D$ (supporting $p_D^o = 0$). In contrast, if $\widetilde{p}_D = 0$ it is easy to see that (A5) is strictly positive (supporting $p_D^o = 1$). It is easy 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 $\widetilde{p}_D$, $\widetilde{p}_D^*$, such that

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

thereby supporting $p_D^o = \widetilde{p}_D$. Note that $\widetilde{p}_D^* \in (\widetilde{\underline{p}}_D, 1)$ where $\widetilde{\underline{p}}_D$ solves $\mu(g) = \theta_D\mu(l,t) + (1 - \theta_D)\mu(h,t)$.

It now remains to verify that, at $\widetilde{p}_D^*$, (A5) is strictly positive for $i = S$ (supporting $p_S^o = 1$) and that (A6) is strictly negative $\forall i$ (supporting $q_S^o = q_D^o = 0$). Given the beliefs stated in (A10) we have

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

which is strictly positive for any $\widetilde{p}_D \in (0, 1]$. Thus, given the definition of $\widetilde{p}_D^*$, it follows from (A8) that (A5) must indeed be strictly positive for $i = S$. Similarly, it follows from (A7) that (A6) must be strictly negative for $i = D$ and hence from (A8) that (A6) must be strictly negative for $i = S$. Since $\sigma_S^o = (1, 0)$ is a solution to (6) for $i = S$ and $\sigma_D^o = (p_D^o = \widetilde{p}_D^*, 0)$ is a solution to (6) for $i = D$, from (3)-(5) the market's beliefs are indeed 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 $\delta \leq \delta^*$ *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* $\sigma_D^o = (1, q_D^o)$ *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. Under 'full disclosure' the market may observe any of the four regulatory outcomes. The regulator's problem is therefore given by

$$\max_{p_i, q_i} \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right) W + \delta \begin{bmatrix} \tfrac{1}{2}\left(q_i + (p_i - q_i)\theta_i\right) \mu(l,t) + \tfrac{1}{2}\left(p_i - (p_i - q_i)\theta_i\right) \mu(h,t) + \\ \tfrac{1}{2}\left(1 - q_i - (p_i - q_i)\theta_i\right) \mu(l,g) + \tfrac{1}{2}\left(1 - p_i + (p_i - q_i)\theta_i\right) \mu(h,g) \end{bmatrix}, \tag{A11}$$

where the market's beliefs $\mu(l,t)$ and $\mu(h,t)$ are given in (4) and (5) and, by Bayes's Rule,

$$\mu(l,g) = \frac{(1 - \widetilde{p}_S)\theta_S + (1 - \widetilde{q}_S)(1 - \theta_S)}{(1 - \widetilde{p}_S)\theta_S + (1 - \widetilde{q}_S)(1 - \theta_S) + (1 - \widetilde{p}_D)\theta_D + (1 - \widetilde{q}_D)(1 - \theta_D)} \tag{A12}$$

and

$$\mu(h,g) = \frac{(1 - \widetilde{p}_S)(1 - \theta_S) + (1 - \widetilde{q}_S)\theta_S}{(1 - \widetilde{p}_S)(1 - \theta_S) + (1 - \widetilde{q}_S)\theta_S + (1 - \widetilde{p}_D)(1 - \theta_D) + (1 - \widetilde{q}_D)\theta_D}. \tag{A13}$$

Differentiating (A11) wrt to p_i and q_i yields

$$\frac{\partial E[U_i]}{\partial p_i} = (\theta_i - \tfrac{1}{2})W + \delta \begin{bmatrix} \tfrac{1}{2}\theta_i \mu(l,t) + \tfrac{1}{2}(1 - \theta_i)\mu(h,t) \\ -\tfrac{1}{2}\theta_i \mu(l,g) - \tfrac{1}{2}(1 - \theta_i)\mu(h,g) \end{bmatrix} \tag{A14}$$

$$\frac{\partial E[U_i]}{\partial q_i} = (\tfrac{1}{2} - \theta_i)W + \delta \begin{bmatrix} \tfrac{1}{2}(1 - \theta_i)\mu(l,t) + \tfrac{1}{2}\theta_i \mu(h,t) \\ -\tfrac{1}{2}(1 - \theta_i)\mu(l,g) - \tfrac{1}{2}\theta_i \mu(h,g) \end{bmatrix}. \tag{A15}$$

Suppose that the market's beliefs are given by

$$\begin{aligned} \mu(l,t) &= \mu(h,g) = \frac{\theta_S}{\theta_S + \theta_D} \text{ and} \\ \mu(l,g) &= \mu(h,t) = \frac{1 - \theta_S}{2 - \theta_S - \theta_D}. \end{aligned} \tag{A16}$$

Substituting for (A16) in (A14) yields

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

Similarly substituting for (A16) in (A15) yields

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

It therefore follows that, for any δ, $\sigma_S^o = \sigma_D^o = (1, 0)$ is a solution to (A11). From (4), (5) (A12), (A13) the market's beliefs are indeed as stated and hence such an equilibrium exists. ■

Having characterised equilibrium behaviour in the four sub-games, we can now solve for the firm's optimal choice of disclosure rule and hence prove Proposition 1.

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 $\sigma_S^o = \sigma_D^o = (1, 0)$. 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 $\sigma_S^o = (1, 0)$ 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, it follows that the firm will be indifferent between disclosure rules when $\delta \leq \delta^*$ but will commit to 'squawk on tough' when $\delta > \delta^*$, since this disclosure rule biases regulatory policy in its favour. The *ex ante* probability of a good decision follows immediately from the discussion in Section 3.2.1. ■

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 $s = l$.

Part (i). First note from Lemma 2 that S has no career concern 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

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

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.

Part (ii). 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. ■

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.

Table 4.1: Sample Size by Firm Classification

Classification	Firms	Firm-State pairs[1]	Observations
Full sample[2]	162	236	2036
Firms experiencing both a review and no review[3]	138	194	1739
Firms serving a single State (single ST firms)	118	118	1025
Firms serving States in which PUC commissioners are appointed (appointing ST firms)	132	200	1719
Firms serving the State in which their HQ is located[4]	161	161	1392
Firms serving their HQ State and residential customers	152	152	1324
Single ST firms serving their HQ State and residential customers[5]	109	109	952

Notes:

1 A firm-State pair is formed each time a firm serves a separate State; e.g. New England Power Co serves MA, NH and VT and hence yields 3 observations in each year.

2 While data was collected for the 11 years between 1980-1990, construction of the lagged operating expenses variable ($opex_{it}$) yields a usable panel for the 9 years between 1982-1990. Since not all of the 162 firms were listed in every EIA yearbook in this period, our panel is unbalenced (i.e. 2036 < NT).

3 Sub-sample used in Conditional Logit regressions, see Table 4.4.

4 The exception is Electric Energy Inc which has its headquarters in Kentucky but serves Illinois.

5 Sub-sample used in price regressions, see Table 4.6.

Table 4.2: Definitions of Variables used in Rate Review Regressions

Variable	Description
Dependent Variable (y_{it})	Indicator: 1 if firm-State pair *i* faces a new review in year *t*, 0 if otherwise
Primary Regressors	
$_{i}$	Firm-State fixed effect; *i* = 1,..., 236
$term_{it}$	Statutory PUC term of office in firm-State pair *i* and year *t* (years)
$opex_{it}$	Firm total electric operating expenses (000$)
$opex_{it}$	$opex_{it-1}$ - $opex_{it-2}$
D_{it}	Indicator: 1 if $opex_{it}$ < 0, 0 if otherwise
t	Time trend, *t* = 1,...,9
PUC Controls ($\mathbf{z}_{it}$)	
$select_{it}$	Indicator: 1 if PUC commissioners are appointed, 0 if elected
aam_{it}	Indicator: 1 if PUC uses an automatic adjustment mechanism for fuel costs, 0 if not
$test1_{it}$	Indicator: 1 if PUC uses a historic test year to determine allowable operating costs
$test2_{it}$	Indicator: 1 if PUC uses a forecast to determine allowable operating costs
$test3_{it}$	Indicator: 1 if PUC uses a combination of historic costs and a forecast
$valst_{it}$	Indicator: 1 if capital valuation standards are pure original cost, 0 if otherwise
$staffpc_{it}$	Total commission staff per 10,000 State population
$numcom_{it}$	Number of commissioners
$stag_{it}$	Indicator: 1 if commissioner's terms are staggered, 0 if concurrent
$minrep_{it}$	Indicator: 1 if minority political party participation is required by statute, 0 if not
$qual_{it}$	Indicator: 1 if specific qualifications are required by statute, 0 if not
$postoc_{it}$	Indicator: 1 if commissioners face time restrictions on industry employment, 0 if not
$ntreg_{it}$	Number of regulated energy utilities

Notes: Details of data sources for all variables are given in Appendix B.

Table 4.3: Descriptive Statistics (Full Sample)

Variable	Number of obs.	Mean	Standard Deviation	Min	Max
Firm-State pair *i* faces a review in year *t* (y_{it})	2036	.287	.452	0	1
Statutory PUC term length ($term_{it}$)	2036	5.549	1.086	3	10
Lagged change in firm operating expenses ($opex_{it}$)	1998	35135	94451	-564127	1141444
Within-group mean lagged change in firm operating expenses	162	32329	45285	-4841	257256
PUC commissioners appointed ($select_{it}$)	2036	.844	.363	0	1
Automatic adjustment mechanism (aam_{it})	2023	.425	.494	0	1
Historic test year ($test_{it}$)	2036	.553	.497	0	1
Full forecast test year ($test2_{it}$)	2036	.105	.307	0	1
Combined test year ($test3_{it}$)	2036	.342	.475	0	1
Valuation standard ($valst_{it}$)	2036	.840	.367	0	1
PUC staff per 10,000 State population ($staff\ pc_{it}$)	2036	.434	.269	.057	1.550
Number of commissioners ($numcom_{it}$)	2036	3.985	1.360	1	7
Staggered appointment of commisssioners ($stag_{it}$)	2036	.938	.241	0	1
Minority political party representation ($minrep_{it}$)	2036	.516	.500	0	1
Statutory qualifications required ($qual_{it}$)	2032	.492	.500	0	1
Time restrictions on industry employment ($postoc_{it}$)	2008	.623	.485	0	1
Number of regulated energy utilities ($ntreg_{it}$)	2022	34.168	62.553	1	368

Notes: We are missing observations for $opex_{it}$ due to the unbalanced nature of the panel and for PUC controls due to printing errors in the original NARUC yearbooks.

Table 4.4: Formal Rate Reviews of Major US Investor-Owned Electric Utilities by State PUCs (1982-90)

			Lagged Change in Firm Operating Expenses		
			Negative	Positive	Total
Statutory PUC Terms of Office	Short (less than 6 years)[1]	Number of Reviews (y_{it} = 1)	30	142	172
		Number of Observations	162	519	681
		% Reviewed	18.5	27.4	25.3
	Long (6 years or more)	Number of Reviews (y_{it} = 1)	69	335	404
		Number of Observations	265	1052	1317
		% Reviewed	26.0	31.8	30.7
	Total	Number of Reviews (y_{it} = 1)	99	477	576
		Number of Observations[2]	427	1571	1998
		% Reviwed	23.2	30.4	28.2

Notes:
1 The data is cut at the sample mean of 6 years (see Table 4.3).
2 This is limited by the number of observations for $opex_{it}$ (see Table 4.1).

Table 4.5: Logit Estimation of the Probability of Formal Review

	Dependent Variable: Probability that a firm-State pair faced a new review in a given year			
	Regression (i)	Regression (ii)	Regression (iii)	Regression (iv)
Statutory PUC term of office (years)	.100**	.064	.340**	.276**
	(2.20)	(1.20)	(2.75)	(2.30)
Lagged change in operating expenses (000$)	2.50e^{-06}**	2.22e^{-06}**	1.08e^{-06}	1.11e^{-06}
	(4.44)	(3.66)	(1.51)	(1.55)
Interaction term: indicator (1 if lagged change in operating expenses is < 0, 0 if not) x term length	.031	.023	.032	.037
	(1.27)	(0.89)	(1.07)	(1.18)
Time trend	-.228**	-.257**	-.289**	-.281**
	(10.50)	(10.74)	(10.96)	(9.01)
PUC controls?	No	Yes	No	Yes
Firm-level fixed effects?	No	No	Yes	Yes
Log Likelihood	-1119.225	-1052.828	-871.036	-832.985
Pseudo R^2	.067	.096	.199	.208
Number of firm-State pairs	236	236	194	193
Number of Observations	1998	1942	1701	1646

Notes: All regressions include a constant and use robust standard errors. Absolute value of z statistics in parentheses. ** denotes significance at the 5% level. All regressions were repeated using alternative cost measures from the EIA's breakdown of operating expenses (i.e. operation and maintenace, power and fuel costs). In each case $opex_{it}$ explained more of the variation in y_{it}. Similarly, using real $opex_{it}$ ($opex_{it}$ deflated by the US GDP deflator in 1996 chained dollars) left the coefficients on all variables of interest unchanged.

Table 4.6: Conditional Logit Estimation of the Probability of Formal Review

	Dependent Variable: Probability that a firm-State pair faced a new review in a given year			
	Regression (iii)	Regression (iv) Full Sample	Regression (iii) Single ST Firms	Regression (iv) Appointing STs
Statutory PUC term of office (years)	.288**	.234*	.270*	.277*
	(2.36)	(1.93)	(1.86)	(1.87)
Lagged change in operating expenses (000$)	9.53e-07**	9.75e-07**	9.20e-07	1.20e-06
	(1.41)	(1.43)	(1.04)	(1.66)
Interaction term: indicator (1 if lagged change in operating expenses is < 0, 0 if not) x term length	.029	.032	.052	.028
	(.98)	(1.06)	(1.25)	(.87)
Time trend	-.255**	-.247**	-.236**	-.230**
	(10.52)	(8.54)	(5.82)	(7.51)
PUC controls?	No	Yes	Yes	Yes
Log Likelihood	-649.544	-705.870	-315.881	-526.127
Pseudo R^2	.109	.107	.138	.133
Number of firm-State pairs	194	193	97	166
Number of Observations	1701	1646	847	1441

Notes: Absolute value of z statistics in parentheses. ** and * denote significance at the 5% level and 10% levels respectively. Given the small number of firms serving electing states (see Table 4.1) we do not estimate Regression (iv) for this sub-sample.

Table 4.7: Definitions of Variables used in Price Regressions

Variable	Description
Dependant Variable (p_{it})	Firm *i* electric operating revenue from sales to residential customers in year *t* / sales to residential customers in year *t* (cents per kwh)
Primary Regressors	
$term_{it}$	Statutory PUC term of office (years)
a_t	Year effect, *t* =1,...9
Supply Controls ($\mathbf{s}_{it}$)	
$avopex_{it}$	Firm *i* total electric operating expenses in year *t* / firm *i* total sales to customers in year *t* (cents per kwh)
$land_{it}$	State land area (square miles)
rg1 - rg9	Census region dummies
Demand Controls ($\mathbf{d}_{it}$)	
$stpop_{it}$	State population
$stdpcy_{it}$	State disposable per capita income ($)
PUC Controls ($\mathbf{z}_{it}$)	(See Table 4.2)

Table 4.8: Ordinary Least Squares Residential Price Regressions

	Dependent Variable: Firm electric operating revenue from sales to residential customers / sales to residential customers (cents per kwh)			
	Regression (i)	Regression (ii)	Regression (iii)	Regression (iv)
Statutory PUC term of office (years)	-.015	.005	-.060**	-0.058**
	(.43)	(0.11)	(2.18)	(2.07)
PUC controls?	No	Yes	No	Yes
Firm-level fixed effects?	No	No	Yes	Yes
F(k, n -k - 1)	107.57	86.01	271.01	286.98
R^2	.727	.747	.939	.941
Number of firm-State pairs	109	109	109	109
Number of Observations	952	931	952	931

Notes: All regressions include a constant, year effects, supply and demand controls and use robust standard errors. Absolute value of *t* statistics in parentheses. ** denotes significance at the 5% level. All regressions were repeated using commercial and industrial prices (the two remaining sectors of note). In every case the coefficient on $term_{it}$ was negative but insignificant at standard levels.

Figure 4.1: Reviews per year and Average PUC Term Length