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Squawk and Capture:

Influencing Appointed Regulators

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Abstract

A regulator appointed on a finite contract has an incentive to signal her worth to the job market. This paper shows that, if her tenure is sufficiently short, a regulated firm can exploit this incentive to secure policy favours. The firm captures its regulator by encouraging her to engage in "minimal squawk" behaviour (Hilton, 1972). Specifically, it reveals the quality of unfavourable decisions, aware that the regulator will set favourable policies more often to keep it silent and her professional reputation intact. Further results suggest that capture may be limited by explicit incentive schemes and changes in the regulatory pool.

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Non-Technical Summary

It is now widely accepted that, even in the absence of an explicit contract, agents may undertake actions today in order to influence their wage tomorrow. In other words that 'career concerns' may prove to be an important motivating force when agents are appointed on short contracts. One profession where short contracts are commonplace is industrial regulation, the justification being that such contracts are necessary to limit collusion between regulators and their regulatees - i.e. 'regulatory capture'.

The use of short regulatory contracts points to a presumption that career concerns either encourage best regulatory practice or are, at worst, benign. Yet it is not obvious that this is the case. In a regulatory setting a third party, namely the regulated firm, has a vested interest and enjoys informational advantages in a manner not found in standard career concern settings. Accordingly, this paper asks whether governments are in danger of replacing one source of regulatory capture with another. In particular, we explore Hilton's (1972) conjecture that regulators appointed on short contracts will engage in "minimal squawk" behaviour: pacifying regulated firms to maintain a favourable reputation and hence secure future employment.

We develop a simple model in which a regulator is appointed to set a price cap for a regulated firm whose costs are either low or high. This price cap can either be 'tough', allowing the firm to pass through the low level of costs, or 'generous', allowing the firm to pass through the higher level. Only 'tough' when costs are low and 'generous' when costs are high are considered to be good decisions. Potential regulators differ in their ability to deduce the correct cost state and hence to make good decisions. Decision-making ability is valued by the job market and thus regulators face an incentive to ensure that their policy choice sends a positive signal to future employers. Since the firm is uniquely placed to judge the quality of these decisions, it seeks to secure generous price caps by 'squawking': strategically divulging this information to the job market.

We show that, if the firm only reveals the quality of the regulator's decision when the regulator is 'tough', less able regulators have an incentive to hide behind 'generous' price caps to protect their professional reputation. If the job market thinks such regulators always set generous price caps however, it will treat tough price caps as evidence that the regulator is able and hence ensure that there is an incentive to set tough price caps. Consequently, we establish that, when career concerns are sufficiently important (i.e. contracts sufficiently short), less able regulators strike a balance between these two effects. Rather than attempt to make good decisions, such regulators set generous price caps in all cost states with positive probability.

In light of these findings we conclude that governments may indeed need to balance the threats posed by alternative sources of regulatory capture. Further results suggest, however, that it may be possible to alleviate such a trade off using explicit incentive schemes or by reducing the public perception of disparity between potential candidates for regulatory office.

1. Introduction

Implicit incentives, once neglected in favour of their explicit counterparts, are now the focus of a rapidly expanding literature. Following Holmström (1982, 1999) this literature suggests that, even in the absence of an explicit contract, agents may undertake actions today to influence an evaluator's expectation of their talent and hence their wage tomorrow. Consequently, it is now widely accepted that 'career concerns' may prove to be an important motivating force when agents are appointed on short contracts.

One profession where contracts have intentionally been kept short is industrial regulation. In the US all but one of the 34 States that currently appoint their public utility commissioners do so for terms of 6 years or less.[1] Furthermore, none of these States used a longer term in 1997 than in 1962, with 10 actually appointing their commissioners on shorter contracts, in some cases by as much as 5 years. Similarly, in the UK, the Director General of every independent body created to regulate the newly privatised entities has been appointed for a fixed term of 5 years or less.

A common justification given for the use of such contracts is that they are necessary to limit the possibility of direct transfers between regulators and their regulatees - i.e. to prevent a form of regulatory capture.[2] The reasoning here is simple: side transfers require an enforcement mechanism. If transfers cannot be made simultaneously, as will almost certainly be the case in a regulatory setting, such an enforcement mechanism must derive from repetition.[3]

Such observations point to a presumption that career concerns either encourage best regulatory practice or are, at worst, benign. Yet, regulated firms enjoy informational advantages that are not present in the standard career concern story and thus it seems natural to question whether this is indeed the case. Accordingly, this paper asks whether governments, by appointing their regulators on short contracts, are in danger of replacing one source of regulatory capture with another.

In fact, while formal models of implicit incentives in the public sector are a recent phenomenon, the potential for regulatory career concerns to create distortions was actually recognised almost thirty years ago. Hilton (1972) noted that the organisation of the US regulatory profession was unlikely to encourage its members to implement socially desirable policies. Specifically, since regulators' appointment terms were limited but generally longer than those of the governors or presidents who appointed them, they could not evaluate the probability of re-appointment highly. Consequently,

[1] Figures taken from data kindly provided by Tim Besley; for more details see Besley and Coate (2000).

[2] Replacing the post of Director General of the National Lottery with a National Lottery Commission, where the post of chairperson would be held for just 12 months, the UK government claimed 'its introduction will reduce the risk, actual or perceived, of conflicts of interest and regulatory capture'. Taken from Hansard Written Answers, 1st April 1998, available at http://www.parliament.the-stationary-office.co.uk/.

[3] For a more detailed exposition of this argument see Tirole (1986).

> 'a reputation for being a great authority on the jurisprudence of his commission or on the implementation of regulation more generally would not be as useful to the typical commissioner as some alternative reputation he could take off the bench when his term ends'[4].

Since employment in the regulated industry was an obvious opportunity after a regulator's term in office, Hilton suggested that alienating members of the regulated industry might prove very costly. Accordingly,

> 'a regulatory commission of members who serve for finite periods must be expected to engage in a great deal of "minimal squawk" behaviour'.[5]

In short, Hilton conjectured that regulators appointed on finite contracts would set policy with an eye on the job market: pacifying regulated firms to maintain a favourable reputation and hence secure future employment.

The notion that short contracts give regulators an incentive to engage in "minimal squawk" behaviour is an intuitively appealing one. In the intervening thirty years, however, legislation has largely closed the 'revolving door' between regulatory office and industry job.[6] Meanwhile, increasing media exposure has ensured that regulators pay attention to the reputation their policies earn them in wider, non-industry circles in the hope of securing desirable future employment.[7] Thus, in contrast to Hilton (1972), this paper focuses on the extent to which career concerns in general, rather than direct offers of future industry employment, prompt regulators to pacify their regulatees to maintain a favourable reputation. More significantly, benefiting from theoretical advances, we develop a formal model of "minimal squawk" behaviour and hence determine the conditions under which such actions are consistent with equilibrium.

In doing so we focus on the following setting. A regulator is appointed for a fixed term to choose a price cap for a firm facing a cost state that is either 'low' or 'high'. The regulator can either be 'tough', allowing the firm to pass-through the lower level of costs, or 'generous', allowing the firm to pass-through the higher level. Only 'tough' when 'low' and 'generous' when 'high' are considered good regulatory decisions. Regulators are either 'smart' or 'dumb', where smart regulators receive a more informative private signal of the true cost state. The accuracy of this signal is private information and reflects decision-making ability. *Ex ante* both types seek to make good decisions but,

[4] Hilton (1972), pp. 48.

[5] *ibid*

[6] In the UK former ministers, civil servants and special advisors must seek clearance from a special independent advisory committe before joining private companies for two years after leaving office. See the reports of The Committee for Standards in Public Life, availiable at http://www.public-standards.gov.uk/. Spiller (1990) and Che (1995) give details of similar legislation limiting the movement of public officials from, and into, private industry in the US.

[7] For instance Phillips (1988) notes that in the 1970's 'the media, after years of neglect, began to cover utility hearings, often giving them top coverage', pp. 13. Similarly Anderson (1980) notes 'Regulators, who a few years before had enjoyed the relative obscurity of technical debates...now saw those same debates recast in emotional terms before a wide audience', pp. 24.

since decision-making ability is valued by the job-market, there is also an incentive to ensure the policy choice sends a positive signal to future employers. Observing the cost state, the firm finds it is uniquely placed to reveal the quality of the regulator's decision-making. It therefore seeks to secure a generous price cap in all cost states by 'squawking' - i.e. strategically divulging the quality of the regulator's decision-making to the job market.

This simple model illustrates that 'squawking' may indeed lead to more generous treatment for the regulated firm. To see why suppose, as we do in section 4.3, that the firm reveals the quality of the regulator's decision-making when she is 'tough' but stays silent when she is 'generous'. Smart regulators relish the opportunity to demonstrate their superior decision-making skills. However, dumb regulators recognise that 'tough' price caps expose their poor decision-making to the market's scrutiny. Dumb regulators therefore have an incentive to hide behind 'generous' price caps to ensure that their professional reputation remains intact.

Of course, if the market thinks dumb regulators **always** set generous price caps it will simply treat tough price caps as evidence that the regulator is smart. (But then dumb regulators have an incentive to set tough price caps). Accordingly in Lemma 4.5 we establish that the regulator strikes a balance between these two effects. Formally, a hybrid sub-game equilibrium exists in which smart regulators try to make good decisions but dumb regulators mix between attempting to make good decisions and simply setting generous price caps. In Proposition 5.1 we therefore confirm Hilton's conjecture that short appointment terms result in a form of regulatory capture. If career concerns are sufficiently important, there is a unique equilibrium: the firm optimally reveals the quality of tough price caps, aware that dumb regulators will respond by engaging in "minimal squawk" behaviour. This therefore prompts the conclusion that governments may indeed need to balance the threats posed by alternative sources of regulatory capture. Further comparative statics results suggest, however, that it may be possible to alleviate such a trade off using explicit incentive schemes or by reducing the public perception of disparity between potential candidates for regulatory office.

The remainder of the paper is organised as follows. The next section discusses related approaches, while Section 3 sets out the formal details of the model. Sections 4 presents the results from the policy selection sub-game and Section 5 the firm's choice of disclosure rule. Sections 6 and 7 give details of the comparative statics and policy implications respectively. Finally, Section 8 concludes with a brief discussion.

2. Related Literature

Several recent papers have examined career concerns in the public sector (e.g. Dewatripont et al (1999), Le Borgne and Lockwood (2000) and Persson and Tabellini (2000, chp 4)). Following Holmström (1982, 1999), the focus has been on an agent's incentive to exert costly effort in an attempt to convince an evaluator of their ability to add to future physical productivity. This paper takes a different approach, examining how public servants **use information** when resolving a policy choice, given such actions may act as a signal of future 'decision-making' ability.

In this sense our model is most closely related to that of Scharfstein and Stein (1990), who analyse managers making sequential investment decisions, and, in particular, Levy (2000), who examines the incentives managers have to consult advisors. In common with Scharfstein and Stein, our model contains two types of decision-maker who receive a binary signal on the binary state of the world and may take two possible actions, only one of which is appropriate in any given state. While, following Levy, we assume that ability is private information and that the decision-maker has an *ex ante* desire to make the correct decision. In contrast with both papers, however, our evaluator (the job market) cannot observe either the state of the world or the decision-maker's signal; an assumption that seems plausible in a regulatory setting since the decision-maker (regulator) has been appointed for her supposed 'expertise'. Thus, unique to this paper, is the fact that the evaluator's ability to update is in the hands of an additional player that can observe the cost state, namely the regulated firm.

The firm may be thought of as an 'intermediary': given the signalling relationship implicit between the regulator and the job market, it seeks to improve its pay-off by revealing information that the job market may use to update its beliefs over the regulator's type. Another closely related paper is therefore Lizzeri (1999), who examines the strategic manipulation of information by certification intermediaries. In common with Lizzeri our intermediary takes the first move, credibly committing to a disclosure rule that induces a favourable sub-game equilibrium in later play between the regulator and the job market. In contrast, however, our intermediary does not search out the sender's type and does not charge a fee. Instead the firm simply announces whether it will reveal its *own* private information (i.e. the cost state and hence the quality of regulatory decision-making) or stay silent, in an attempt to influence the probability of a generous price cap.

3. The Model

3.1. Description

A social welfare maximising legislature seeks to impose a price cap on a single product monopolist. In any period this firm faces only 'unavoidable' costs which may be either low or high. This cost state is denoted by $\omega \in \{l, h\}$ and it is assumed that, while the firm knows ω, the legislature retains the common prior $\Pr(\omega = l) = \Pr(\omega = h) = 0.5$. Given the nature of the firm's costs, the legislature seeks to implement an $RPI + k$ price cap formula, where k denotes the level of cost pass-through.

Attention is restricted to price caps that are 'tough', allowing the firm to pass-through the lower level of costs l, or 'generous', allowing the firm to pass-through the higher level of costs h, and hence the regulatory policy choice is denoted by $k \in \{t, g\}$. Accordingly, there are four possible regulatory outcomes: tough when costs are low (l, t), generous when costs are low (l, g), tough when costs are high (h, t) and generous when costs are high (h, g). The firm is known to shave on socially desirable investment if it cannot pass-through the full extent of its costs and hence it is common knowledge that only (l, t) and (h, g) are socially optimal (hereafter good) decisions.

Regulators can conduct experiments which generate informative, private cost signals. The accuracy of a regulator's signal is private information and is determined by her innate ability to process information. For instance, how easy she finds it to form an accurate picture of the cost state ω from accounting information, external legislation and discussions with the regulated firm. For simplicity it is assumed that regulators are either 'smart' S or 'dumb' D. Formally, a regulator of ability θ_i receives a private signal $s \in \{l, h\}$, where $\Pr(s = \omega \mid \omega) = \theta_i$ and $i = S, D$. Smart regulators receive more accurate signals than dumb regulators in the sense that $\Pr(s = \omega \mid \omega, \theta_S) = \theta_S > \Pr(s = \omega \mid \omega, \theta_D) = \theta_D$. Moreover, for convenience it is assumed that $\theta_i \in (0.5, 1)$ $\forall i = S, D$[8].

In an attempt to improve social welfare the legislature appoints a regulator to choose a price cap $k \in \{t, g\}$ every period for a fixed term of y periods. For simplicity, it is assumed that this regulator is drawn from a pool that contains an equal proportion of each type. Thus, while the regulator knows her type, all other interested parties share the prior $\Pr(\theta_S) = \Pr(\theta_D) = 0.5$.

The appointed regulator derives utility from two sources: directly from her policy choice which we term her **policy preferences** as well as from the effect that such decisions have on her future job prospects which we term her **career concerns**. It is assumed that both types derive utility H_r from making a good decision. The regulator's policy preferences are therefore denoted by

$$
\begin{aligned}
u(l, t) &= u(h, g) = H_r > 0 \\
u(l, g) &= u(h, t) = 0,
\end{aligned}
$$

where $u(\omega, k)$ denotes her pay-off to choosing price cap k in cost state ω.

For convenience all future private sector employers - with the exception of the regulated firm which is forbidden from employing the regulator - are subsumed into a single player called 'the market'. The ability to make state dependent decisions is known to be relevant in the private sector and hence θ_i determines the regulator's market value. For simplicity, it is assumed that the market offers the regulator a wage **equal** to its posterior beliefs μ over θ_i at information sets determined by the regulator's equilibrium choice of k and any action taken by the regulated firm. Note that the market's beliefs therefore completely characterise its actions and hence regulatory career concerns.

We restrict attention to a single policy choice k and wage offer μ, introducing dynamic considerations by weighting the utility that the regulator receives from her future wage by the term $\delta(y)$, where $d\delta/dy < 0$. Adopting a simple additive specification, the regulator's objective function is therefore denoted by $U = u(\omega, k) + \delta\mu$.

Driven by profit maximisation, the firm weakly prefers a generous price cap in all

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[8] The imposition of the upper bound implies incorrect signals are received with positive probability, thereby reducing the number of occasions on which information sets are off the equilibrium path. See section 4.

cost states and hence its direct pay-offs are given by

$$\begin{aligned} v(l,g) &= H_f \\ v(h,g) &= v(l,t) = L_f \\ v(h,t) &= 0, \end{aligned}$$

where $v(\omega, k)$ denotes the firm's utility when the regulator chooses k in cost state ω and $H_f > L_f > 0$. To enable us to focus on alternative sources of regulatory capture, it is assumed that the firm cannot offer direct transfers or policy relevant information. It is aware, however, that the market will use Bayes' Rule and the regulator's strategy to update its wage offer μ when it observes ω. Since the regulator will take this wage offer into account when resolving her policy choice, the firm therefore seeks to influence k indirectly by selectively disclosing its private information over ω.

The firm publicly commits to a disclosure rule which states when it will stay silent and when it will reveal cost information to the market. Revelation is assumed to be a costless activity, for instance taking the form of issuing press releases drawing attention to the firm's plight. However editors only run stories that are supported by credible evidence such as audited accounts. Thus, following any regulatory decision, it is assumed that the firm has just two possible actions: silence or reveal ω. These possible actions are denoted by $a \in \{\emptyset, \omega\}$ and the firm's strategy by $d \in \mathcal{D}$, where $\mathcal{D}$ denotes the set of possible disclosure rules defined by these two actions and the four regulatory decisions.

Formally, the model contains four possible 'types' of regulator: a smart regulator that receives a low signal, a smart regulator that receives a high signal and so on. However, in order to focus on the extent to which career concerns induce each ability type to use the information content of their signals, we adopt the following convention. Let $\sigma_i = (p_i, q_i)$ denote the probability that a regulator with ability θ_i sets a tough price cap, 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 $i = S, D$ as before. We may now define four pure strategies for any $i = S, D$ and $d \in \mathcal{D}$:

i) 'follow': $\sigma_i = (1, 0)$, t if $s = l$ and g if $s = h$.

ii) 'contradict': $\sigma_i = (0, 1)$, g if $s = l$ and t if $s = h$.

iii) 'set t': $\sigma_i = (1, 1)$, t $\forall s = l, h$.

iv) 'set g': $\sigma_i = (0, 0)$, g $\forall s = l, h$.

Note that in the first two cases ('follow', 'contradict') the regulator uses the information content of her signal, while in the latter two cases ('set t', 'set g') she ignores it.

In light of the above, an equilibrium strategy for a regulator with ability θ_i, σ_i^o,[9] is defined by the solution to

$$\max_{p_i, q_i} E[U_i] = E[u(\omega, k) + \delta\mu(d, k, a) \mid s, \theta_i, p_i, q_i], \tag{1}$$

[9]Throughout the superscript o is used to denote an equilibrium value.

where the expectations operator reflects her uncertainty over ω. While an equilibrium strategy for the firm, d^o, is defined by the solution to

$$\max_{d \in \mathcal{D}} E[v(\omega, k(\theta_i, s, d)], \tag{2}$$

where the expectations operator reflects its uncertainty over the regulator's ability θ_i.

It should now be clear that this dynamic game of incomplete information has three stages. In the first stage the firm chooses a disclosure rule $d \in \mathcal{D}$ to induce a sub-game between the regulator and market. Within this sub-game the regulator moves first choosing $k \in \{t, g\}$. Given the cost state ω, this choice of k induces an action $a \in \{\emptyset, \omega\}$ as stipulated by the disclosure rule d. The market has the final move offering the regulator a wage equal to its expectation of the regulator's talent conditional on d, k and a.

The solution concept we use is perfect Bayesian equilibrium (PBE). As Lizzeri (1999) notes, the fact that the disclosure rule is observable implies that a PBE for such a game is a list of PBE in every sub-game induced by each $d \in \mathcal{D}$ together with the requirement that d solves 3.1. Since the market's action is completely characterised by its beliefs we solve for such a PBE by backwards induction.

3.2. Discussion of Assumptions

Several of the above assumptions warrant further discussion. First, to enable us to pin down equilibria in the event that the market pays the same wage for any policy choice, we have assumed that the regulator derives utility from making good decisions. As a possible justification suppose the legislature offers the regulator a wage contract contingent on information revealed later in the game. Providing the regulator has limited liability, one would expect the optimal scheme to pay a bonus if she is shown to have made a good decision. Alternatively, one could take a more traditional view and assume that regulators attach some weight to maximising social welfare.

Second, we restrict attention to single 'on the job' and 'post-agency' periods, incorporating dynamic considerations by weighting the regulator's future wage with a factor that is decreasing in the length of appointment term. Although simplistic, this approach captures the intuitive notion that career concerns should play a greater role in determining policy choices in regimes where regulators are appointed for shorter periods of time. Moreover, it offers a simple way to explore the welfare consequences of changing the length of regulatory appointments, as well as a natural empirical test of our predictions using US State level variations in appointment length.

Finally we have assumed that the firm cannot lie to the market about its cost realisation thereby greatly reducing its strategy space. While this assumption suggests that it may be possible to find a contractual solution to this regulatory problem, we abstract from the possibility of mechanism design. In doing so our aim is to draw attention to the fact that common place regulatory institutions, such as short appointments and price cap / rate reviews, may foster alternative, indirect sources of regulatory capture.

4. The Policy Selection Sub-Game

We define a PBE of any sub-game between the regulator and the market induced by the firm's choice of disclosure rule d as a pair of strategy functions σ_S^o, σ_D^o and a set of beliefs μ^o such that: i) at information sets on the equilibrium path these beliefs are derived via Bayes' Rule from the firm's choice of disclosure rule d and the regulator's strategy and ii) σ_S^o and σ_D^o solve (1) given μ^o. Since our aim is to highlight the potential for indirect regulatory capture, we adopt the convention that at information sets off the equilibrium path it is common knowledge that the market will retain its prior belief.[10] In what follows we will refer to a PBE of any sub-game that satisfies this restriction simply as a 'sub-game equilibrium'.

In attempting to establish all possible sub-game equilibria we exploit the fact that $\mathcal{D}$ may be partioned into four generic classes of disclosure rule - 'no disclosure', 'silent on tough', 'silent on generous' and 'full disclosure' - according to the information sets that each rule induces. Since sub-games in which the market has the same information sets share equilibria, this enables us to restrict our analysis to each class of disclosure rule rather than every $d \in \mathcal{D}$.

To see why this is the case take the example of 'silent on tough'. Suppose the market is aware that the firm will reveal ω on, say, (h, g) but not (l, g). If $k = g$ then $\emptyset$ is as informative as ω; regardless of the firm's action the market is able to deduce the true cost state. In contrast if $k = t$ then $\emptyset$ contains no new information; the market is aware that the firm will **never** reveal ω and hence must conclude that either cost state could have occurred. Thus under any disclosure rule that is 'silent on tough' the market's information sets are $\{l; h; \theta_S; \theta_D; t\}$, $\{l; \theta_S; \theta_D; g\}$ and $\{h; \theta_S; \theta_D; g\}$. The remaining three classes of disclosure rule are established by exactly analogous logic.

We now proceed to establish all possible sub-game equilibria for each class of disclosure rule in turn.

4.1. No disclosure

When the firm adopts a policy of 'no disclosure' the only information the market receives while the regulator is in office is that she chose t or g. The market's posterior beliefs that the regulator is smart at each of these information sets are denoted by $\mu(t)$ and $\mu(g)$ respectively. Let $\widetilde{\sigma}_i = (\widetilde{p}_i, \widetilde{q}_i)$ denote the strategy function that the market believes the regulator is playing. Noting that Bayes' Rule implies $\Pr(s = l) = 0.5$, the market may simply deduce from $\widetilde{\sigma}_i$ that $\Pr(t \mid \theta_i, \widetilde{\sigma}_i) = \frac{1}{2}(\widetilde{p}_i + \widetilde{q}_i)$ and $\Pr(g \mid \theta_i, \widetilde{\sigma}_i) = \frac{1}{2}(2 - \widetilde{p}_i - \widetilde{q}_i)$.

[10] Che (1995) adopts an analogous approach, assuming that "the regulator's out-of-equilibrium monitoring performance is signal free; i.e., the firm does not update its beliefs off the equilibrium path", p. 386. In making this assumption 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.

Moreover, given $\Pr(\theta_S) = \Pr(\theta_D) = 0.5$, Bayes' Rule implies

$$\begin{aligned} \mu(t) &= \frac{\Pr(t \mid \theta_S, \widetilde{\sigma}_S) \cdot \Pr(\theta_S)}{\Pr(t \mid \theta_S, \widetilde{\sigma}_S) \cdot \Pr(\theta_S) + \Pr(t \mid \theta_D, \widetilde{\sigma}_D) \cdot \Pr(\theta_D)} \\ &= \frac{\widetilde{p}_S + \widetilde{q}_S}{\widetilde{p}_S + \widetilde{q}_S + \widetilde{p}_D + \widetilde{q}_D} \end{aligned} \tag{3}$$

and

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

To verify whether $\widetilde{\sigma}_i$ is in fact an equilibrium strategy $\forall i = S, D$ we must establish the probability with which a regulator with ability θ_i will expect to receive H_r, $\mu(t)$ and $\mu(g)$. Clearly, given $\sigma_i = (p_i, q_i)$, she will expect to receive $\mu(t)$ with $\Pr(t \mid \theta_i, \sigma_i) = \frac{1}{2}(p_i + q_i)$ and $\mu(g)$ with $\Pr(g \mid \theta_i, \sigma_i) = \frac{1}{2}(2 - p_i - q_i)$. However, to establish the probability with which she will expect to receive H_r we must first derive $\Pr(l, t \mid \theta_i, \sigma_i)$ and $\Pr(h, g \mid \theta_i, \sigma_i)$.

Note that Bayes' Rule implies $\Pr(\omega = s \mid s, \theta_i) = \theta_{i.}$ Thus, upon receipt of $s = l$, the regulator may deduce that $\Pr(l, t \mid l, \theta_i, \sigma_i) = p_i\theta_i$ - i.e. the probability that she sets $k = t$ when $s = l$ given $\sigma_i(p_i, q_i)$ times the probability that her signal was correct. Similarly she may deduce that $\Pr(h, g \mid l, \theta_i, \sigma_i) = (1 - p_i)(1 - \theta_i)$. Alternatively, if she receives $s = h$ she may deduce that $\Pr(l, t \mid h, \theta_i, \sigma_i) = q_i(1 - \theta_i)$ and that $\Pr(h, g \mid h, \theta_i, \sigma_i) = (1 - q_i)\theta_i$. Therefore, given $\Pr(s = l) = 0.5$, the regulator will expect to make a good decision with probability

$$\Pr(l, t \mid \theta_i, \sigma_i) + \Pr(h, g \mid \theta_i, \sigma_i) = \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right).$$

In light of the above, when d = '*no disclosure*' we may restate our definition of σ_i^o as the solution to

$$\max_{p_i, q_i} \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right) H_r + \delta\left[\tfrac{1}{2}(p_i + q_i)\mu(t) + \tfrac{1}{2}(2 - p_i - q_i)\mu(g)\right]. \tag{5}$$

Solving (5) for every set of beliefs defined by (3) and (4) yields our first preliminary result.

Lemma 4.1. *When the regulated firm adopts a policy of 'no disclosure', for any δ, there exists a unique 'follow' pooling sub-game equilibrium in which $\sigma_i^o = (1, 0)$ $\forall i = S, D$.*[11]

Since the market never observes the quality of regulatory decision-making, D can mimic any favourable action - making a good decision might be difficult but simply picking t is no harder than picking g! Pooling behaviour is therefore the only possibility. If the market thinks both types use (i.e. 'follow' or 'contradict') their signals it will

[11] The market's equilibrium beliefs, together with formal proofs, where necessary, may be found in the accompanying appendix.

believe that they are equally likely to set t, and hence that they equally likely to set g, and will therefore retain its priors following both t and g. However, since the market retains its priors at information sets off the equilibrium path, it also pays the same wage for both t and g when both types ignore their signals (i.e. 'set t' or 'set g'). Career concerns are therefore irrelevant under any strategy. Consequently, both S and D seek to further their policy preferences by following their signals.

Corollary 4.2. *When the regulated firm adopts a policy of 'no disclosure', for any δ, $\Pr(\textit{good decision}) = \frac{1}{2}(\theta_S + \theta_D)$. Delegation therefore achieves a second best solution to the legislature's regulatory problem.*

Both S and D play 'follow' and hence make a good decision with probability θ_i. Given the legislature is equally likely to appoint either type, the ex ante probability of a good decision is simply the average of the two abilities. Since the legislature can only make good decisions with probability $0.5 < \theta_i \; \forall i = S, D$, delegation achieves the second best.

4.2. Silence on tough

When the firm adopts a disclosure rule that is 'silent on tough' the market learns either that the regulator chose t, that she made the bad decision (l, g) or that she made the good decision (h, g). The market's beliefs that the regulator is smart at these information sets are denoted by $\mu(t)$, $\mu(l, g)$ and $\mu(h, g)$ respectively. Note $\mu(t)$ is given by (3). Following the logic outlined above, the market's remaining beliefs are given by

$$\mu(l, g) = \frac{1 - \tilde{q}_S - (\tilde{p}_S - \tilde{q}_S)\theta_S}{2 - \tilde{q}_S - \tilde{q}_D - (\tilde{p}_S - \tilde{q}_S)\theta_S - (\tilde{p}_D - \tilde{q}_D)\theta_D} \tag{6}$$

and

$$\mu(h, g) = \frac{1 - \tilde{p}_S + (\tilde{p}_S - \tilde{q}_S)\theta_S}{2 - \tilde{p}_S - \tilde{q}_D + (\tilde{p}_S - \tilde{q}_S)\theta_S + (\tilde{p}_D - \tilde{q}_D)\theta_D}. \tag{7}$$

When d = '*silent on tough*' we may therefore restate our definition of σ_i^o as the solution to

$$\max_{p_i, q_i} \tfrac{1}{2}\left(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)\right) H_r + \delta \left[\begin{array}{c} \frac{1}{2}(p_i + q_i)\mu(t) + \frac{1}{2}\left(1 - q_i - (p_i - q_i)\theta_i\right)\mu(l, g) \\ + \frac{1}{2}\left(1 - p_i + (p_i - q_i)\theta_i\right)\mu(h, g) \end{array} \right]. \tag{8}$$

Solving (8) for every set of beliefs defined by (3), (6) and (7) we establish our second preliminary result.

Lemma 4.3. *When the regulated firm adopts a disclosure rule that is 'silent on tough' there exist δ_f, δ_c, $\overline{q}_D$, $\underline{p}_D$ and $\overline{p}_D$ such that*[12]*:*

[12] For a definition of δ_f, δ_c, $\overline{q}_D$, $\underline{p}_D$ and $\overline{q}_D$ see the formal proof of Lemma 4.3. in the appendix.

i) iff $\delta \leq \delta_f$ then there exists a 'follow' pooling sub-game equilibrium with $\sigma_i^o = (1,0)$ $\forall i = S, D$;

ii) iff $\delta > \delta_f$ then there exists a 'follow, set t' hybrid sub-game equilibrium with $\sigma_S^o = (1,0)$ and $\sigma_D^o = (1, q_D)$, for some $q_D(\theta_S, \theta_D, H_r, \delta) \in (0, \overline{q}_D)$;

iii) iff $\delta \geq \delta_c$ then there exists a 'contradict, set t' hybrid sub-game equilibrium with $\sigma_S^o = (0,1)$ and $\sigma_D^o = (p_D, 1)$, for some $p_D(\theta_S, \theta_D, H_r, \delta) \in (\underline{p}_D, \overline{p}_D]$.

No other sub-game equilibria exist for any δ.

The market now observes the quality of the regulator's decision 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 the market thinks both S and D play 'follow'. Since both signals occur with equal probability the market will expect to observe t as often as g. It must therefore pay the same wage conditional on the observed policy choice. However, given the firm's disclosure rule, the market can also condition on the quality of the regulator's decision when she sets g. When $s = h$ the market will expect S (D) to set g and hence to make the good decision (h, g) with probability θ_S (θ_D) and the bad decision (l, g) with probability $1 - \theta_S$ ($1 - \theta_D$). It will therefore offer a higher wage following (h, g) and a lower wage following (l, g). Moreover, this implies that its beliefs must satisfy

$$\mu(t) = \tfrac{1}{2}(\theta_S + \theta_D)\mu(h, g) + \tfrac{1}{2}(2 - \theta_S - \theta_D)\mu(l, g);$$

that is, the 'split' between the two wages will ensure that the market pays the correct wage given its expectation of the regulator's ability (i.e. $\frac{1}{2}(\theta_S + \theta_D)$).

Now consider the career concern incentive each type has to set g on receipt of each signal. If either type sets g when $s = l$ they will expect to make the good decision (h, g) with probability $1 - \theta_i$ and the bad decision (l, g) with probability θ_i. Given

$$(1 - \theta_i)\mu(h, g) + \theta_i\mu(l, g) < \tfrac{1}{2}(\theta_S + \theta_D)\mu(h, g) + \tfrac{1}{2}(2 - \theta_S - \theta_D)\mu(l, g) \quad \forall i = S, D,$$

both types find setting g yields a lower expected wage than t.

On the other hand when $s = h$ each type will expect to make the good decision with probability θ_i and the bad decision with probability $1 - \theta_i$. Thus, given

$$\theta_S\mu(h, g) + (1 - \theta_S)\mu(l, g) > \tfrac{1}{2}(\theta_S + \theta_D)\mu(h, g) + \tfrac{1}{2}(2 - \theta_S - \theta_D)\mu(l, g)$$

and

$$\theta_D\mu(h, g) + (1 - \theta_D)\mu(l, g) < \tfrac{1}{2}(\theta_S + \theta_D)\mu(h, g) + \tfrac{1}{2}(2 - \theta_S - \theta_D)\mu(l, g),$$

S prefers to set g, whilst D finds that she prefers to set t. More intuitively S knows she is an above average decision-maker and hence that she can 'beat the market'. Accordingly, she has no interest in "minimal squawk" behaviour. Rather the firm's disclosure rule allows her to demonstrate her ability, yielding her a higher expected wage. In contrast, D is aware of her limitations and therefore prefers to silence the regulated firm to ensure that the market retains its priors.

In short, D has a career concern incentive to **ignore** her signals by setting t for all $s = l, h$. If δ is sufficiently low (the appointment term sufficiently long) her policy preference incentive to follow both signals will dominate, resulting in the pooling sub-game equilibrium stated in the lemma. However if δ is too high career concerns dominate and she deviates to 'set t'.

Alternatively, suppose the market thinks S plays 'follow' but D mixes between 'follow' and 'set t'. The more likely the market thinks D is to play 'set t', the lower the wage it offers after observing t and the higher wage it offers after observing **either** good or bad decisions. Thus, the more likely the market thinks D is to play 'set t', the lower her career concern incentive to set t when $s = h$ actually becomes, eventually disappearing altogether. Suppose δ is sufficiently high such that D's career concerns dominate her policy preferences when the market thinks she plays 'follow' with certainty. There must then exist some market belief over the likelihood that D plays 'set t' such that, when $s = h$, her career concern incentive to set t exactly offsets her policy preference to set g. Given this leaves D willing to mix, there must therefore exist a 'follow, set t' hybrid sub-game equilibrium as stated in the lemma.

In essence, decision-making ability acts as a **sorting mechanism** when career concerns are sufficiently important: if able regulators **use** their signals less able regulators have a career concern incentive to **ignore** their signals to keep their professional reputation intact. Note that since regulators can also **use** their signals to increase the probability of bad decisions, analogous logic supports the possibility of 'mirror' equilibria.

Corollary 4.4. *When the regulated firm adopts a disclosure rule that is 'silent on tough':*

i) if the 'follow, set t' hybrid sub-game equilibrium prevails then $\Pr(\text{good decision}) = \frac{1}{2}\left[\theta_S + (1 - q_D^o)\theta_D + q_D^o \frac{1}{2}\right]$ *and thus delegation offers a Pareto improvement but does not achieve the second best;*

ii) if the 'contradict, set t' hybrid sub-game equilibrium prevails then $\Pr(\text{good decision}) = \frac{1}{2}\left[1 - \theta_S + (1 - (1 - p_D^o)\theta_D - p_D^o \frac{1}{2})\right]$ *and thus delegation results in a Pareto worsening.*

Suppose the 'follow, set t' hybrid sub-game equilibrium prevails. S plays 'follow' and makes good decisions with probability θ_S, while D mixes between 'follow' and 'set t'. The more often D plays '*set t*' the closer she is to making good decisions with the same probability as the legislature. Given the probability of a good decision is the average of these probabilities, delegation therefore offers a Pareto improvement but not the second best. Analogous logic applies if the 'contradict, set t' sub-game equilibrium prevails.

4.3. Silence on generous

When the firm adopts a disclosure rule that is 'silent on generous' the market learns either that the regulator made the good decision (l, t), that she made the bad decision bad (h, t) or that she chose g. We denote the market's posterior beliefs at these information sets by $\mu(l, t)$, $\mu(h, t)$ and $\mu(g)$ respectively. Note $\mu(g)$ is given by (4), while the market's remaining beliefs are given by

$$\mu(l,t) = \frac{\widetilde{q}_S + (\widetilde{p}_S - \widetilde{q}_S)\theta_S}{\widetilde{q}_S + (\widetilde{p}_S - \widetilde{q}_S)\theta_S + \widetilde{q}_D + (\widetilde{p}_D - \widetilde{q}_D)\theta_D} \tag{9}$$

and

$$\mu(h,t) = \frac{\widetilde{p}_S - (\widetilde{p}_S - \widetilde{q}_S)\theta_S}{\widetilde{p}_S - (\widetilde{p}_S - \widetilde{q}_S)\theta_S + \widetilde{p}_D - (\widetilde{p}_D - \widetilde{q}_D)\theta_D}. \tag{10}$$

Moreover, when d = '*silent on generous*' we may restate our definition of σ_i^o as the solution to

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

Solving (11) for every set of beliefs defined by (4), (9) and (10) we establish our third preliminary result:

Lemma 4.5. *When the regulated firm adopts a disclosure rule that is 'silent on generous' there exist* δ_f, δ_c, $\underline{p}_D$, $\underline{q}_D$ *and* $\overline{q}_D$ *such that*[13]*:*

i) iff $\delta \leq \delta_f$ *then there exists a 'follow' pooling sub-game equilibrium with* $\sigma_i^o = (1, 0)\ \forall i = S, D$;

ii) iff $\delta > \delta_f$ *then there exists a 'follow, set g' hybrid sub-game equilibrium with* $\sigma_S^o = (1, 0)$ *and* $\sigma_D^o = (p_D, 0)$, *for some* $p_D(\theta_1, \theta_2, H_r, \delta) \in (\underline{p}_D, 1)$;

iii) iff $\delta \geq \delta_c$ *then there exists a 'contradict, set g' hybrid sub-game equilibrium with* $\sigma_S^o = (0, 1)$, $\sigma_D^o = (0, q_D)$, *for some* $q_D(\theta_1, \theta_2, H_r, \delta) \in [\underline{q}_D, \overline{q}_D)$.

No other sub-game equilibria exist for any δ.

Corollary 4.6. *When the regulated firm adopts a disclosure rule that is 'silent on generous':*

i) if the 'follow, set g' hybrid sub-game equilibrium prevails then $\Pr(\text{good decision}) = \frac{1}{2}\left[\theta_S + p_D^o\theta_D + (1 - p_D^o)\frac{1}{2}\right]$ *and thus delegation offers a Pareto improvement but does not achieve the second best;*

[13] δ_f, δ_c, $\underline{q}_2$, $\overline{q}_2$ and $\underline{p}_2$ are derived in a manner exactly analagous to Lemma 4.3. See the formal proof of Lemma 4.3. in the appendix.

ii) if the 'contradict, set g' hybrid sub-game equilibrium prevails then $\Pr(\textit{good decision}) = \frac{1}{2}\left[1 - \theta_S + (\frac{1}{2} + q_D^o \frac{1}{2} - q_D^o \theta_D)\right]$ *and thus delegation results in a Pareto worsening.*

The intuition here is analogous to that of Lemma 4.3 and Corollary 4.4. If career concerns are weighted sufficiently highly, D sets g (rather than t) more often than S in an attempt to protect her professional reputation.

4.4. Full Disclosure

When the firm adopts a policy of 'full disclosure' the market learns the quality of the regulator's decision-making. The market's beliefs are given by (6), (7), (9) and (10). In light of the above, when the firm plays $d = \text{'}\textit{full disclosure}\text{'}$ σ_i^o is given by the solution to

$$\max_{p_i, q_i} \frac{1}{2}(1 + p_i(2\theta_i - 1) + q_i(1 - 2\theta_i)) H_r + \delta \begin{bmatrix} \frac{1}{2}(q_i + (p_i - q_i)\theta_i)\mu(l,t) + \frac{1}{2}(p_i - (p_i - q_i)\theta_i)\mu(h,t) + \\ \frac{1}{2}(1 - q_i - (p_i - q_i)\theta_i)\mu(l,g) + \frac{1}{2}(1 - p_i + (p_i - q_i)\theta_i)\mu(h,g) \end{bmatrix}. \quad (12)$$

Solving (12) for every set of beliefs defined by (6), (7), (9), (10) we establish our final preliminary result.[14]

Lemma 4.7. *When the regulated firm adopts a policy of 'full disclosure' there exists* δ_m *such that*[15]*:*

i) for any δ *there exists a 'follow' pooling sub-game equilibrium with* $\sigma_i^o = (1,0)\ \forall i = S, D$;

ii) iff $\delta > \delta_m$ *then there exists a 'contradict' pooling sub-game equilibrium with* $\sigma_i^o = (0,1)\ \forall i = S, D$.

No other sub-game equilibria exist for any δ.

Corollary 4.8. *When the firm adopts a policy of 'full disclosure', if the 'contradict' pooling sub-game equilibrium prevails, then* $\Pr(\textit{good decision}) = \frac{1}{2}[2 - \theta_1 - \theta_2]$ *and thus delegation results in a Pareto worsening.*

The market now 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 (bad) decisions, D will follow suit since the market treats bad (good) decision-making as evidence of low ability. Clearly, if the mirror pooling equilibrium prevails both types will endeavour to make bad decisions and hence the legislature would do better to resolve the regulatory policy choice itself.

[14] This result extends, albeit for two types, Lemma 1 of Levy (2000) by allowing for the possibility of 'asymmetric strategies'. See Levy (2000) pp. 6-7.

[15] For a definition of δ_m see the formal proof of Lemma 4.7. in the appendix.

5. The Firm's Choice of Disclosure Rule

We are now in a position to establish our central results concerning the firm's ability to engage in indirect regulatory capture. From above the definition of d^o may now be restated as the solution to:

$$\max_{d \in \mathcal{D}} \sum_{i=S,D} \Pr(\theta_i) \left[\sum_{\omega,k} \Pr(\omega, k \mid \theta_i, \sigma_i(d, .)\, v(\omega, k) \right]. \tag{13}$$

For convenience it is assumed that anticipation of equilibria in the sub-games induced by 'silence on tough' and 'silence on generous' is symmetric - i.e. if the 'follow' pooling sub-game equilibrium is expected to prevail under 'silence on tough' then it must also be expected to prevail under 'silence on generous'. Given this assumption, solving (13) yields the following result.

Proposition 5.1. *In the game defined by* $\{\mathcal{D}, \sigma, \mu, U, v\}$*:*

i) if $\delta \leq \delta_f$*, or if* $\delta \geq \delta_c$ *but the firm anticipates that the 'follow' pooling sub-game equilibrium will prevail, then* $d^o \in \mathcal{D}$*;*

ii) if $\delta > \delta_f$*, or if* $\delta \geq \delta_c$ *and the firm anticipates that the 'contradict, set* g*' hybrid sub-game equilibria will prevail, then* d^o = *'silent on generous'.*

If the firm expects both S and D to play 'follow' then $E[v(\omega, k) \mid s = l] = \theta_i L_f$ and $E[v(\omega, k) \mid s = h] = (1 - \theta_i)H_f + \theta_i L_f$. Without loss of generality let $L_f = \frac{1}{2}H_f$. The firm's expected pay-off therefore simplifies to L_f. Similarly, if it anticipates pooling on 'contradict', $E[v(\omega, k)] = L_f$. In contrast, if S plays 'follow' but D mixes between 'follow' and 'set t', the firm receives a strictly lower pay-off. To see why suppose D plays '*set t*'. Recall the firm holds the common priors $\Pr(\theta_S) = \Pr(\theta_D) = 0.5$ and thus $E[v(\omega, k)] = \frac{3}{4}L_f$. Given D's strategy is a convex combination of 'follow' and 'set t', the firm's pay-off must lie between L_f and $\frac{3}{4}L_f$. By analogous logic, the firm receives a strictly lower pay-off if S plays 'contradict' but D mixes 'contradict' and 'set t'. Alternatively, if S plays 'follow' (contradict) but D mixes between 'follow' (contradict) and 'set g' the firm receives a strictly higher pay-off, lying between L_f and $\frac{3}{2}L_f$.

From Lemma 4.7, when d = '*full disclosure*' the firm will expect S and D to pool either on 'follow' or 'contradict' for any δ. Moreover, Lemmas 4.1- 4.5 imply that if $\delta \leq \delta_f$ and $\delta \leq \delta_c$ the firm will also anticipate pooling on 'follow' for any $d \in$ {'*no disclosure*', '*silence on tough*', '*silence on generous*'}, implying that the firm is happy to choose any disclosure rule $d \in \mathcal{D}$ in equilibrium. Intuitively, the firm is aware that career concerns are simply not important enough to enable it to use the job market to influence regulatory policy and hence, given costless revelation, it is willing to choose any revelation strategy. Similarly, if career concerns are more important and $\delta_c \leq \delta \leq \delta_f$ but the firm anticipates that, in equilibrium, unable regulators follow both their signals. Hence part (a).

From Lemmas 4.3 and 4.5 if $\delta > \delta_f$ and $d \in \{$'*silence on tough*', '*silence on generous*'$\}$, the firm will expect S to either 'follow' or 'contradict' but D to mix into setting the k-factor upon which it has committed to remain silent. Hence d^o = '*silence on generous*'. Intuitively, when career concerns are sufficiently important, the firm can persuade D to set g more often by offering her a way to protect her professional reputation. Similarly, if career concerns are less important and $\delta_c \leq \delta \leq \delta_f$ but the firm anticipates that D will mix between 'contradict' and 'set g'. Hence part (b).

6. Comparative Statics

From Lemma 4.5 and Proposition 5.1 it is possible to establish the following comparative statics results.

Proposition 6.1. *When $\sigma_S^o = (1,0)$ and $\sigma_D^o = (p_D, 0)$, for any $p_D \in (\underline{p}_D, 1]$:*

i) S plays 'follow' $\forall\delta$;

ii) the probability with which D plays 'set g' is increasing in δ, $\forall\delta > \delta_f$;

iii) the level of δ necessary to induce D to 'set g' with any given probability is increasing in H_r and θ_D but is decreasing in θ_S.

When the market thinks D plays 'follow' with certainty, she has a career concern incentive to set g when $s = l$. If $\delta = \delta_f$ her career concerns exactly offset her policy preferences, thereby inducing her to mix. Suppose the market thinks that S plays 'follow' but D mixes between 'follow' and 'set g'. As δ increases above δ_f the market must believe that D plays 'set g' with higher probability since this decreases her career concern incentive to 'set g', thereby ensuring that she will continue to mix. Note that, as this probability increases, D's career concern incentive to set g when $s = l$ will eventually disappear, thereby ensuring that no level of δ will induce her to mix.

If H_r increases D has a stronger policy preference incentive to set t when $s = l$. Thus the level of δ necessary to exactly offset these two effects - and hence induce her to mix - must also increase. On the other hand if θ_S increases S is more likely to make good decisions when following her signals, implying that the market will take a good (bad) decision to be stronger (weaker) evidence that the regulator is smart. D, aware of her 'decision-making' limitations, therefore finds she has a stronger career concern incentive to set g when $s = l$. Accordingly, the level of δ necessary to induce her to mix decreases with θ_S.

An increase in θ_D has two separate effects. First, D is more likely to make good decisions when following her signals, implying that the market will take a good (bad) decision to be weaker (stronger) evidence that the regulator is smart. More confident of her 'decision-making ability, D therefore has a weaker career concern incentive to set g when $s = l$. Second, given D makes a good decision with higher probability when she follows her signals, she also has 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 is increasing in θ_D.

Proposition 6.2. *When $\sigma_S^o = (0,1)$ and $\sigma_D^o = (0, q_D)$, for any $q_D \in [0, \overline{q}_D)$:*

i) S plays 'contradict' $\forall\delta \geq \delta_c$;

ii) the probability with which D plays 'contradict' is increasing in δ, $\forall\delta \geq \delta_c$;

iii) the level of δ necessary to induce D plays 'contradict' with any given probability is increasing in H_r and θ_S;

iv) the level of δ necessary to ensure S contradicts $s = h$ and both S and D contradict $s = l$ is increasing in H_r but decreasing in θ_S.

Parts (i)-(iii) are analogous to Proposition 6.1 above. The level of δ necessary to ensure that S sets t when $s = h$ and both S and D set g when $s = l$ is increasing in H_r, simply because this results in a stronger policy preference incentive to follow any signal. Furthermore, by inspection, the level of δ necessary to ensure S sets t when $s = h$ and both S and D set g when $s = l$ is decreasing in θ_S.

The implications of an increase in θ_D are harder to determine. In essence, when the market thinks that S plays 'follow' but D mixes, career concern and policy preference incentives 'work together' to ensure δ is increasing in θ_D. However, when the market thinks that S plays 'contradict', as θ_D increases, D has a stronger policy preference incentive to set g when $s = h$ but also a stronger career concern incentive to set t. When the probability that the market thinks she plays 'set g' is low, the policy preference effect dominates and hence an increase in θ_D *increases* the level of δ necessary to induce mixing behaviour. However when this probability is high the career concern effect dominates and hence an increase in θ_D *decreases* the level of δ necessary to induce mixing behaviour.

7. Policy Implications

The policy implications of these results are best illustrated with the aid of numerical examples. We focus on the *ex ante* probability that the appointed regulator makes a good decision and, for the sake of clarity, assume that if the firm is indifferent it adopts a disclosure rule that is 'silent on generous'.

When $\theta_S = 0.9$, $\theta_D = 0.6$ and $H_r = 1$ we have $\delta_f = 3.333$ and $\delta_c = 4.817$. Thus, providing the regulator is appointed on a sufficiently long contract - i.e. $\delta \leq 3.333$ - the probability of a socially optimal decision rises under delegation, in this case to 0.75. However, if the legislature responds to the possibility of direct collusion by shortening the appointment term such that $3.333 \leq \delta \leq 4.817$, it offers the firm the opportunity to engage in indirect collusion. In other words, the firm now has a strict incentive to adopt a disclosure rule that is 'silent on generous' since D will set g more often. The probability of a good decision unambiguously falls, in this case to $0.7 + 0.05p_D^o$. Moreover, if the appointment term shortens to such an extent such that $\delta \geq 4.817$, S may choose to signal her ability by virtue of bad decision-making. If such a mirror equilibrium prevails, the *ex ante* probability of a good decision is just $0.3 - 0.05 q_D^o$, suggesting that delegation could result in a welfare loss.

It appears, then, that the legislature may face a choice between direct and indirect collusion. However the above comparative statics results suggest that it may be possible to alleviate this trade-off. Suppose that $\theta_S = 0.9, \theta_D = 0.6$ but $H_r = 10$. We now have $\delta_f = 33.33$ and $\delta_c = 48.17$. In other words, an increase in the extent to which the regulator cares directly about the quality of her decision-making allows for a (one for one) *decrease* in the length of the appointment term before indirect collusion becomes a worry. In this paper we have assumed that H_r is exogenously given, but it is not hard to think of a scenario in which the legislature may influence the regulator's policy preferences by virtue of a high powered incentive scheme. Although this issue demands an independent investigation, the above results suggest that it may be desirable for the legislature to counter the implicit incentives created by finite contracts with explicit incentives schemes.

Alternatively suppose that the composition of the regulatory pool changes such that $\theta_S = 0.75$. We now have $\delta_f = 15.60$ and $\delta_c = 11.67$. Again, far shorter appointment contracts can be used before indirect collision becomes a worry, particularly if, for some reason, the 'mirror' equilibrium is not expected to prevail. Note, however, that even if both regulators follow their regulatory signals the probability of a socially optimal decision is only 0.675, which is *less* than the worse case scenario under the 'follow, set g' hybrid equilibrium when $\theta_S = 0.9$. Thus a reduction in the decision-making ability of the most able is only of benefit if, for some reason δ must be greater than 4.817 *and* the mirror equilibrium is expected to prevail.

Finally suppose that $\theta_S = 0.9$ and $H_r = 1$ but $\theta_D = 0.75$. We now have $\delta_f = 22.67$ and $\delta_c = 7.517$. Providing the 'mirror' equilibrium is not expected to prevail, raising the ability of the least able therefore has two advantages: firstly *even shorter* contracts can be implemented for the same absolute difference in ability; and secondly the probability of a socially optimal decision rises, in this case to a maximum of 0.825. Again an independent investigation would be desirable, but it would appear that the legislature may be able to alleviate the trade-off between direct and indirect regulatory capture by re-thinking exactly *who* it is willing to appoint to the job.

8. Conclusion

Given the observation that finite contracts imbue regulators with career concerns, this paper asks whether governments, in appointing regulators on short contracts, might be replacing one source of political failure with another. Specifically, since regulated firms are uniquely placed to judge the quality of regulatory decision-making, do finite contracts offer firms an opportunity to influence policy *indirectly* by transmitting this information to the job market?

We show that, if the market never observes the quality of regulatory decisions, career concerns have no bearing on the regulatory policy choice, leaving appointed regulators free to follow any *ex ante* desire to make good decisions. On the other hand, if the market always observes the quality of decision-making, career concerns become important. If able regulators *use* their signals in an attempt to make good decisions, less able regulators follow suit since the market treats bad decisions as evidence of low ability. Appointed regulators therefore attempt to make good decisions (or, if career concerns are sufficiently important, bad decisions) as often as possible.

Perhaps unsurprisingly we find that the firm's optimal strategy is to publicise the quality of the regulator's decision-making when she sets a tough price cap. However the intuition here lies in the firm's awareness that the regulator will seek to protect her professional reputation rather than in any hope of having regulatory decisions overturned. The firm knows that, when able regulators attempt to make good decisions, less able regulators have an incentive to engage in what Hilton (1972) termed "minimal squawk" behaviour. That is, to set generous price caps more often to ensure the firm stays silent and their professional reputation remains intact. If the appointment term is short enough this effect can dominate any desire to make good decisions, thereby giving rise to an *indirect* source of regulatory capture.

Short appointment terms may therefore not be the panacea that some have claimed; a conclusion that is strengthened by the finding that the welfare gain from delegation diminishes, possibly becoming a welfare loss, as the term shortens. In particular, if direct collusion poses a real threat, optimal appointment contracts may need to balance one source of political failure against another. This issue would benefit from further investigation. Two possible directions are suggested by our remaining comparative statics results. First, the appointed regulator's *ex ante* desire to make a good decision limits the extent of indirect collusion. Given such a desire could be strengthened by the use of a high powered incentive scheme, shorter appointment terms might be desirable if accompanied by explicit incentive contracts. Second, an increase in the ability of the least able potential regulators, as well as a decrease in the ability of the most able, reduces the extent of indirect collusion. Thus, again, shorter appointment terms could be desirable if accompanied by changes in the composition of the regulatory pool.

In concluding we draw some comparisons with existing results. First, in contrast to Levy's (2000) benchmark result in the absence of consultation, we show that decision-makers may *not* always use the information content of their signals: the presence of a firm ready to 'squawk' ensures that less able regulators are no longer prepared to attempt good decision-making. Moreover, contrary to Lizzeri (1999), we show that 'no disclosure' may not be an optimal policy for the intermediary: the firm has an incentive to reveal the quality of unfavourable decisions, aware that less able regulators will attempt to protect their professional reputation by setting favourable policies with positive probability. Furthermore, in contrast to Le Borgne and Lockwood (2000) who find that *political* career concerns increase effort for all types, we demonstrate that *regulatory* career concerns can be welfare reducing since they enable firms to engage in a form of regulatory capture.

The firm secures policy favours by encouraging less able regulators to tailor their policy decisions to ensure that it remains quiet. This result clearly echoes Prendergast's (2000) finding that bureaucracies may be forced to monitor inefficiently since bureaucrats have an incentive to accede to consumer demands to avoid complaints being made. In a similar vein, Epstein and O'Halloran (1995) suggest that regulatory agencies may silence an interest group to limit the possibility of congressional veto and hence ensure that the policy choice remains close to its ideal point. A contribution of this paper is therefore to highlight that *career concerns*, as well as policy preferences or explicit contracts, may offer regulators an incentive to silence possible critics. More generally, interest groups are thought to influence policy by virtue of direct transfers (e.g. Grossman and Helpman (1994)), the provision of policy relevant information (e.g. Austen-Smith and Wright (1992)), fire-alarm signals (e.g. Epstein and O'Halloran (1995)) or threats (e.g. Dal Bó and Di Tella (2000)). This paper therefore offers an alternative, micro-founded model of precisely how interest groups could (perfectly legally) 'threaten' policy-makers into concessions by exploiting their concerns for a future career.

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Appendix

Proof of Lemma 4.1. Differentiating (5) wrt to p_i and q_i yields

$$\frac{\partial E[U_i]}{\partial p_i} = (\theta_i - \tfrac{1}{2})H_r + \delta\left[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}\mu(g)\right] \tag{A1}$$

and

$$\frac{\partial E[U_i]}{\partial q_i} = (\tfrac{1}{2} - \theta_i)H_r + \delta\left[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}\mu(g)\right]. \tag{A2}$$

Note that

$$\begin{aligned}\frac{\partial E[U_S]}{\partial p_S} - \frac{\partial E[U_D]}{\partial p_D} &= \frac{\partial E[U_D]}{\partial q_D} - \frac{\partial E[U_S]}{\partial q_S} \\ &= (\theta_S - \theta_D)H_r > 0.\end{aligned} \tag{A3}$$

(a) Existence. Suppose $\mu(t) = \mu(g) = 0.5$. Since $(\theta_i - \frac{1}{2})H_r > 0\ \forall i$, (A1) is strictly positive and (A2) is strictly negative $\forall i = S, D$. It therefore follows that (5) has a unique solution characterised by $\sigma_i^o = (1, 0)\ \forall i$. Given $\sigma_i^o = (1, 0)\ \forall i$, (3) and (4) imply that the market's beliefs are indeed as stated and hence that such an equilibrium exists.

(b) Uniqueness. Suppose that $\mu(t) > \mu(g)$. From (3) and (4) we require $\tilde{p}_S + \tilde{q}_S > \tilde{p}_D + \tilde{q}_D$. Given these beliefs, (A1) is strictly positive, implying $p_i^o = 1\ \forall i = S, D$. While (A2) is strictly positive for any δ, 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, (3) and (4) imply that $\tilde{p}_S = \tilde{p}_D$, $\tilde{q}_S = \tilde{q}_D$ and $2 > \tilde{p}_S + \tilde{q}_S > 0$. Moreover $\mu(t) = \mu(g) = 0.5$. Recall that the market is assumed to retain its prior belief $\Pr(\theta_S) = 0.5$ at information sets off the equilibrium path. Thus $\mu(t) = \mu(g) = 0.5$ for any $\tilde{p}_S = \tilde{p}_D$, $\tilde{q}_S = \tilde{q}_D$. However we know from part (a) that, given these beliefs, $\sigma_i^o = (1, 0)\ \forall i = S, D$ is the unique solution to (5). ■

Proof of Lemma 4.3. Differentiating (8) wrt to p_i and q_i yields

$$\frac{\partial E[U_i]}{\partial p_i} = (\theta_i - \tfrac{1}{2})H_r + \delta\left[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}\theta_i\mu(l, g) - \tfrac{1}{2}(1 - \theta_i)\mu(h, g)\right] \tag{A4}$$

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

Note that

$$\frac{\partial E[U_i]}{\partial p_i} - \frac{\partial E[U_j]}{\partial q_j} = (\theta_i + \theta_j - 1)H_r + \delta\left[\tfrac{1}{2}(\theta_i + \theta_j - 1)(\mu(h, g) - \mu(l, g))\right] \tag{A6}$$

for $i, j = S, D$ while

$$\begin{aligned}\frac{\partial E[U_S]}{\partial p_S} - \frac{\partial E[U_D]}{\partial p_D} &= \frac{\partial E[U_D]}{\partial q_D} - \frac{\partial E[U_S]}{\partial q_S} \\ &= (\theta_S - \theta_D)H_r + \delta\left[\tfrac{1}{2}(\theta_S - \theta_D)(\mu(h, g) - \mu(l, g))\right].\end{aligned} \tag{A7}$$

(a) Existence of the 'follow' pooling sub-game equilibrium. Suppose that

$$\mu(t) = \tfrac{1}{2},\ \mu(l,g) = \frac{1-\theta_S}{2-\theta_S-\theta_D} \text{ and } \mu(h,g) = \frac{\theta_S}{\theta_S+\theta_D} \tag{A8}$$

and $\delta \leq \delta_f$, where

$$\delta_f = \frac{2(2\theta_D-1)H_r(2-\theta_S-\theta_D)(\theta_S+\theta_D)}{(\theta_S-\theta_D)^2}.$$

Substituting for (A8) in (A4) yields,

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

and

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

Similarly, substituting for (A8) in (A5) yields,

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

and

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

which may be positive or negative depending on δ.

Given $\delta \leq \delta_f$, it follows that $\sigma_i^o = (1,0)$ is a solution to (8) $\forall\ i = S, D$. From (3), (6) and (7) the market's beliefs are indeed as stated and hence such an equilibrium exists.

(b) Existence of the 'follow, set t' hybrid sub-game equilibrium. Suppose that

$$\begin{aligned} \mu(t) &= \frac{1}{2+\widetilde{q}_D},\ \mu(l,g) = \frac{1-\theta_S}{(1-\theta_S)+(1-\widetilde{q}_D)(1-\theta_D)} \\ \text{and } \mu(h,g) &= \frac{\theta_S}{\theta_S+(1-\widetilde{q}_D)\theta_D}, \end{aligned} \tag{A9}$$

for some $\widetilde{q}_D \in (0, \overline{\widetilde{q}}_D)$ and $\delta > \delta_f$, where $\overline{\widetilde{q}}_D$ solves

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

Note that (A8) and (A9) are equivalent if $\widetilde{q}_D = 0$. Thus, given $\delta > \delta_f$, it follows from part (a) that when $\widetilde{q}_D = 0$ (A5) is strictly positive for $i = D$. In contrast,

$$\tfrac{\partial E[U_D]}{\partial q_D}\ |_{\widetilde{q}_D=1} = (\tfrac{1}{2} - \theta_D)H_r - \delta\left[\tfrac{1}{3}\right] < 0.$$

It is easy to show that

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

(i.e. D's incentive to choose t following $s = h$ decreases the more likely the market thinks she is to play 'set t'). Thus there must exist a unique value of $\widetilde{q}_D \in (0, \overline{\widetilde{q}}_D)$, $\widetilde{q}^*_D(\theta_S, \theta_D, H_r, \delta,)$, such that

$$\frac{\partial E[U_D]}{\partial q_D} |_{\widetilde{q}^*_D} = 0$$

thereby supporting $q^o_D = \widetilde{q}_D$.

It now remains to verify that, at $\widetilde{q}^*_D$, (A4) is strictly positive $\forall i$ (supporting $p^o_i = 1$ $\forall i = S, D$) and (A5) is strictly negative for $i = S$ (supporting $q^o_S = 0$). From (A9)

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

is strictly positive for any $\widetilde{q}_D \in [0, 1)$. Thus for $i = S, D$, $j = D$ (A6) and (A7) are strictly positive for any $\widetilde{q}^*_D$.

Given the definition of $\widetilde{q}^*_D$, it therefore follows that $p^o_S = 1$, $q^o_S = 0$ is a solution to (8) for $i = S$ and $p^o_D = 1$, $q^o_D = \widetilde{q}^*_D$ is a solution to (8) for $i = D$. From (3), (6) and (7) the market's beliefs are indeed as stated and hence such an equilibrium exists.

(c) Existence of the 'contradict, set t' hybrid sub-game equilibrium. This can be proved in a similar manner to part (b) above. The market's beliefs in this case are given by

$$\mu(t) = \frac{1}{2 + \widetilde{p}_D}, \ \mu(l, g) = \frac{\theta_S}{\theta_S + (1 - \widetilde{p}_D)\theta_D}$$

$$\text{and } \mu(h, g) = \frac{1 - \theta_S}{(1 - \theta_S) + (1 - \widetilde{p}_D)(1 - \theta_D)}$$

for some $\widetilde{p}_D \in (\underline{\widetilde{p}}_D, \overline{\widetilde{p}}_D]$. δ_c and $\overline{\widetilde{p}}_D$ solve the simultaneous equations

$$\delta_{mix\ \widetilde{p}_D} = \frac{(2\theta_D - 1)H_r}{\theta_D \mu(l, g) + (1 - \theta_D)\mu(h, g) - \mu(t)}$$

$$\delta_{ord} = \frac{2H_r}{\mu(l, g) - \mu(h, g)}$$

given θ_S, θ_D and H_r, and $\underline{\widetilde{p}}_D$ solves

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

(d) Uniqueness. Suppose the market's beliefs are given by (A8). From (3), (6) and (7) we require $\widetilde{p}_i = 1$ and $\widetilde{q}_i = 0$ $\forall i$. However from part (a) when $\delta > \delta_f$ we have $q^o_D = 1$, thereby inducing a contradiction. The 'follow' pooling equilibrium therefore cannot exist when $\delta > \delta_f$. Alternatively, suppose the market's beliefs are given by (A9). From (3),

(6) and (7) we require $\widetilde{p}_i = 1\ \forall i$, $\widetilde{q}_S = 0$, and $\widetilde{q}_D = \widetilde{q}^*_D \in (0, \overline{\widetilde{q}}_D)$. However from part (a) when $\delta < \delta_f$ (A5) is strictly negative $\forall i$ at $\widetilde{q}_D = 0$. While if $\delta = \delta_f$, (A5) is zero at $\widetilde{q}_D = 0$. By inspection (A5) is decreasing in $\widetilde{q}_D$. Thus, when $\delta \leq \delta_f$, $q^o_D = 0$ for any $\widetilde{q}_D \in (0, 1]$ inducing a contradiction. The 'follow, set t' hybrid equilibrium therefore cannot exist when $\delta \leq \delta_f$. Similar reasoning establishes that the 'contradict, set t' hybrid equilibrium cannot exist when $\delta < \delta_c$.

We now proceed to verify that no other sub-game equilibria exist for any δ. Suppose $\mu(h, g) = \mu(l, g)$. There are three possibilities. First, suppose $\mu(h, g) = \mu(l, g) = 0$. From (6) and (7) $\widetilde{p}_S = \widetilde{q}_S = 1$ and $\widetilde{p}_D + \widetilde{q}_D < 2$. However substituting for these beliefs in (A4) for yields

$$\frac{\partial E[U_{\mathsf{D}}]}{\partial p_{\mathsf{D}}} = (\theta_D - \tfrac{1}{2})H_r + \delta[\tfrac{1}{2}\mu(t)]$$

which is clearly strictly positive for any $\mu(t) \in [0, 1]$ implying that $p^o_D = 1$. We therefore require $q^o_D < 1$. However, given $\mu(l, g) = \mu(h, g) = 0$, (A7) is strictly positive. Thus if $q^o_S = 1$ we must also have $q^o_D = 1$, thereby inducing a contradiction.

Second, suppose $\mu(t) < \mu(l, g) = \mu(h, g) = 1$. From (6) and (7) $\widetilde{p}_D = \widetilde{q}_D = 1$. However substituting for these beliefs in (A5) yields

$$\frac{\partial E[U_{\mathsf{D}}]}{\partial q_{\mathsf{D}}} = (\tfrac{1}{2} - \theta_D)H_r + \delta[\tfrac{1}{2}\mu(t) - \tfrac{1}{2}]$$

which is clearly negative for any $\mu(t) \in [0, 1]$ implying $q^o_D = 0$ and thus inducing a contradiction. Analogously if $\mu(t) = 1$ (3) implies $\widetilde{p}_D + \widetilde{q}_D = 0$. However substituting for $\mu(t) = 1$ in (A4) yields

$$\frac{\partial E[U_{\mathsf{D}}]}{\partial p_{\mathsf{D}}} = (\theta_D - \tfrac{1}{2})H_r + \delta[\tfrac{1}{2} - \tfrac{1}{2}\theta_D\mu(l, g) - \tfrac{1}{2}(1 - \theta_D)\mu(h, g)]$$

which is clearly strictly positive for any $\mu(l, g)$, $\mu(h, g) \in [0, 1]$. It therefore follows that $p^o_D = 1$ inducing a contradiction.

Finally the market could retain its prior belief $\mu(l, g) = \mu(h, g) = 0.5$. From (6) and (7) if these beliefs have been derived via Bayes' Rule then $\widetilde{p}_i = \widetilde{q}_i = 0\ \forall i$. Since the market also retains its priors off the equilibrium path $\mu(t) = 0.5$. However, given these beliefs, (A4) is strictly positive and thus $p^o_i = 1\ \forall i$, inducing a contradiction. Alternatively $\mu(l, g)$ and $\mu(h, g)$ could be off the equilibrium path, implying $\mu(l, g) = \mu(h, g) = 0.5$. But then $\widetilde{p}_i = \widetilde{q}_i = 1\ \forall i$ and hence from (3) $\mu(t) = 0.5$. Given these beliefs (A5) is strictly negative and thus $q^o_i = 0\ \forall i$ inducing a contradiction. (Analogously if $\mu(t)$ is off the equilibrium path.)

Now suppose $\mu(h, g) > \mu(l, g)$. From (3), (6) and (7) it must be the case that

$$\begin{aligned} \widetilde{p}_i + \widetilde{q}_i &< 2\ \forall i \\ \text{and } \widetilde{p}_S - \widetilde{q}_S &> \widetilde{p}_D - \widetilde{q}_D\left(\frac{2\theta_D - 1}{2\theta_S - 1}\right). \end{aligned} \tag{A10}$$

Given $\mu(h, g) > \mu(l, g)$, (A6) and (A7) imply that, for any δ, we have

$$\frac{\partial E[U_{\mathsf{S}}]}{\partial p_{\mathsf{S}}} > \frac{\partial E[U_{\mathsf{D}}]}{\partial p_{\mathsf{D}}} > \frac{\partial E[U_{\mathsf{D}}]}{\partial q_{\mathsf{D}}} > \frac{\partial E[U_{\mathsf{S}}]}{\partial q_{\mathsf{S}}}. \tag{A11}$$

It now remains to verify whether a strategy function exists that is consistent with both (A10) and (A11). First note that only $p_S = 1$ and $q_S = 0$ satisfy both for $i = S$. Next, $p_D < q_D$ and $p_D = q_D \in [0,1)$, whilst consistent with (A10), fail to satisfy (A11). Recall from above that $p_D = q_D = 0$ can never be part of an equilibrium since $\mu(t) = 1$. Thus if an equilibrium exists we must have $p_D > q_D$.

There are three possibilities. i) $p_D = 1$, $q_D = 0$; ii) $p_D = 1$, $q_D \in [0,1]$; and iii) $p_D \in [0,1]$, $q_D = 0$. Suppose $p_D \in [0,1]$. Then in equilibrium the market's beliefs must be given by

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

Clearly if $\widetilde{p}_D = 0$ then $\mu(t) = 1$ and $p_D^o = 1$. Similarly if $\widetilde{p}_D = 1$ then the market's beliefs are equivalent to (A8) and thus from part (a) we also have $p_D^o = 1$. By inspection (A4) is decreasing in $\widetilde{p}_D$, implying that there does not exist a value of $\widetilde{p}_D \in [0,1]$ such that (A4) is equal to zero for $i = D$. Thus if an equilibrium exists when $\mu(h,g) > \mu(l,g)$ it must be the either the pooling or hybrid equilibrium stated in the lemma.

Finally suppose $\mu(l,g) < \mu(h,g)$. From (3), (6) and (7) it must be the case that

$$\begin{aligned} \widetilde{p}_i + \widetilde{q}_i &< 2\ \forall i \\ \text{and } \widetilde{q}_S - \widetilde{p}_S &> \widetilde{q}_S - \widetilde{p}_S\left[\frac{2\theta_D-1}{2\theta_S-1}\right]. \end{aligned} \tag{12}$$

Moreover suppose that δ is sufficiently high such that (A6) and (A7) are strictly negative. We therefore have

$$\frac{\partial E[U_S]}{\partial q_S} > \frac{\partial E[U_D]}{\partial q_D} > \frac{\partial E[U_D]}{\partial p_D} > \frac{\partial E[U_S]}{\partial p_S}. \tag{13}$$

Again it remains to verify whether a strategy function exists that is consistent with both (A12) and (A13).

First note only $p_S = 0$ and $q_S = 1$ satisfy both for $i = S$. Next $p_D > q_D$ and $p_D = q_D \in [0,1]$, whilst consistent with (A12) fail to satisfy (A13). Recall from above that $p_D = q_D = 0$ can never be part of an equilibrium. Thus, if an equilibrium exists we must have $p_S = 0$, $q_S = 1$ and $p_D < q_D$.

Again there are three possibilities: i) $p_D = 0$, $q_D = 1$; ii) $p_D \in [0,1]$, $q_D = 1$; and iii) $p_D = 0$, $q_D \in [0,1]$. Suppose $p_D = 0$, $q_D = 1$. Then in equilibrium the market's beliefs must be given by

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

However it follows from part (a) that given these beliefs (A4) is strictly positive for $i = D$ and thus $p_D^o = 0$ inducing a contradiction.

Alternatively suppose $q_D \in [0,1]$. Then in equilibrium the market's beliefs must be given by

$$\mu(t) = \frac{1}{1+\widetilde{q}_D},\ \mu(l,g) = \frac{\theta_S}{1-\widetilde{q}_D+\theta_S+\widetilde{q}_D\theta_D}$$
$$\text{and } \mu(h,g) = \frac{1-\theta_S}{2-\theta_S-\widetilde{q}_D\theta_D}.$$

Note that

$$\frac{\partial E[U_D]}{\partial p_D}\Big|_{\widetilde{q}_D=0} = (\theta_D - \tfrac{1}{2})H_r + \delta\left[\frac{1+\theta_S+\theta_D-2\theta_S\theta_D}{4+2\theta_S-2\theta_S^2}\right] > 0$$

and

$$\frac{\partial E[U_2]}{\partial p_2}\Big|_{\widetilde{q}_2=1} = (\theta_2 - \tfrac{1}{2})H_r + \delta\left[\frac{(\theta_S-\theta_D)^2}{4(2-\theta_S-\theta_D)(\theta_S+\theta_D)}\right] > 0.$$

By inspection (A4) is decreasing in $\widetilde{q}_D$ and thus it follows that there cannot exist a value of $\widetilde{q}_D \in [0,1]$ such that (A4) is strictly negative.

Next suppose that $\mu(h,g) < \mu(l,g)$ but that δ is sufficiently low such that (A6) and (A7) are strictly positive. Note this implies (A11) and hence that $p_S \geq q_S$ and $p_D \geq q_D$. Clearly $p_i = q_i = 1$ for any $i = S, D$ violates (A12). Moreover from (A11) if $p_S = q_S = 0$ we must also have $p_D = q_D = 0$ which we know from above cannot be part of an equilibrium. Thus, if a sub-game equilibrium exists, we must have $p_S > q_S$ and $p_D > q_D$. This leaves: i) $p_i = 1$, $q_i = 0$; ii) $p_S = 1$, $q_S = 0$, and $p_D \in [0,1], q_D = 0$; and iii) $p_S = 1$, $q_S = 0$, and $p_D = 1, q_D \in [0,1]$. However in the latter two cases $q_S - p_S < q_D - p_D < 0$ and thus, given $2\theta_S - 1 > 2\theta_D - 1$, both strategies fail to satisfy (A12).

Noting that we do not characterise equilibria in the knife edge case where δ is such that (A6) and (A7) hold with equality therefore completes the proof. ■

Proof of Lemma 4.5. This can be proved in an exactly analogous manner to Lemma 4.3. ■

Proof of Lemma 4.7. Differentiating (12) wrt to p_i and q_i yields

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

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

(a) Existence of the 'follow' pooling sub-game equilibrium

Suppose that

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

Substituting for (A16) in (A14) yields

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

Similarly substituting for (A 16) in (A15) yields

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

It therefore follows that, for any δ, $\sigma_i^o = (1, 0)$ is a solution to (12). From (6), (7), (10) and (11) the market's beliefs are indeed as stated and hence such an equilibrium exists.

(b) Existence of the 'contradict' pooling sub-game equilibrium. This can proved in a similar manner to part (a). The market's beliefs in this case are given by

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

δ_m is given by

$$\delta_m = \frac{H_r(2-\theta_S-\theta_D)(\theta_S+\theta_D)}{(\theta_S-\theta_D)}.$$

(c) Uniqueness. This can be proved in an exactly analogous manner to part (d) in Lemma 4.3. ■

Proof of Proposition 6.1. Let the function $\delta_{mix\ p}(\theta_S, \theta_D, H_r, \widetilde{p}_D)$ denote the values of δ such that D is willing to mix on $s = l$, given $\widetilde{p}_S = 1$ and $\widetilde{q}_i = 0\ \forall i$. Note $\delta_f = \delta_{mix\ p}(\theta_S, \theta_D, H_r, 1)$, implying δ_f gives the value of δ beyond which D mixes on $s = l$.

Part (i). This follows immediately from the proof of Lemma 4.7; S has no career concern incentive to deviate from setting t when $s = l$ for any $\widetilde{p}_D$.

Part (ii). From (11), for D to mix on $s = l$, we require

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

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 given by (4), (9) and (10) (i.e. 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

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

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 (iii). 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 H_r as stated.

Differentiating Z wrt to θ_S yields, after some re-arrangement,

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

which by inspection is strictly positive for any $\widetilde{p}_D \in (0,1]$. Thus $\delta_{mix\ p}$ must be decreasing in θ_S.

Differentiating Z wrt to θ_D yields, after some re-arrangement,

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

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

Proof of Proposition 6.2. This can be proved in an analogous manner to Proposition 6.1. ■