Complexity, Capacity, and Capture

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1 Introduction

In the debates on financial market reform that followed the Financial Crisis of 2007 and the Great Recession, reformers advocated three distinct approaches. Some argued that governments should act to fundamentally restructure the financial sector. Large banks should be broken up. Investment and commercial banks should be separated as they had been under the Glass Steagall reforms of the 1930s (or at least the investment activity of commercial banks should be drastically restricted). Limits on the types on financial products that could be marketed and taxes on financial transactions were promoted. Opponents of government intervention positioned themselves at the opposite position. They argued that a government-led reconstruction of the financial marketplace would be counter-productive if not futile. Such actions would impede financial innovation and restrict credit and liquidity. At most, according to this view, reform should get the taxpayer off the hook for the failure of financial firms. The middle ground in this debate was held by those who argued that the basic structure of the financial sector should remain intact but that the capacity and powers of regulatory agencies should be enhanced to better monitor the sector for systemic risks, financial fraud, and predatory lending practices. As of this writing, the middle ground, reflected in the Dodd-Frank financial reform bill, appears to have won out.

Although much of the debate centered on the economic trade-offs embedded in this approach, the question is essentially one of politics and public administration. Can the government effectively regulate a large, complex, and interconnected financial sector? If the answer is yes, then the middle ground of enhanced regulatory supervision seems promising. If the answer is no, then the more extreme approaches become somewhat more compelling.

Unfortunately, there are many reasons to believe the answer might be no. Perhaps financial markets and products are so complex that outgunned agencies lack the capacity to detect systemic risk and fraud. Regulators may be so extremely dependent on the industry for information, expertise, and talent that they are not able to exercise independent regulatory authority. At best under such conditions, the financial industry will be highly influential. At worst, regulators may be captured by the industry.

Although bureaucratic capacity and capture in complex policy environments are particularity salient in financial reform, these issues manifest themselves in a very large number of policy domains ranging from rate and service regulation to product and workplace safety to the environment. Despite the centrality of these concerns, political scientists have been slow to develop theories and models of how complexity, capacity, and capture interact in the regulatory sphere and what policymaking trade-offs these interactions induce.

To be sure, political scientists have focused on the role of information and expertise in regulatory settings. Much of political science scholarship on the structure and development of the regulatory state focuses on the decision of elected politicians to delegate policymaking authority to better informed experts in the bureaucracy. Because legislators are policy generalists rather than experts, they may find it difficult to select good policies in uncertain environments. Consequently, they grant bureaucratic specialists wide discretion in policy choice.[1].

But the informational approach to delegation downplays at least four issues that are important for understanding regulation in complex policy domains. The first is that the informational delegation literature does not problematize the source of bureaucratic expertise and information. Bureaucratic expertise is often taken as exogenous (bureaucrats are simply assumed to have it) or as the result of human capital investments (bureaucrats can pay to get it).[2] Likewise, information is something that the bureaucrat is assumed to have or can obtain at some cost or effort. In this regard, the approach in political science is quite different from that of regulatory economists for whom the regulator's extraction of

[1]The seminal works in this genre include Epstein and O'Halloran (1999), Huber and Shipan (2002), and Bendor and Meirowitz (2004).

[2]See Gailmard and Patty (2004); Bendor and Meirowitz (2004).

information from the regulated firm is the central problem.[3].

Second, political scientists often treat bureaucratic drift and regulatory capture as exogenous. Preference divergence between politicians and bureaucrats is taken as a more or less fixed and is not influenced directly by the nature of the regulatory or policymaking environment.[4] Consequently, the legislative response to drift and capture is either to limit the bureaucrat's discretion through ex ante constraints and ex post oversight or to influence agency preferences through the politics of appointments.[5]

Third, much of the work on bureaucratic delegation assumes that bureaucrats can efficiently and effectively implement their target policies. But as Huber and McCarty (2004) point out, imperfect implementation generates ex post control problems for political principals.[6] When there are errors in policy implementation, it is more difficult for political principals to detect when agents attempt to implement policies that the principals do not approve. This problem enhances the possibility of bureaucratic drift and capture.

Fourth, the literature often draws no distinction between information and knowledge. Expertise is treated as the obtainment of missing data that can be applied to a known model to generate some desired policy outcome. But expertise also reflects knowledge of the underlying model. As I explain below, treating expertise as missing data can make inferences by non-experts too easy which in turn undermines the value of expertise. But the more encompassing notion of expertise as both data and the knowledge of what to do with it makes deference to experts more likely.

In an attempt to fill in some of the gaps in our understanding of regulatory policymaking, I develop a very simple model of policymaking in *complex* policy domains. By

[3]See Dal Bó (2006) for a recent review of the economic literature on regulation and capture.

[4]Much of the empirical work on delegation in the United States assumes that bureaucratic preferences are derived from the preferences of the President e.g. Epstein and O'Halloran (1999). McCarty (2004) and Boehmke, Gailmard and Patty (2005) are exceptions in that they consider the optimal preference divergence between principals and agents.

[5]On the use of statutory discretion, see Epstein and O'Halloran (1999) and Huber and Shipan. On appointments, see McCarty (2004).

[6]For counter examples, see Huber and McCarty (2004); Bendor and Meirowitz (2004).

complex, I mean that bureaucrats find it very difficult to establish autonomous sources of information and expertise about the consequences of different policies.[7] In such cases, regulators are highly dependent on the regulated industry for both policy relevant information and expertise. Financial regulation fits this notion well. In a less complex regulatory environment, the government might mitigate any informational advantages of the regulated industry by hiring its own experts to serve on the staffs of legislative and regulatory agencies. In finance and other complex environments, the wage premium on expertise might be large enough that the government cannot match the expertise of the industry. For example, Thomas Philippon and Ariel Reshef have recently estimated that on the eve of the Financial Crisis, wages in the financial sector were 70% higher than those of comparably skilled and educated workers outside the sector. Governmental pay scales cannot compete with Wall Street for talent.[8]

Another aspect of complex environments is that the necessary expertise and training might be available only through the industry or in professional schools and training programs were the curriculum is favorable to industry interests. In finance, there are few opportunities to acquire the necessary expertise about financial markets outside of the industry or from business schools. Consequently, financial regulators often share strong social ties to the industry and are more sympathetic on average to the industry's interests and viewpoints.[9].

Together these features of complex policy environments invariably create trade-offs between expertise and capacity on one hand and autonomy on the other. In this chapter, I

[7]Political scientists often term complex policies as those for which informational asymmetries between legislators and regulators are the greatest. But if these are exactly the domains where the regulators find it difficult to obtain policy relevant information, the information gap between legislators and regulators may or may not be larger.

[8]See Philippon and Reshef (2009). Some financial regulatory agencies, such as the Federal Reserve, have higher pay schedules than those of the rest of the Federal government. But even these agencies pay much less than Wall Street for similar job qualifications.

[9]For similar arguments and a review of the social and psychological mechanisms that produce such effects, see James Kwak in this volume.

explore the implications of these trade-offs by developing a simple game theoretic model. In the model, a legislative principal must decide whether to create a new agency (or delegate power to an existing one) to regulate the activities of a firm. The policy domain is complex in that knowledge of the implications of different policy choices is embedded in the firm. Unless the agency is willing and able to commit significant resources to building its own expertise, it can learn about the policy environment only through monitoring the firm. This learning, however, is imperfect and the information obtained from monitoring declines in the complexity of the policy environment.

The main result of the model is that as policy becomes more complex, regulatory outcomes are increasingly biased towards those preferred by the firm. In light of these outcomes, the political principal may prefer not to delegate power to the agency at all. If the outcomes are going to be what the firm prefers anyway, the principal may prefer to economize on the fixed cost of regulation and let the firm go unregulated. Alternatively, if the outcomes associated with a unregulated firm are too unfavorable, the principal may decide either to ban the firm's activities or select some other bright-line rule that can be implemented by less expert bureaucrats.

2 The Model

In this section, I sketch a simple model of the decision to regulate in a complex policy environment. I present the basic results and the underlying intuitions but leave most derivations and proofs to the appendix.

To simplify, I assume that there are just three relevant actors: a legislative principal denoted L, a regulatory agency denoted A, and a firm denoted F. So that the model may be generalized across a large number of regulatory settings, I do not explicitly model the firm's production and the marketing of its output. Rather I assume that the model's actors have preferences over regulatory outcomes. Let $X \subset \mathbb{R}$ denote the set of outcomes. I interpret of an outcome $x \in X$ as the social cost imposed by the firm's activities, for a given level of social benefits. Because the firm internalizes social costs and benefits to a lesser degree that the legislator, it is natural to assume that the legislator prefers lower outcomes on this dimension than does the firm. To clarify this notion, consider an example from financial regulation. Suppose regulations are targeted at the degree of economic concentration in the financial sector. Concentration is presumed to have benefits in terms of economies of scale and costs in terms of increased systemic risk. One can think of x as reflecting a specific trade-off between the benefits of the economy of scale and the reduction of systemic risk. The principal might prefer low values of x where the economies of scale and the risks are small. The firm might prefer larger values because it captures more of the value of the scale economies and does not fully internalize the risk.[10]

So let l, a, and f be the ideal regulatory outcomes for L, A, and F, respectively. I assume that each player has quadratic preferences so that the utility of outcome x for player i is $-(x-i)^2$. Further, I set $l = 0$ and $f = 1$. This specification of ideal outcomes is simply a normalization. All that matters is that L prefers less social costs per unit of social benefit than does the firm. In the analysis that follows, I consider a variety of assumptions about the preferences of the regulatory agency.

Following much of the literature on delegation to experts, I model expertise as the knowledge of how to obtain specific outcomes. But as I discuss in the introduction, the required knowledge is not reducible to missing data as in previous models. Those models assume that outcomes are generated by a combination of policy choices and random shocks. Non-experts know the relationship between the shocks and the outcome, but do not know the exact value of the shocks. Experts know the values of the random shocks and

[10]It is important to glean from this discussion that I intend to differentiate regulatory outcomes from ex post outcomes like a financial crisis, nuclear meltdown, or offshore rig blowout. Rather the regulatory outcomes might be thought of as probability distributions on the ultimate outcomes.

are therefore able to choose policy to get a desired outcome.[11] These assumptions imply that expertise is a simple question of missing data. But in real world regulatory settings, regulators have ample opportunities to obtain data through regulatory reporting requirements and investigatory powers. What is more relevant is whether the agency knows what to do with the data. In other words, expertise is more than information it is the deeper knowledge of the model that links policies and outcomes.

Recently, Steven Callander has pointed out an important limitation of the standard model. Because it implies that the non-expert need only observe one policy and one outcome to become an expert, the principal generally has an ex post incentive to renege on its delegation of policymaking authority and move policy toward its preferred outcome. Callander argues instead that the policy choices of experts should only reveal *local* information; that is, the principal should be able to make inferences about the effects of policy close to the one chosen by the expert but learn little about the effects of very distinct approaches.[12]

Callander's critique is extremely pertinent here, because I am precisely interested in those situations where policy information is difficult to obtain. These criticisms have even more bite in thinking about the informational asymmetry between the regulator and firm. Regulators ought not to be assumed to be able to draw precise inferences about the consequences of policy choices simply by observing the firm's behavior.

So I develop a model of policy expertise with both of these considerations in mind.[13] First, I assume that any of the actors can become expert enough to implement a specific regulatory outcome by incurring a cost. Formally, if agent i selects regulatory outcome x and pays c_i, she can perfectly implement x. Returning to the example of financial

[11]Formally, the link between outcome x and policy p is given by $x = p + \omega$ where ω is a random variable observed by the regulator but not the principal policymaker.

[12]See Callander (2008).

[13]Callander proposes a model similar to the one I pursue here. Unfortunately, his framework was not tractable within my model.

regulation, suppose the regulator wanted to trade off economies of scale and systemic risk consistent with regulatory outcome x. At some cost (perhaps a prohibitive one), the regulator could hire sufficient numbers of economists to estimate the level of concentration that produces x and enough lawyers to write the regulations that enforce x. Because information obtained by paying these costs is acquired unilaterally and not through the interaction with other agents, I label it *independent* information. It is reasonable to assume that the costs of acquiring independent information is lower for the firm than the regulatory agency and lower for the agency than the principal. For simplicity, I invoke an extreme form of this assumption and set $c_f = 0$, $c_a > 0$, and $c_l = \infty$.[14].

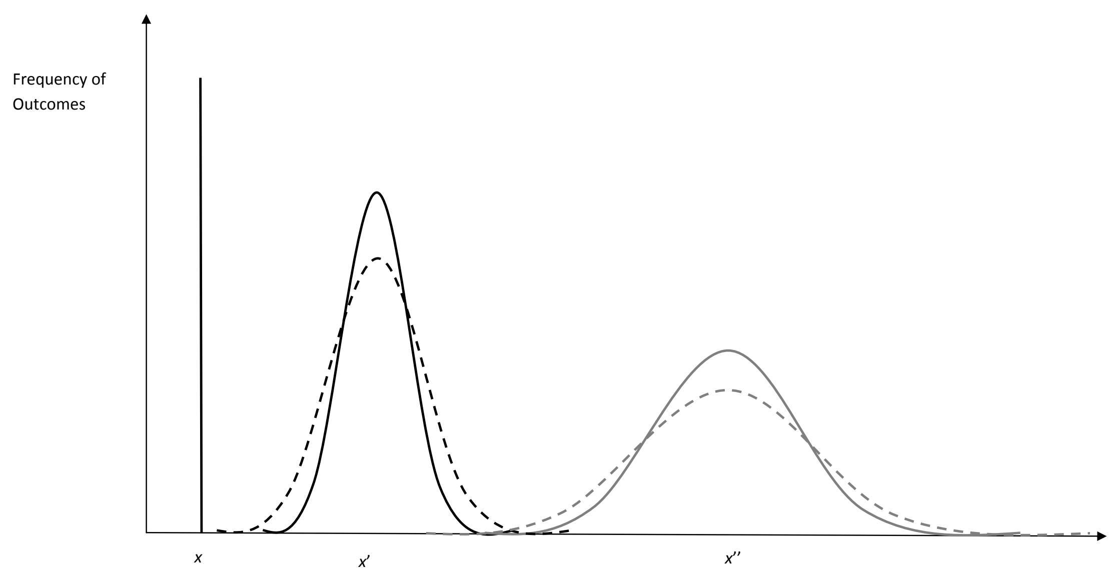
Second, I assume that the inferences other agents draw from observing the policy choices of others are limited and local. So the regulator cannot simply monitor the firm's actions that led to x and use that information to perfectly implement some other policy x'. Although the agency can observe some of the firm's actions that led to x, she does not know exactly how to modify them to get a distinct outcome. Formally, I assume that if any agent tries to implement *target outcome* x' after only observing x, the *realized outcome* is $x' + \omega$ where ω has mean zero and variance $|x - x'|\sigma^2$. This setup captures the notion that it is easier to implement outcomes that are closer to existing outcomes because the variance term is close to zero when x' is close to x. Moreover, the term σ^2 provides a handy index of complexity. When σ^2 is large, policymaking is complex in that moving from x to x' is more fraught with uncertainty. I call the information based on observing a policy choice *embedded*.

The assumptions about embedded information are presented in Figure 1. In this figure, regulatory outcome x was implemented by an expert agent. As there is no variance in this outcome, the frequency distribution is a spike at x. Now assume that non-expert agents

[14]Again it is important to distinguish between what I can regulatory outcomes and ultimate outcomes. That the firm can implement a regulatory outcome with zero error does not imply that there is no risk associated with final outcomes. Indeed, the perfect implementation of a regulatory outcome desired by the firm may create substantial risks for society.

attempt to implement two distinct outcomes x' and x'' with embedded information. The distributions of realized outcomes following these targets have positive variances. The solid black and gray lines denote the distribution of outcomes for targets x' and x'', respectively. Because the target outcome x'' is farther from x than x', the variation in the outcomes following its attempted implementation is much greater than that following x'. The dashed lines represent the effects of increasing σ^2 as the variation in outcomes for both x' and x'' increase. [15]

Figure 1: Regulatory Outcomes



To illustrate the assumptions of the model, consider another example from financial regulation. On May 6, 2010, the Dow Jones Industrial Average lost 900 points in a matter

[15] My approach is also related to Hirsch and Shotts (nd) and Lax and Cameron (2007) who assume that informed policymakers invest effort to produce higher quality policies (equivalent to low variance policies in my model). But none of these investments in information or quality are expropriable by other agents: if the policy proposal is amended the quality investment is lost. Wiseman (2009) also proposes a model of regulatory review where adjusting rules set by agency experts is costly. But in his model, the marginal cost of policy adjustment at the target policy is zero. So all agency rules are amended in equilibrium. In my model, however, the marginal cost of adjusting policy is always positive so that the agency may choose not to override the firm's decision.

of minutes. The belief that this "flash crash" was caused or exacerbated by high frequency trading led both regulators and the industry to consider new regulations including circuit breakers that would stop trading securities whose price has fluctuated too much. The exchanges and their private regulator Financial Industry Regulatory Authority (FINRA) moved first to formulate rules for such circuit breakers. The Securities and Exchange Commission (SEC) therefore had the choice of accepting the FINRA standards, modifying them in various ways, or developing different ones from scratch. In my model, accepting the FINRA standards leads to the regulatory outcome targeted by the industry. But modifying the proposal would lead to outcomes that are closer in expectation to the SEC's preferences, presumably a more aggressive set of circuit breakers. But because of the SECs limited expertise and capacity, changes in the target outcome may have unintended consequences. Requiring trading halts for smaller price changes may distort markets too much. So the SEC may be hesitant to change the FINRA proposal too much. Finally, my model assumes that the SEC would only develop a completely new proposal if it paid the cost for independent information.[16]

Given these preferences and specifications of independent and embedded information, I now describe the sequence of actions of agents in the model. These are represented graphically in Figure 2. In the first stage, the principal L chooses whether or not to allow the firm to engage in the activity in question. If L decides to ban the activity, the realized outcome has mean $q < 0$ and variance σ_q^2. Under this assumption, the ban is economically and politically inefficient. All of the actors in the model would prefer any target outcome $x < -q$ to a ban were it known how to implement it with a variance less than σ_q^2. Another interpretation of this choice is that it is a bright-line rule that can be implemented with considerably less information and bureaucratic capacity.

Alternatively, if L allows the activity, she must choose whether or not to create an

[16]In September 2010, the SEC adopted the FINRA rules. See http://www.sec.gov/news/press/2010/2010-167.htm, downloaded July 10, 2011.

agency to regulate the firm. If the principal creates the agency, she must pay a fixed cost κ. This cost reflects the resources of staffing and funding an agency. In the simplest version of the model, the ideal point of the new agency a is exogenous and known to the principal. I subsequently relax this assumption and allow the principal to directly influence the agency's preferences.[17] I label the three possible outcomes or regimes as *banned*, *regulated*, and *unregulated*.

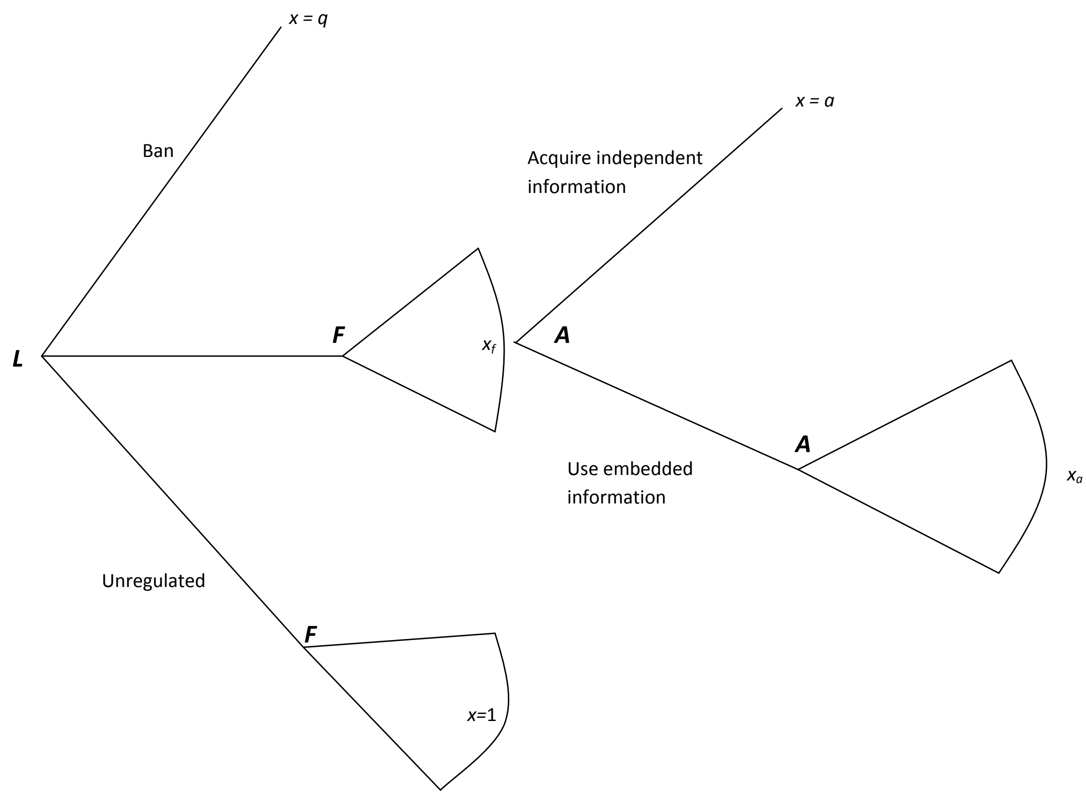
In the unregulated regime, the firm implements a regulatory outcome and the game ends. Because $c_f = 0$, the firm perfectly implements the regulatory outcome of its choice. Clearly, F chooses $x_f = 1$. Consequently, F earns a payoff of 0 and L gets one equal to -1.

Outcomes in the regulated regime are the most interesting. In this regime, A observes F's policy choice x_f and then has two choices. First, A may choose to pay c_a to obtain independent policy information. With this information, A can implement the policy outcome of its choice. Clearly, A uses this information to implement outcome $x = a$. Therefore, the payoffs when the agency is independently informed are $u_a = -c_a$, $u_l = -a^2$, and $u_f = -(1-a)^2$.

The agency's second option is to forgo the acquisition of independent information and target a different outcome based on embedded information. If the agency chooses to use embedded information, it understands that any attempt to implement a distinct target outcome $x \neq x_f$ leads to a random outcome with mean x and $|x - x^f|\sigma^2$.

[17]The exogenous agency preference model is most appropriate in one of two situations. First it may reflect the effects of the separation of powers where the legislature makes the decision of whether to create the agency but the executive retains the authority for staffing the agency. See McCarty (2004). Second, the assumption is consistent with the limiting case of perfect capture where the firm or some other outside interest controls the agency.

Figure 2: The Complex Policy Model



Given these beliefs, the agency's optimal use of embedded information is to choose x_a to maximize its expected utility. This expected utility can be written as: [18]

$$-(x_a - a)^2 - |x_f - x_a|\sigma^2$$

In words, A faces a crucial trade-off between increasing the utility of the target outcome and increasing the implementation variance. It can choose a target outcome x_a that is close to a in order to maximize its utility from the expected outcome (the first term in the expression). But if doing so involves a policy target far from x_f, the uncertainty about the policy outcomes increases (the second term).

[18] This derivation uses the fact that $E[(a - x - \omega)^2] = E[(a - x)^2] + var(\omega)$ (McCarty and Meirowitz 2006).

In the appendix, I show that A's optimal target outcome when it uses embedded information is to choose x_a equal to the maximum of $a + \frac{\sigma^2}{2}$ and x_f. Consider the first of these expressions, $x_a = a + \frac{\sigma^2}{2}$ is optimal when the firm's target x_f is much higher than A's ideal point. Here the agency uses embedded information to adjust the policy towards its ideal point. But due to the uncertainty involved in using only embedded information, the agency moves the target outcome only so far. It stops at exactly $a + \frac{\sigma^2}{2}$ so that the difference between the agency's ideal policy and the target policy is an increasing function of complexity σ^2.

If x_f is relatively close to the agency's ideal point so that $x_f < a + \frac{\sigma^2}{2}$, the agency does not have an incentive to move the outcome target at all. The utility of any movement towards the agency's ideal point is outweighed by the increase in policy variance.

Now that I have described how the agency uses (or fails to use) embedded information, I consider whether it has an incentive to acquire independent information. Here we have to consider the two cases described above: $x_a = a + \frac{\sigma^2}{2}$ and $x_a = x_f$.

In the first case, the agency's payoffs from embedded information are

$$-\frac{\sigma^4}{4} - |x_f - a - \frac{\sigma^2}{2}|\sigma^2$$

where the first term reflects the average policy distance from a, $\frac{\sigma^2}{2}$, and the second is the resulting policy variation. The payoffs to acquiring independent information (and implementing $x_a = a$) are $-c_a$. A simple comparison of these utilities reveals that A prefers independent information if and only if

$$a + \frac{c_a}{\sigma^2} - \frac{\sigma^2}{2} \leq x_f$$

This result reveals that the agency is more likely to choose independent information when the firm pursues an extreme policy and when its expertise costs c_a are low and complexity σ^2 is high.

Now consider the second case. Here $x_a = x_f$ so that A compares a utility $-(x_f - a)^2$ for embedded information with a utility of $-c_a$. So the agency prefers independent information if and only if $a + \sqrt{c_a} < x_f$. In this case complexity plays no part of the calculus (because embedded information is not actually used). But the effects of the firm's target outcome and the agency's expertise costs are the same as in the first case.

Having specified the agency's best response to the target outcome of the firm x_f, I now derive the firm's optimal target. Basically, the firm's choice boils down to three options. First, it could set a target so extreme that the agency decides to acquire independent information. Second, it could set a relatively extreme target that the agency might modify using embedded information. Or third, the firm might choose a policy that sufficiently accommodates the agency such that no regulatory revision is necessary.

It is easy to see that the first option is a losing proposition. It results in an outcome of a whereas I demonstrated above that the firm can always appease the agency by choosing a target strictly greater than a. So the firm will not provoke the agency sufficiently that it chooses to acquire independent information. That the second strategy never pays is just a little more subtle. Suppose the firm did choose some x_f in the expectation that the regulator would modify it to x_a. The expected outcome would be x_a but there would be variation in the realized outcome equal to $|x_f - x_a|\sigma^2$. But the firm could just as well have chosen x_a in the first place which would not be modified and would produce no uncertainty in implementation. Clearly, the latter choice dominates the former.

So it is clear that the firm would like to deter the agency from using either embedded or independent information. Therefore, the firm's outcome choice must satisfy both $x_f < a + \frac{\sigma^2}{2}$ (else the agency uses embedded information) and $x_f < a + \sqrt{c_a}$ (else the agency acquires independent information). Of course, the firm's best regulatory outcome that satisfies these constraints is the smaller of 1 and $a + min\{\sqrt{c_a}, \frac{\sigma^2}{2}\}$.

To simplify the notation in what follows, let $\theta = min\{\sqrt{c_a}, \frac{\sigma^2}{2}\}$ so that $x_f^* = min\{1, a + \theta\}$. The new term θ has an important interpretation. It reflects the deviation in the final target outcome that can be attributed to the firm's informational and expertise advantages. So henceforward I will refer to θ as the firm's information rent. It is important to note that this information rent is increasing in both the costs of independent information (reflected by c_a) and in the complexity of the policy (reflected by σ^2). Since the equilibrium policy target is $a+\theta$, the firm gains not only from the information rent but from a *preference rent* when the agency's ideal point is increased.

Finally, I can back up to the first stage of the game and analyze the legislator's decision to ban, regulate, or not regulate. Given that the regulatory regime produces $x_f^* = a + \theta$, the legislator's utility from creating the regulatory regime is $-\kappa - (a+\theta)^2$. Recall that the payoffs from banned and unregulated firms are $-q^2 - \sigma_q^2$ and -1, respectively. Consequently, L prefers regulation to non-regulation if and only if $\sqrt{1-\kappa} > a+\theta$ and a regulatory regime to a ban if and only if $\sqrt{q^2 + \sigma_q^2 - \kappa} > a+\theta$. So two factors make regulation less attractive than the ban or unregulated outcome: preference divergence from the agency, a, and the size of the firm's information rent. When the sum of these terms is high, regulation is less attractive. Of course, regulation is also less likely to emerge when the fixed cost of creating the regulatory regime, κ is large. If the regulatory approach is eschewed, the choice of a ban versus non-regulation depends exclusively on the comparison of the firm's ideal policy with the status quo outcome and variance. Clearly, if the ban is not too inefficient (q close to zero), the ban would be preferred. The same is true when the implications of the ban are well known so that σ_q^2 is low.

Table 1 summarizes the findings from the basic model by listing the payoffs to the actors as well as the final policy outcome for each of the regimes. For completeness, I include the payoffs and outcomes for regulation with independent information even though this situation does not occur on the equilibrium path.

Table 1				
Payoffs and Regulatory Outcomes				
Regime	**Principal**	**Firm**	**Agency**	**Target Outcome**
Banned	$-q^2 - \sigma_q^2$	$-(1-q)^2 - \sigma_q^2$	na	q
Unregulated	-1	0	na	1
Regulated - Independent Info	$-a^2 - \kappa$	$-(1-a)^2$	$-c_a$	a
Regulated - Embedded Info	$-(a+\theta)^2 - \kappa$	$-(1-a-\theta)^2$	$-\theta^2$	$a+\theta$

3 Proximity Learning

In the basic model, the ideal point of the agency a is an exogenous feature of the political environment. But in reality, the agency's preferences are influenced directly by both the legislator and the firm. In the baseline model, the preferences of the legislator and firm over the agency's ideal point are clear. L prefers $a = -\theta$ so that the preference rent and the information rent cancel out and generate a policy outcome of zero. So absent any other consideration, the legislator would like to delegate to an agency that is somewhat antagonistic to the firm. The firm, on the other hand, prefers a favorable agency with ideal point $a = 1$.[19]

But these diametrically opposed preferences over the agency's ideal point depend on a key assumption: that the agency's ability to use embedded information is independent of its ideal point. There are several theoretical and empirical reasons to doubt such an assumption. On theoretical grounds, it runs counter to the basic findings of models of strategic communication that predict that more information can be communicated when there is less preference divergence between the sender and receiver.[20] Although my model departs

[19]The firm's payoff is maximized at $u_f = 0$ for any agency preference such that $a > 1 - min\{\sqrt{c_a}, \frac{\sigma^2}{2}\}$.
[20]See Crawford and Sobel (1982) and Gilligan and Krehbiel (1987).

from the strategic communication framework, it seems reasonable to relax the assumption that learning is independent of preference divergence. A second reason is empirical. In many regulatory settings (especially financial market regulation), the regulators may share social, educational, and professional ties to the industry that both cause the regulators to sympathize with the industry and make it easier for the regulators to extract embedded information.

To capture these effects, I consider an extension of the model where the agency's ability to learn from the firm is a function of the preference distance of the agency from the firm. I capture this relationship by assuming that variance associated with amending policy x with x' (based on embedded information) is $h(|f-a|)|x-x'|\sigma^2$ where $h(\cdot)$ is an increasing, convex function. I label this effect *proximity learning* because the agency learns more from the firm's actions the more proximate its preferences are to those of the firm's. This idea can be captured visually by returning to Figure 1. Now I assume that the solid curves represent the information about the consequences of policy change for an agent close to the firm and that the dashed curves represent the beliefs of an agency far from the firm. To simplify the analysis, I assume that the cost of independent information c_a is sufficiently high that the agency never chooses to acquire it.[21]

The agency's problem is solved exactly as before by maximizing its expected utility function that includes the negative of the sum of the expected outcome distance and the outcome variance. The agency's optimum is now:

$$x_a = min\{a + h(1-a)\frac{\sigma^2}{2}, x_f\}$$

[21] Although I have only considered proximity learning effects related to embedded information, proximity effects of independent information can be modeled by allowing the expertise cost to decline with the proximity of the agency to the firm. The results of that model are qualitatively similar to those discussed here.

Just as above, the firm has an incentive to deter a regulatory adjustment by choosing

$$x_f = a + min\{h(1-a)\frac{\sigma^2}{2}, 1-a\}$$

This solution is very similar to that above, only now the information rent is given by $h(1-a)\frac{\sigma^2}{2}$. From the firm's perspective, a more sympathetic agency is something of a mixed bag. On one hand, the agency is more likely to tolerate outcomes close to the firm's ideal point. But on the other hand, the firm's information rent is decreasing in a (because $h(\cdot)$ is an increasing function). In fact, if the marginal effect of preference proximity on the outcome variance is large enough, the firm gets a worse outcome when a moves toward its ideal point. The intuition is that under such circumstances the information rent dissipates much faster than the agency's ideal point increases. But beyond some point, the firm benefits unambiguously from a sympathetic agency as an agency close to its ideal point accepts $x_f = 1$. But the firm is always weakly worse off with an agency whose ability to use embedded information increases with preference proximity to the firm.

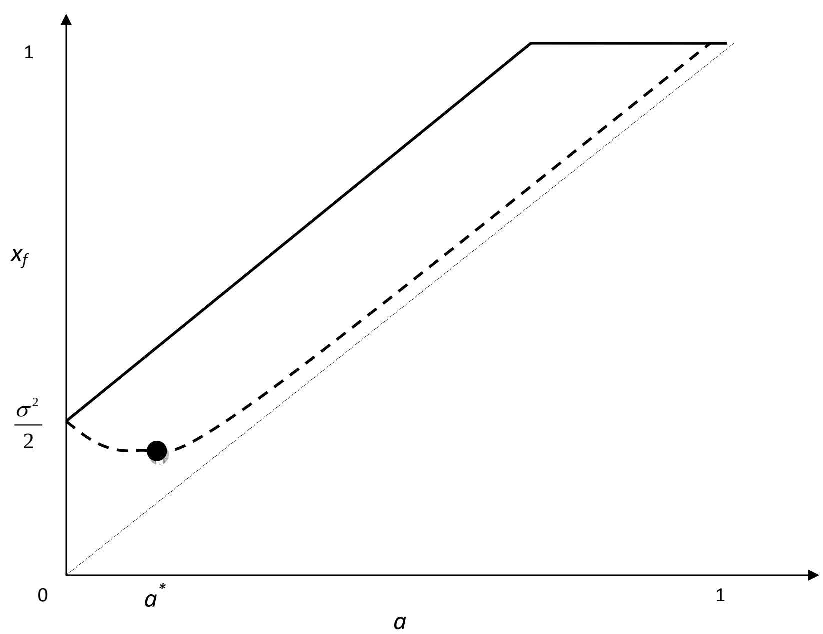
The situation for the principal is just the opposite. By allowing A's preferences to move in the direction of the firm, the principal gains from dissipating the information rent at the loss of its own preference rent. So if the informational effect of preference proximity is large enough, the principal would prefer to create an agency closer to firm's ideal point.

Figure 3 illustrates the policy outcomes for various assumptions about the proximity learning effect. The solid line represents the baseline case where there is no proximity learning effect. In this case, the information rent is constant for all agency ideal points a (plotted on the horizontal axis). Therefore, the policy outcome (plotted on the vertical axis) is parallel to the 45° line (the thin dotted line that represents $x_a = a$) until the policy reaches 1 where it remains for all higher values of a.

The thicker dashed line represents the policy when there is a proximity learning effect.

The learning effect is represented by the decreasing gap between the dashed line and the 45° line. In this case, the information rent dissipates sufficiently fast for low values of a that policy moves toward the legislator's ideal point. Clearly, the principal would prefer an agency located at $a^\star$ the position corresponding to the minimum policy outcome (denoted by the black circle) to one located at her ideal point of 0. I should further note that proximity learning weakly advantages the principal for all values of a. Therefore, the existence of proximity learning effects makes it more likely that the L prefers a regulatory regime to a ban or the unregulated outcome.

Figure 3: Policy Outcomes with Proximity Learning Effect



That the principal may prefer an agency that leans toward the preferences of the firm has implications for our thinking about regulatory capture. An agency whose preferences are more aligned with the regulated firm than those of the legislative principal need not be evidence of capture. In fact, my model suggests just the opposite. In the case illustrated in Figure 3, the firm would be better off with the larger information rent that comes from $a = 0$ than it is when the agency is located at $a^{\star}$. So in evaluating the extent of capture, it is important to distinguish optimal agency designs which account for complexity from more illicit forms of capture.[22] My results nicely complement those of Carpenter (2004) who argues that in the context of product approval consumer welfare may be enhanced by a regulator who appears biased towards the incumbent firms in the industry.

4 Capture

The previous section provides an informational rationale for an agency biased somewhat towards the preferences of the firm. But clearly the firm often has incentives to increase the bias well beyond what the principal would tolerate. The firm would have strong incentives to influence the ideal point of the agency. The firm may pressure the president to appoint an agency head sympathetic to the firm and oppose the confirmation of someone who is not. But much of what firms do is to incentivize the agency to make policy choices that are more favorable to the firm without directly influencing the agency's policy preferences. In this section, I consider a simple extension of the model where the firm may transfer resources to the agency in exchange for not interfering with the firm's policy choices. Although it may be natural to think of these transfers as bribes, they can take many less questionable and more legal forms such as the creation of expectations for future employment of the regulators and political support for the agency in the legislature.

In this extension, the firm offers a transfer schedule $t(x_f)$ that specifics resources transfered to the agency if it accepts firm policy proposal x_f. I assume that the firm has all the power in this influence market so that it can make a take-it-or-leave-it offer. As I show in

[22] Boehmke, Gailmard and Patty (2005) also provide a rationale for delegating to a agent that is more sympathetic to the firm than is the principal. The underlying mechanism is quite different, however. In their model, the decision of the firm to lobby the legislature rather than a favorably biased agency sends a stronger signal that the state of the world is one where the firm and legislature share policy goals.

the appendix, the optimal transfer schedule would be

$$t(x_f) = \begin{cases} 0 & \text{if } x_f \leq a + \theta \\ (x_f - a)^2 - (x_f - a)\sigma^2 + \frac{\sigma^4}{4} & \text{if } x_f > a + \theta \end{cases}$$

This schedule assumes that if the agency rejects the offer and adjusts policy, it does so optimally by setting policy to $a + \theta$ based on embedded information. Now I must consider whether the firm is willing to provide the required resources. So assume that the firm maximizes its policy utility minus the transfers paid out. Again, I prove in the appendix that the firm's target policy is

$$x_f = \begin{cases} \frac{1+a+\theta}{2} & \text{if } 1 > a + \theta \\ 1 & \text{if } a + \theta \geq 1 \end{cases}$$

and the equilibrium level of transfers are

$$t(x_f) = \begin{cases} \frac{(1-a+\theta)^2}{4} - \theta(1-a) & \text{if } 1 > a + \theta \\ 0 & \text{if } a + \theta \geq 1 \end{cases}$$

Two features of this equilibrium are noteworthy. First, whenever the "no capture" outcome is $a + \theta$ implemented on embedded information, the firm uses transfers to move the outcome to $\frac{1+a+\theta}{2}$ which happens to be the midpoint between the firm's ideal points and the equilibrium policy in the game without transfers. Therefore, the overall regulatory outcome continues to be an increasing function of the information rent.[23]. Second, the level of the transfer depends on the information rent. When the information rent is large, the payment is lower. So the complexity of the policy benefits the firm through lower transfers

[23]It is important however to know that the distortion in regulatory policy caused by the transfers $\frac{1+a+\theta}{2} - (a + \theta)$ decreases in the information rent. This result is true precisely because the firm does so well in the model without transfers when this rent is large.

and better policy outcomes. So this model suggests the possibility of a strong link between policy complexity and regulatory capture.

A feature of this capture model is that the transfers are easy to detect by the principal. If the principal observes the agency's ideal point and the policy outcome, she can infer that a transfer occurred whenever $x > a + \theta$. So if the principal has sanctions at her disposal, the capture equilibrium may unravel. A more interesting scenario, therefore, involves the case where the agency takes unobserved policy actions. In such cases, the principal may not be able to perfectly detect capture, but can only draw inferences about whether it occurred from the realized outcomes.

A full analysis of the model when agency actions are unobservable to the principal is beyond the scope of this chapter. So instead I limit myself to a few observations about the effects of policy complexity on the ability of the principal to monitor the agent. Complexity makes monitoring for capture harder for two reasons. The first is that as σ gets larger it is harder for the principal to discriminate between bad realizations of a policy outcomes by a non-captured agency and an extreme policy chosen to favor the industry.[24] In turn, the loss of this ability to discriminate means that the principal must cut the agency more slack which in turn dulls to the agency's incentives to avoid capture.

A second effect enhances the first. In the model, agency target policies close to x_f have lower outcome variation than more distant ones. This feature has the effect of reducing the likelihood of extreme outcomes when the agency caters to the firm. This provides extra insurance against the sorts of outcomes that might elicit suspicion and sanctions from the principal. In other words, the agency may be able to use embedded information to cover its tracks. Clearly, this incentive makes the agency more susceptible to capture.

In summary, policy complexity makes capture easier.

[24] This variance effect is explored in more detail in Huber and McCarty (2004).

5 Conclusions

Dramatic outcomes such as the financial crash and the blowout of British Petroleum's Deepwater Horizon well have resurfaced perennial questions about the undue influence of economic interests over their regulators. But as many chapters in this volume point out, "capture" is not a constant. Some agencies are clearly dominated by the interests they are supposed to regulate while others pursue their mandate remarkably well in spite of well organized opposition. A second theme of this volume is that industry influence and participation in the regulatory process is not always a bad thing and does not always deserve the capture sobriquet.

In my chapter, I have explored both of these themes in relation to the role of expertise and complexity. The simple model of regulatory policymaking in complex environments should help both to understand when we should expect industry to be disproportionately influencesd as well as the conditions under which industry influence can or cannot be justified in terms of democratic control of the agency.

My basic model highlights that the regulated firm may benefit from two sources of rent. The first is the preference rent in which an agency with preferences sympathetic to the firm tolerates the activities favored by the firm. The second is an informational rent in which the agency's dependence on the firm for information forces it to tolerate policies that the firm finds advantageous.

Even in the baseline case, my model argues that policies in complex domains will be biased towards the preferences of the firm. But an extension of the model also suggests that the legislative principal may have incentives to bias the preferences of the agency even more towards that of the firm if doing so raises the agency's ability to extract information. Consequently, substantial pro-firm biases may be part of an "optimal" regulatory design and be fully consistent with democratic control of the agency. This argument has implications for how social scientists conceptualize and measure “capture” as well as arguments for the appropriate design of agency procedures and human resource policies.

Although a pro-firm bias may be optimal in complex policy settings, the model also suggests that complexity does indeed make agencies more prone to capture. In the model where agency policy targets are observable, complexity reduced the optimal transfer that a firm would pay to shift policy toward its preferences. In the unobservable target case, a variance effect combined with an insurance effect makes undue firm influence harder to detect by the legislative principal. Of course, these provides additional slack for the agency to succumb to industry influence.

Ultimately, I hope the framework I have sketched here is useful in thinking about when exactly regulatory approaches will be the the best approach to policy problems. In complex policy environments, information rents to the firm may be so substantial that the optimal policy response is to forsake regulation for non-regulation, bright-line rules, or a ban. The additional opportunities for capture in complex settings only enhance the incentives for these blunter policies.

6 Appendix

Proposition 1. *The unique subgame perfect Nash equilibrium to the regulation regime involves*

$$x_f^* = \begin{cases} a+\theta & \text{if } a+\theta < 1 \\ 1 & \text{if } a+\theta \geq 1 \end{cases}$$

where $\theta = min\{\sqrt{c_a}, \frac{\sigma^2}{2}\}$. *A accepts this policy proposal.*

Proof. I begin with A's best use of embedded information following x_f. Clearly, choosing $x_a > x_f$ is a dominated strategy. So A chooses x_a to maximize

$$-(x_a - a)^2 - |x_f - x_a|\sigma^2$$

subject to $x_a \leq x_f$.

The Kuhn-Tucker necessary conditions for this optimization problem are

$$x_a = a + \frac{\sigma^2}{2} - \frac{\lambda}{2}$$

$$\lambda(x_f - x_a) = 0$$

$$\lambda \geq 0$$

$$x_a \leq x_f$$

where λ is the multiplier on the constraint. The only solution is

$$x_a^*(x_f) = \begin{cases} a + \frac{\sigma^2}{2} & \text{if } a + \frac{\sigma^2}{2} < x_f \\ x_f & \text{if } a + \frac{\sigma^2}{2} \geq x_f \end{cases}$$

Because the objective function is strictly concave, the solution is a maximum.

Inserting this solution into A's utility function, one finds that the agency's payoffs from embedded information are

$$-(x_f - a)^2 \text{ if } a + \frac{\sigma^2}{2} \geq x_f$$
$$-\frac{\sigma^4}{4} - |x_f - a - \frac{\sigma^2}{2}|\sigma^2 \text{ if } a + \frac{\sigma^2}{2} < x_f$$

Now consider the acquisition of independent information. Because the agency always targets its ideal outcome with independent information, its payoffs from independent information are $-c_a$. Therefore, it prefers accepting the firm's target policy to acquiring independent information if $-(a - x_f)^2 \geq -c_a$ or $x_f \geq a + \sqrt{c_a}$. From above, we know that the agency prefers embedded information to both accepting x_f and acquiring independent information if $-\frac{\sigma^4}{4} - |x_f - a - \frac{\sigma^2}{2}|\sigma^2 \geq -c_a$ or $x_f \geq \frac{c_a}{\sigma^2} + \frac{\sigma^2}{4}$.

Summarizing these two conditions, the agency therefore prefers independent information if and only if

$$a + \frac{\sigma^2}{2} > x_f > a + \sqrt{c_a}$$
$$x_f > a + max\{\frac{\sigma^2}{2}, \frac{c_a}{\sigma^2} + \frac{\sigma^2}{4}\}$$

Now I turn to F's best response given $x_a^*(x_f)$. First, I argue that F never chooses x_f so that A uses embedded information. Suppose F chooses x_f such that $a + \frac{c_a}{\sigma^2} + \frac{\sigma^2}{4} > x_f > a + \frac{\sigma^2}{2}$ (the only case where embedded information would be used). Then A chooses $a + \frac{\sigma^2}{2}$ and F's payoff is $-(1 - a - \frac{\sigma^2}{2})^2 - (x_f - a - \frac{\sigma^2}{2})\sigma^2$. This is lower that the utility of proposing $x_f = a + \frac{\sigma^2}{2}$ which is accepted and generates a payoff of $-(1 - a - \frac{\sigma^2}{2})^2$.

Now I claim that the firm will not to induce the agency to acquire independent information. There are two possible cases. First, suppose F chooses x_f such that $a + \frac{\sigma^2}{2} > x_f > a + \sqrt{c_a}$. This generates an outcome of a with certainty which generates a lower utility than $x_f = a + \sqrt{c_a}$ which is accepted by the agency with certainty. Second, suppose F chooses $x_f > a + max\{\frac{\sigma^2}{2}, \frac{c_a}{\sigma^2} + \frac{\sigma^2}{4}\}$. This results in a policy of a and is dominated by $x_f = a + max\{\frac{\sigma^2}{2}, \frac{c_a}{\sigma^2} + \frac{\sigma^2}{4}\}$ which is accepted with certainty.

Because the firm does not induce the agency to use either form of information, x_f must be lower than both $a + \sqrt{c_a}$ and $a + \frac{\sigma^2}{2}$ so that $x_f \leq a + \theta$ where $\theta = min\{\sqrt{c_a}, \frac{\sigma^2}{2}\}$. The optimality of x_f^* follows.

□

Proposition 2. *With proximity learning, the unique subgame perfect Nash equilibrium to the regulation regime involves*

$$x_f^* = \begin{cases} a + \theta & \textit{if } a + \theta < 1 \\ 1 & \textit{if } a + \theta \geq 1 \end{cases}$$

where $\theta = h(1-a)\frac{\sigma^2}{2}$. A accepts this policy proposal. The optimal location of the agency's ideal point from the perspective of L is solves either $h'(1-a^*)\sigma^2 = 1$ or $a^* + h(1-a^*)\sigma^2 = 0$.

Proof. With proximity learning the outcome variance associated with embedded information has been rescaled by $h(1-a)$. Because this term does not depend on x, all of the Kuhn-Tucker conditions are identical when $h(1-a)\sigma^2$ replaces σ^2.

The principal would like to select the agency ideal point that sets x_f^* as close to zero as possible. There are two possible cases. First, assume that $a + h(1-a)\sigma^2 le0$ for some a. Then by continuity, there exists a^* such that $a^* + h(1-a^*)\sigma^2 = 0$. The principal implements her ideal point by choosing this agency ideal point. Such a possibility would be ensured if the proximity learning effects were small such that $h'(\cdot)\sigma^2 < 1$.

Now consider the case where $a + h(1-a)\sigma^2 > 0$ for all a. The legislator's first order condition is $-2(a + h(1-a)\sigma^2)(1 - h'(1-a)\sigma^2) = 0$. Since $h(\cdot)$ is strictly convex, $h'(1-a^*)\sigma^2 = 1$ defines a global maximum since $a^* + h(1-a^*)\sigma^2 > 0$.

$\square$

Proposition 3. *In the capture model, the firm's target outcome is*

$$x_f = \begin{cases} \frac{1+a+\theta}{2} & \text{if } 1 > a+\theta \\ 1 & \text{if } a+\theta \geq 1 \end{cases}$$

and the equilibrium transfers are given by

$$t(x_f) = \begin{cases} \frac{(1-a+\theta)^2}{4} - \theta(1-a) & \text{if } 1 > a+\theta \\ 0 & \text{if } a+\theta \geq 1 \end{cases}$$

Proof. I begin by computing the transfers necessary for the agency to accept a given firm policy outcome rather than amend the policy using embedded information. From above, we know that the firm's utility from using embedded information to amend x_f is given by $-\frac{\sigma^4}{4} - |x_f - a - \frac{\sigma^2}{2}|\sigma^2$. So the agency is willing to accept x_f and transfer $t(x_f)$ if $-(a-x_f)^2 + t(x_f) \geq -\frac{\sigma^4}{4} - |x_f - a - \frac{\sigma^2}{2}|\sigma^2$. This will hold whenever

$$t^*(x_f) = \begin{cases} 0 & \text{if } x_f \leq a+\theta \\ (x_f-a)^2 - (x_f-a)\sigma^2 + \frac{\sigma^4}{4} & \text{if } x_f > a+\theta \end{cases}$$

Now we must compute the optimal policy target x_f given $t^*(x_f)$. The firm must maximize $-(1-x_f)^2 - t^*(x_f)$. In the case where $a+\theta \geq 1$, $t^*(1) = 0$ so the firm's optimal is clearly $x_f = 1$. When $a+\theta < 1$, the firm maximizes $-(1-x_f)^2 - (x_f-a)^2 + (x_f-a)\sigma^2 + \frac{\sigma^4}{4}$. The first order condition is $2(1-x_f) - 2(x_f-a) - 2\theta = 0$. So the firm's optimal target outcome is $\frac{1+a+\theta}{2}$.

$\square$

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