Misreporting and Regulatory Incentives

Aneesh Raghunandan*

Stanford University

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Abstract

I develop a model of regulatory behavior as it relates to earnings management. There is a self-interested regulator who may or may not wish to revolve to a higher-paying private-sector job. Whether or not he wants to do so, as well as his talent level and available resources, is his private information. The two types of regulators (revolvers and non-revolvers) face different decision problems. Revolvers would like to catch as much earnings management as possible in order to establish a track record (regardless of how much goes undetected). By contrast, non-revolvers would like for there to be as little undetected earnings management as possible, as this reflects poorly on them. I show that, unlike in the case with only one dimension of information asymmetry, there is a nontrivial disclosure equilibrium where the regulator reveals information for certain amounts of available resources. Despite the presence of the revolving door, allowing the regulator to selectively disclose leads to lower overall ex-ante expected earnings management.

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1 Introduction

Regulators' actions, both realized and potential, play a significant role in firms' reporting decisions. In particular, enforcement is likely to (at least partially) deter earnings manipulation. Consistent with this idea, Leuz et al. (2003) provides empirical evidence that earnings management is more prevalent in countries with weak enforcement. Moreover, enforcement varies both across countries and within; Costello et al. (2015) finds that when a strict regulator takes over from a weak one, banks are forced to restate financial reports more frequently, consistent with the idea that firms engage in more misreporting when enforcement is weak. These studies show that stricter enforcement by a regulator has the dual effects of ceteris paribus more manipulation being detected and also of deterring manipulation in the first place. As a result, in equilibrium, regulators can affect the level of manipulation that goes undetected both by choosing the level of enforcement and also by signaling future enforcement intensity to firms. Credible signaling is necessary since firms are inherently uncertain about regulators' ability to detect manipulation and their incentives to make enforcement a priority. In this paper, I study a parsimonious model of regulators' behavior and firms' manipulation decisions that captures the strategic interaction between regulators and firms. I characterize the equilibrium behavior when firms are uncertain about regulatory incentives, ability and available resources to support enforcement actions.

Recent empirical work on the revolving door phenomenon has shown that regulators significantly differ in their incentives to detect and deter misconduct. One takeaway from such studies is that not all regulators seek to revolve, but that those who do behave in fundamentally different ways. For example, Lucca et al (2014) find that more bank regulators revolve during periods of high enforcement, perhaps in part due to the ability to demonstrate a stronger track record. In the context of earnings management, DeHaan et al. (2015) find that SEC lawyers who revolve tend to pursue more aggressive enforcement actions; this can be interpreted as the regulator "showing off" in order to attract private-sector attention. This type of behavior can extend all the way to the top of an agency, as in the case of several recent SEC heads. For example, former SEC chairman Christopher Cox declared enforcement to be the SEC's top priority.[1] A lawyer by trade, Cox's ability to revolve to a prominent law firm (which he ultimately did) was likely aided by strong performance as head of the SEC. Cox's successor Mary Schapiro also spoke of a focus on aggressive enforcement, and the SEC under her tenure brought about a record number of enforcement actions.[2] Schapiro leveraged her accomplishments and expertise to revolve to Promontory Financial Group, a well-known consulting company that "steers banks and other firms through regulatory scrutiny".[3]

In the model, I capture the consequences of the revolving door phenomenon for regulators' enforcement actions and firms' manipulation decisions by allowing regulators to be one of two (unobservable) types: revolvers and non-revolvers. Revolvers seek to obtain private sector employment following their term as a regulator. In order to obtain lucrative offers, revolvers try to signal their ability by catching as much manipulation as possible. Revolvers' incentives are therefore tied to the amount of manipulation they detect. By contrast, non-revolvers' main concern is the amount of manipulation that goes undetected. Whether a regulator is a revolver or a non-revolver is initially unobservable to firms. In equilibrium, firms will therefore form conjectures about regulators' incentives in order to

[1] `https://www.sec.gov/news/speech/spch111105cc.htm`

[2] `https://www.sec.gov/news/press/2012/2012-240-accomplishments.htm`

[3] Source: `http://dealbook.nytimes.com/2013/04/02/after-running-s-e-c-schapiro-becomes-bank-consultant/`. Note that another former SEC chair, Arthur Levitt, also took a post-SEC job at Promontory. However, Levitt joined Promontory in 2006, five years after leaving the SEC, while Schapiro went directly from the SEC to Promontory in 2013. Source for Levitt: `http://www.bondbuyer.com/news/-246327-1.html`

assess the probability of being caught if they choose to manipulate reported earnings.

Specifically, in the model, the firm may choose to manipulate earnings in order to obtain a higher valuation of its equity in the capital market. However, if the firm's earnings manipulation is detected by a regulator, the firm must pay a fine. The regulator in turn chooses his level of enforcement upon observing the firm's reported earnings. Regulators may choose different levels of enforcement for various reasons: they may differ in their ability to detect manipulation, their benefits from detecting manipulation (revolver vs. non-revolver) and the resources available to them. In order to capture the deterrence effect of future enforcement actions, I allow the regulator to make a (truthful) ex-ante disclosure about available resources. That is, the regulator takes two actions in the game: an ex-ante (voluntary) disclosure and an ex-post choice of enforcement level. In practice, disclosure of available resources may represent the level of detail provided in a regulator's mandatory disclosures. For example, SEC budget proposals and justifications have varied significantly in size and detail in recent history: from 2006 to 2013, SEC budget proposals ranged from 35 to 82 pages in length[4] with longer proposals providing more detail over proposed hiring and enforcement focuses..[5] Additionally, a more detailed proposal is likely to better stand up to legislative questioning and receive fewer modifications, i.e., the initial budget estimate resulting from a more detailed proposal is likely to be a lower-variance estimate of the finalized budget.

The model predicts that available resources are not always disclosed in equilibrium. Firms' three-dimensional uncertainty about the regulator's incentives (ability, resources and revolver/non-

[4] `https://www.sec.gov/about/budgetreports.shtml`

[5] Budget proposal size as well as the ratio of agency budget to proposal size have both been used as proxies for ambiguity in government organizations (Meier (1980), Chun and Rainey (2005))

revolver) prevents unraveling in equilibrium. Generally speaking, non-revolvers make a disclosure when available resources are high in order to deter manipulation while revolvers make a disclosure when available resources are low in order to increase manipulation and therefore increase their chance in detecting such manipulation. The disclosure regions of revolvers and non-revolvers are mutually exclusive in the sense that there is no region on which both types disclose; additionally, there could be intermediate resource levels that are not disclosed by either type. In practice, these disclosures come in many shapes and sizes; one example of such a disclosure by a subsequent revolver comes from Chairwoman Mary Schapiro,[6] who in February of 2011 publicly bemoaned a budget freeze and the negative impacts it would have on the SEC's availability to do its job.

The regulatory disclosure decision is complicated by the link between a regulator's type and his incentives to disclose available resources. A revolver's goal is for firms to manipulate as much as possible (so that he can catch them in the act), and to this end he would like for the firm to believe that he has little resources to work with but also that he does not have the added incentives to detect manipulation from seeking to signal his ability to the private sector. Conversely, the non-revolver would prefer to minimize the amount of undetected manipulation in the economy, and so he would like for the firm to believe that he has ample resources but also that he has strong incentives to detect manipulation due to the incentive provided by the revolving door. Nevertheless, in equilibrium, the disclosure strategy is such that disclosing available resources fully reveals the regulator's incentives. That is, the regulator is forced to settle for a second-best solution: while the regulator would prefer to disclose beneficial resource amounts and simultaneously either convince the firm that he is of the opposite type to his own or to preserve uncertainty, disclosure

[6]`http://www.washingtonpost.com/wp-dyn/content/article/2011/02/04/AR2011020406792.html`

along one dimension causes unraveling among the other.

In addition to characterizing regulators' disclosure behavior, I use the model to analyze the level of (undetected) earnings manipulation and find that allowing selective disclosure on the regulator's behalf leads to an ex-ante reduction in expected manipulation by the firm relative to the case where disclosure always occurs (whether mandated or as a result of unraveling). Finally, I also examine the effect of prohibiting regulators from obtaining private-sector jobs in related industries after finishing their term as regulator. Various policy initiatives have aimed at curbing regulators' ability to switch to certain jobs or firms shortly after leaving the regulatory agency.[7] However, in the model, incentives provided by the revolving door both increases the amount of detected manipulation but also decreases the amount of undetected and total manipulation. Based on this analysis, curtailing regulators' incentives from revolving doors may be counter-productive.

The paper contributes to the literature in three ways. First, in the context of financial reporting, the regulatory environment can be thought of comprising two (very broad) parts: agreed-upon reporting and disclosure rules as well as a set of punishments and enforcement policies to levy for rule violations. When firms choose to violate a rule, the decision to do so is driven in part by potential (feasible) punishments as well as the expected probability of being caught. This is the cost of engaging in earnings management. Most theoretical work on misreporting and earnings management assumes the cost structure of engaging in manipulation is known and focuses on the mechanics of the payoff structure in various settings (see Chapter 6 of Ronen and Yaari's (2008) book for an overview).[8] My model

[7] A detailed list, broken down by state, is available at `http://www.ncsl.org/research/ethics/50-state-table-revolving-door-prohibitions.aspx`

[8] One recent exception to this is Nagar and Petacchi (2014), who focus on how a regulator's budget constraint can affect firms' expected costs of earnings manipulation. Their paper, however, does not assume

seeks to endogenize the costs of manipulation by modeling not only the firm but also the regulator as strategic players with costly actions.

Second, my model contributes to the disclosure literature be examining a voluntary disclosure setting in which partial disclosure occurs due to unknown incentives of the disclosing party. While Einhorn (2007) also analyzes a disclosure decision where a strategic sender may aim to either suppress or increase receivers' beliefs, her capital market setting is such that the disclosure strategy of both sender types is characterized by a single threshold. Senders who aim to suppress receivers' beliefs disclose values that are less than the threshold and withhold values that are higher than the threshold while the reverse is true for senders who aim to increase receivers' beliefs. In contrast, in the equilibrium of my model, the disclosure threshold of revolvers generally differs from that of non-revolvers. As a result, there are values that are never disclosed (i.e., from neither revolvers nor non-revolvers). This is because of the additional degree of freedom in my model introduced by the payoff premium regulators obtain from revolving to private practice, in contrast with Einhorn's identification requirement that the cutoff threshold be the same for both types.

Third, my paper adds to the literature on regulatory capture. While there is an extensive literature on both the theory and empirical evidence of regulatory capture (e.g., Che (1995), Kane (1989), Brown and Dinc (2005)) the literature has not examined the implications of incentives such as the revolving door on regulators actions other than the immediate enforcement action. My model studies how regulatory capture affects regulators' disclosure

that the regulator's personal incentives affect the firm's behavior, as they instead focus on the effects of multiple firms interacting strategically. By contrast, I focus on a one-firm, one-regulator model in which both regulator and firm have individual strategic incentives and costly actions. This allows me to study both how firms believe a regulator will act and how a regulator might behave based on a firm's anticipated responses to any policies he chooses to enact.

decisions, thereby providing a potential explanation of empirically observed variation in the level of detail in regulators' disclosures in both more formal (e.g., budget proposals) and less formal (e.g., speeches) settings.

The paper proceeds as follows. Section 2 describes relevant literature from accounting, economics, and political science. Section 3 introduces the model. Section 4 characterizes the unique equilibrium of the base model, providing a sufficient condition for this equilibrium to involve partial disclosure. Section 5 provides some comparative statics and compares the implications of the model to the baseline case of unraveling. Finally, Section 6 concludes.

2 Related Literature

I draw from a variety of literatures spanning accounting, economics, and political science. I assume the firm follows a rational-expectations decision process which results in constant and perfectly anticipated manipulation, similar to Stein (1989). While introducing more uncertainty along this dimension would make the model more realistic, doing so unnecessarily complicates the model without substantially altering the main result. As such, I use the most basic possible form of earnings management, and do not draw upon later studies using this type of framework with more complexity (Dye and Sridhar (2004), Fischer and Verrecchia (2000), etc.).

I model the regulator's decision problem as one of voluntary disclosure, drawing upon the insights in works such as Dye (1985) and Jung and Kwon (1988). My model differs from theirs, however, in that I do not use uncertainty about the existence of private information as the mechanism to prevent unraveling; rather, I use uncertainty about the regulator's incentives. Most models in finance and economics involving explicit regulatory behavior assume the structure of the regulator's incentive is known, i.e., the quantity he wishes to minimize or maximize is known (as well as whether or not he wishes to minimize or maximize it). For example, Glaeser (2001) models prosecutors who take actions in criminal cases in part due to private career benefits. However, prosecutors have much less influence over individuals' propensities to commit crime than regulatory agencies do over firms' decisions to engage in earnings management. Further, Glaeser's model is more concerned with the allocation of various cases to federal or state attorneys based on their expected outcomes; the idea that a prosecutor would want to send signals of weakness is not a feature of this model. In my setting there is a more direct linkage between the signals the regulator sends and firms' subsequent propensities to engage in earnings management.

The notion of uncertain incentives (in this case "maximize or minimize?") has been studied in the accounting literature in the context of stock price manipulation by managers. Einhorn (2007) considers a manager who may wish to temporarily depress the price of his firm to coincide with granting stock options. The equilibrium structure of my model is similar to hers. Specifically, in Einhorn's model, managers receive a signal unrelated to their type (inflator or deflator) and may then choose to disclose (truthfully) or withhold these signals. Einhorn shows that when there is no uncertainty about incentives unraveling occurs, but under uncertainty there is a partially-revealing equilibrium with a threshold structure: deflators disclose when their signal is below the threshold and inflators disclose when their signal is above. The structure of the equilibrium in my model is slightly different – there are potentially two thresholds $y_R \leq y_N$ such that revolvers disclose their private signals y when $y \leq y_R$ and non-revolvers disclose only when $y \geq y_N$. In other words, the main mechanical difference between the equilibrium structure in my model and in Einhorn's (2007) model is the potential for an interval on which neither type wishes to disclose.

My approach to the revolving door phenomenon follows from previous models in the literature. Che (1995) details two main potential settings for the revolving door to exist, which he calls the "contracting" and "monitoring" settings.[9] Similar to Che's monitoring case, I assume that the firm the regulator is tasked with overseeing and the entity the regulator may wish to revolve to are distinct, and only explicitly model the firm that the regulator oversees. In the context of accounting manipulation and the SEC, this assumption makes more sense than collusion between regulator and overseen firm; SEC regulators oversee a broad range of industries, but are three times more likely (deHaan et al (2015)) to revolve to legal positions due to the nature of their jobs.[10]

3 Model

Voluntary disclosure models must somehow resolve the potential for unraveling. One common assumption (e.g., Dye (1985)) is that the "informed" party may actually receive no information with some positive probability. By contrast, my model assumes that the "informed" party always receives information, but avoids unraveling by providing a plausible setting in which the informed party's incentives are unknown. This is the main difference between my paper and previous papers. While mine is not the first study to assume unknown incentives, most studies assume the form of the informed party's problem is invariant. For example, it may be known that the informed party wishes to maximize $f(x, \eta)$

[9] Contracting refers to the case where the relation between regulator and firm is one of procurement; an example of this would be the relationship between Department of Defense officials and defense contractors such as Northrop Grumman. By contrast, monitoring refers to the case where the relation between regulator and firm is one of oversight; examples of such staff might include employees of the SEC or Federal Reserve.

[10] One can think of a three-agent model (regulator, overseen firm, law firm) that explicitly models the relation between the law firm, its potential new hire the regulator, and its potential client the formerly-overseen firm. But the mechanics of such a model are significantly more complicated without significantly altering the model's main results.

with respect to x, where only the quantity η may be unknown. By contrast, in the context of the example above my study assumes that the other parties do not know whether the informed party wishes to maximize or minimize $f(x, \eta)$. I describe the model in further detail below and provide an equilibrium disclosure result.

3.1 Firm's Problem

The relevant parties in this game consist of one representative firm to be regulated, one strategic regulator, and the market (the latter in a passive role). The firm privately observes cash flows $\tilde{x}$ drawn from the distribution $F(\cdot)$. I assume that $F(\cdot)$ is continuous and has finite first and second moments, but require no further parametric assumptions about the form of this distribution. Upon observing a realization x of $\tilde{x}$, the firm makes a report $d(x)$ to the market. The firm may choose to manipulate the report by some amount m, i.e., $d(x) = x + m$. As is standard in misreporting models, I assume a rational market that prices the firm according to its expected value conditional on the report, i.e., the firm's market value is equal to $\mathbb{E}[\tilde{x}|d(x)]$. For simplicity, I assume that the manager of the firm obtains payoff proportional to the firm's value, and that this payoff is known.

Penalties for misreporting are generally increasing in the severity of the violation. Karpoff et al. (2008) find that for each dollar that a firm falsely inflates its market value, it loses on average this dollar plus \$0.36 in legal penalties and \$2.71 in "lost reputational costs." Thus, if the firm is caught manipulating its earnings, I assume that it must pay a fine of $c \cdot m$ for some commonly known parameter c. The firm's costs can therefore be expressed as $c \cdot m \cdot \mathbb{P}(\text{caught})$, where the probability of being caught is determined by the regulator's enforcement decision. This means that the firm chooses manipulation in order to solve

$$\max_{m} \pi(d) = \mathbb{E}[\tilde{x}|x+m] - c \cdot m \cdot \mathbb{P}(\text{caught}) \tag{1}$$

where $\mathbb{P}(\text{caught})$ will depend on the firm's report.

3.2 Regulator's Problem

The regulator can take on one of two types; he is either a Revolver (R) with probability γ or a Non-Revolver (NR) with probability $1-\gamma$. Revolvers seek to enter the private sector, while Non-Revolvers have no desire to enter the private sector. Any strategic decisions an NR type makes are with the intent of minimizing [expected] undetected manipulation in the economy. Regulators also have talent level θ, which is drawn from some distribution $H(\cdot)$ with positive support and finite variance, but θ is private information that they cannot credibly disclose. Ceteris paribus, a more talented regulator (higher θ) will catch a higher proportion of manipulation than a less talented regulator. I assume that law firms looking to hire Revolvers prefer to hire more talented regulators.

While regulators cannot disclose θ, the fact that a more talented regulator will catch more manipulation when all else is equal provides a rationale for law firms to hire revolvers based on enforcement outcomes; this will be formalized in the model later on. The ability for a Revolver to obtain private sector employment is therefore dependent upon the outcome of the Revolver's investigation into the firm, which means that the Revolver's intent is to maximize the amount of detected manipulation. This phenomenon also reflects the idea that private-sector firms pay for the regulator's track record in the absence of a more direct proxy for the regulator's talent. While an imperfect measure, it is easier for a regulator to demonstrate a track record with successful detection than for the regulator to claim, unverifiably, that no earnings management occurred due to his skill. This structure is motivated by both empirical and theoretical literature (DeHaan et al (2015); Che (1995); Salant (1995)). As such, although a mechanism by which a revolver could reliably signal his/her talent would be optimal for firms looking to hire the revolver, such a mechanism may not be available – and, I assume, is not available in this case. Law firms must therefore make employment decisions based on enforcement outcomes.

For simplicity, I assume that a regulator who fails to detect a firm engaging in fraud (even if there is no fraud occurring) is ineligible to receive offers from the private sector. Assuming instead that both types are eligible to receive offers from the private sector, but that the probability of receiving an offer or expected compensation is higher when the regulator catches a firm, does not substantially change my analysis so long as these probabilities are known.

Regulators bear a cost of effort when exerting effort toward fraud detection. As is standard in the literature, I assume for the sake of tractability that this cost of effort is quadratic. Specifically, suppose that if the regulator invests effort such that he will catch a firm with probability b, then he faces costs of $\frac{b^2}{2y\theta}$, where $y, \theta > 0$. The parameters θ and y are initially the regulator's private information. A higher value of talent θ or resources y results in lower costs per unit of effort exerted by the regulator. Since the regulator cannot credibly disclose θ, this remains private information throughout. The regulator may choose to disclose y early on, possibly altering the firm's behavior by doing so. Alternatively, he may choose to say nothing about y. However, given that the firm knows that the regulator has a choice, nondisclosure of available resources y is still potentially revealing of some information about y and the likelihood the regulator is a Revolver.

I refer to y as the regulator's *resources*, distinct from the notion of "talent" or "skill". This refers to the technology and/or resources available to the regulator, for example more computing power or more researchers at his disposal. Empirically the parameter y reflects, for example, Agarwal et al.'s (2014) finding that financial and human resources available to banking regulators influence those regulators' levels of enforcement or leniency even under an identical set of rules. In contrast to the inherent talent level θ, the resource level y is verifiable and can therefore be credibly disclosed; however, since y is a quantity not determined by the regulator, the law firm will not hire the regulator based on the parameter y. Disclosure of y could reflect, for example, the regulator choosing to disclose that his agency has invested substantially in new technologies or in human capital that will help catch firms cheating; or even simply disclosing the total budget he has allocated for a given program. Ceteris paribus, a low value of y should lead firms to cheat more due to a reduction in the probability of detection and, consequently, a reduction in expected costs. The incentive to disclose y, therefore, depends on whether the regulator ex-ante wants the firm to engage in a higher or lower level of misreporting.

The Revolver's payoff function also depends on the size of the manipulation detected, i.e., the greater the manipulation he detects the higher his benefit. I include this quantity in terms of the overall amount of manipulation detected so that, e.g., a 10% overstatement by a smaller firm may not be as attractive to the Revolver as a 5% overstatement by a larger firm, if the larger firm is more than twice as big as the smaller firm. This magnitude weighting in the regulator's payoff function captures the idea that high-profile success by the regulator is likely to attract more attention by third parties, an idea borrowed from the empirical corporate finance literature (e.g., Dyck et al. (2010)).[11] Finally, I assume that Revolvers obtain wage w if successful in obtaining private-sector employment, similar to Salant's (1995) notion of a "consulting wage." I assume that the default wage of a regulator while in a government role is normalized to zero. Both the government numeraire and the outside wage w are assumed to be commonly known to all parties. Thus, if the regulator is a Revolver, then given a choice of b he obtains expected benefit of $w \cdot b \cdot \mathbb{E}[m]$.This could represent, e.g., the following scenario. Suppose there are a continuum of law firms that could potentially hire the firm, but these firms are in a competitive labor market and therefore will offer the same wage; these law firms are distinguished by some sort of (unmodelled) "prestige" factor. Catching more manipulation, while it does not reward a Revolver with a higher salary in the immediate future, does allow the regulator to revolve to a more prestigious law firm.

If the regulator is a Non-Revolver, then he obtains *disutility* from undetected expected earnings management in the economy. This reflects, for example, career concerns, in the sense that more undetected earnings management makes it more likely the regulator will be forced out of his job if the misreporting comes to light. In the context of the model, this is represented as follows. Given a choice of effort level b, the Non-Revolver obtains a "benefit" of $-(1-b)\mathbb{E}[m]$.[12] As such, his benefit function looks similar to the Revolver's; it is $\mathbb{E}[m] \cdot b - \mathbb{E}[m]$. Since the optimization in the final stage is with respect to b, we can essentially ignore the $-\mathbb{E}[m]$ term. This term is important, however, for the regulators'

[11] The model formulation is analogous to one in which the firm's private information $\tilde{x}$ is binary instead of continuous and $\mathbb{E}[m]$ is replaced with some probability ζ that the firm misreports; in this case, the regulator's payoff is simply $w \cdot b \cdot \zeta$, i.e., the unconditional probability that he will detect fraud $b \cdot \zeta$ multiplied by the payoff w he would obtain from successful detection. I use the continuous analogue of these quantities, in the form of making $\tilde{x}$ continuous and replacing ζ with $\mathbb{E}[m]$, primarily for the sake of tractability.

[12] Or $K-(1-b)\mathbb{E}[m]$ for some sufficiently large known constant K if we need the benefit to be positive – there is no difference in the subsequent analysis

ex-ante incentives. A Revolver does not have the $-\mathbb{E}[m]$ term in his payoff function, and so when given the chance to influence m via early-stage disclosure he does everything he can to make m as high as possible. Conversely, since $b - 1 \leq 0$, when given the chance to influence m via first-stage disclosure a Non-Revolver will do what he can to make m as low as possible. Formulating the two types of regulators' possible problems in the manner described above captures both the difference in ex-ante incentives between Revolvers and Non-Revolvers as well as the similarity in incentives both types of regulators face after the firm has manipulated.

Formally, the regulator's final-stage payoff can be written as

$$\pi_R = m\tilde{z}b - \frac{b^2}{2y\theta} \tag{2}$$

where $\tilde{z} \in \{1, w\}$, for $w \geq 1$. This means that in equilibrium, the regulator will spend effort level $b = m \cdot \tilde{z} \cdot y \cdot \theta$ investigating the firm. This equilibrium relation also shows why the outcome of the investigation is a reasonable proxy for the law firm's hiring decision in the absence of better information. When the law firm observes a successful enforcement action by the regulator, it is ex-post likely that a higher value of b was chosen compared to a lower value. Since b is an increasing function of θ, it is more likely that high-θ regulators would detect manipulation, all else equal, than low-θ regulators who would exert lower effort (recall that the regulator cannot credibly disclose θ, and so the firm's manipulation decision m is invariant to θ).

Given the regulator's payoff, the firm's expected costs are $m \cdot c \cdot \mathbb{E}[\tilde{z} \cdot y \cdot m \cdot \theta | s]$, where s now represents whether or not the regulator has disclosed the unknown value of y. Since the disclosure/nondisclosure decision occurs before the firm observes its cash flows, and since the firm has no other private information about its payoff function, we can pull m outside the expectation. Doing so yields the familiar linear-quadratic model with a signal-jamming solution,[13] in which manipulation is constant. The simplicity of this type of solution allows me to focus on how the regulator's optimal disclosure policy depends on his type (Revolver or Non-Revolver) and how it is affected by the parameters of the environment. Solving the second-stage game (the manipulation game) reveals that the firm's constant manipulation is equal to $\frac{1}{c\mathbb{E}[\tilde{z} \cdot y \cdot \theta | \{D, ND\}]}$. Ex-ante, a revolver would like to maximize this quantity (i.e., minimize the denominator), while a non-revolver would like to minimize this quantity (maximizing the denominator). There could also be another reason a revolver might want to disclose a low value of y; doing so, and then subsequently catching a firm engaging in fraud, could boost the revolver's reputation in the sense that for any given outcome, the ex-post expected value of θ is higher when the expected value of y is lower. For example, in 2006 the SEC under chairman Christopher Cox disclosed a budget crunch.[14] Subsequent successful enforcement by the SEC under Cox could then make Cox look more impressive to law firms (where Cox obtained employment after the SEC) on the other side of the revolving door.

Recall that γ denotes the ex-ante probability that the regulator is a Revolver. This parameter captures nonmonetary information about the regulatory environment and whether it is particularly conducive to revolving (e.g., via short noncompete windows between when a regulator leaves the firm and when he is allowed to work at any job he wants). This could also capture commonly-known information about, for example, the types of people that tend to take jobs similar to the Revolver's; for example, if the regulator in the model

[13] The firm manipulates, but the market anticipates this manipulation and values the firm accordingly; however, since the firm knows the market will anyway act this way, it becomes optimal to misreport.

[14] `http://www.washingtonpost.com/wp-dyn/content/article/2006/11/02/AR2006110201701.html`

is an SEC lawyer, γ may be different from the case where the regulator is a lawyer at the IRS. I assume that γ is common knowledge. Empirically, one possible proxy for γ could be based on historical revolving rates using data such as that in deHaan et al (2014). While we cannot set γ equal to the historical revolving rate since by construction not all would-be Revolvers are able to successfully revolve, we can treat γ as a lower bound and draw upon studies (e.g., Dyck et al (2010)) that estimate the incidence of corporate fraud and the probability of detection. Such an empirical framework would likely need to relax the binary assumption that only successful Revolvers can revolve and assume instead that Revolvers' probability of being able to revolve is some $\rho \in (0,1)$ when unsuccessful at catching a cheating firm and $\rho + \delta > \rho$ when successful.

Denote by Ω_R and Ω_N the sets in equilibrium on which Revolvers and Non-Revolvers do *not* disclose, respectively (that is, a Revolver does not disclose y when $y \in \Omega_R$). Recalling that γ denotes the ex-ante probability a regulator is a revolver and $F(\cdot)$ denote the distribution y is drawn from, we can write

$$q \equiv \mathbb{P}(R|ND) = \frac{\gamma \int_{\Omega_R} dF(y)}{\gamma \int_{\Omega_R} dF(y) + (1-\gamma)\int_{\Omega_N} dF(y)} \tag{3}$$

This yields

$$\mathbb{E}[\tilde{z} \cdot y|ND] = wq\frac{\int_{\Omega_R} ydF(y)}{\int_{\Omega_R} dF(y)} + (1-q)\frac{\int_{\Omega_N} ydF(y)}{\int_{\Omega_N} dF(y)} \tag{4}$$

The expression above simplifies further, to

$$\mathbb{E}[\tilde{z} \cdot y|ND] = \frac{\gamma w \int_{\Omega_R} ydF(y) + (1-\gamma)\int_{\Omega_N} ydF(y)}{\gamma \int_{\Omega_R} dF(y) + (1-\gamma)\int_{\Omega_N} dF(y)} \tag{5}$$

In the following sections I make the distributional assumption that F is uniform with support $[\underline{y}, \overline{y}]$. This assumption allows me to more easily characterize the model's main results, but does not change the structure of the model equilibrium.

4 Equilibrium

Consider first the baseline case where the regulator's type $\tilde{z}$ is known. In this case, the regulator's incentives (whether he wants to maximize or minimize m) are clear to the firm. That is, unraveling occurs, and the regulator will disclose fully. Revolvers would always prefer to disclose a given value y instead of having it be the lowest value of a nondisclosure set, and Non-Revolvers would have the reverse preferences. Given this, there is no sustainable interval of nondisclosure for either type of regulator, and full information is always present. With only one degree of uncertainty, there is no mechanism by which the regulator can conceal his intentions.

Under uncertainty about both the regulator's type and his efficiency, however, this outcome does not occur. For the sake of tractability I first present the equilibrium outcome when the regulator's ability θ is common knowledge to the firm and the regulator (but not the revolving law firm), and then extend this to the full model where θ is in fact private information. The common-knowledge formulation of the game allows me to present the disclosure equilibrium more simply; extending it to the full model is then straightforward and does not alter the main results.

4.1 When θ is Known to Regulator and Firm

Recall that the regulator's ex-ante disclosure strategy is determined by whether he wishes for the firm to manipulate more or less. This leads to a threshold-type equilibrium, where disclosure only occurs by Revolvers with low budgets (low y) and Non-Revolvers with high budgets (high y). Although a closed-form solution for these thresholds is unavailble, I characterize this equilibrium in the following result:

Proposition 1. *Suppose $\gamma \in (0,1)$ and θ are known to the regulator and the firm (but not the potential law firm that would hire a Revolver). Then there exists a threshold equilibrium of the form $\Omega_N = [\underline{y}, y_N]$ and $\Omega_R = [y_R, \overline{y}]$ for some y_R, y_N, i.e., the Revolver only discloses when $y \in [\underline{y}, y_R]$ and the Non-Revolver only discloses when $y \in [y_N, \overline{y}]$. This equilibrium has the following properties:*

1. *Letting $m^{-1}(ND)$ denote the reciprocal of the level of manipulation that occurs under nondisclosure, in equilibrium we must have*

$$y_N = m^{-1}(ND) = w \cdot y_R \tag{6}$$

   Since $w > 1$, this means that $y_R < y_N$, i.e., if there is disclosure then all uncertainty is removed in that the firm learns both y and the regulator's type.

2. *A sufficient condition for $y_R > \underline{y}$ and $y_N < \overline{y}$ is the following inequality:*

$$\left(\frac{2\frac{\underline{y}}{\underline{y}+\overline{y}} - \gamma}{1-\gamma} \right) \cdot w < 1 \tag{7}$$

   That is, regardless of the regulator's type there is always an interval on which the regulator discloses when the sufficient condition (7) holds. As a special case, note that when $\underline{y} = 0$, the inequality (7) is always true.

3. *The equilibrium defined by y_R and y_N is the unique equilibrium with at most one disclosure interval.*

The proof of Proposition 1 is in Appendix A.[15] The first condition of Proposition 1 states

[15]The multiplicative structure of the regulator's payoff function with respect to θ results in all three

that there is never incentive for the regulator to to reveal y according to a disclosure policy that does not also reveal his type (Revolver or Non-Revolver). The second condition provides a sufficient condition for the disclosure set of both types to be nonempty. When w is too high and $\underline{y} > 0$, the Revolver potentially has too much to lose when his type is revealed, because it is then known that he will expend a large amount of effort for a potentially lucrative payoff. Note also that since $\underline{y} < \overline{y}$, we will always have $\frac{2\underline{y}}{\underline{y}+\overline{y}} < 1$. This means that regardless of the parameters characterizing the distribution of y, there is always a w close enough to 1 for an interior solution $\{y_R, y_N\}$. Part (2) of the proposition also provides some insight into the relation between the spread of the distribution of y and the maximum permissible outside payoff w such that the regulator's disclosure set is nonempty. When $\overline{y} - \underline{y}$ is small – which means that the variance of y is low – then $2\frac{\underline{y}}{\underline{y}+\overline{y}}$ is close to one and so guaranteeing an interior solution requires a small revolving premium w. By contrast, when the variance of the distribution of resources available to the regulator is larger, firms are less informed. This informational advantage allows the regulator to play an interior strategy even for larger values of w. Note that the bound given in Part (2) is not tight in the sense that the converse need not necessarily be true.

It is also possible to establish uniqueness of the equilibrium presented in Proposition 1 over the set of threshold equilibria. Uniqueness results from the equilibrium condition of indifference at the thresholds y_R and y_N for the Revolver and Non-Revolver, combined with the monotonicity of the payoff to non-disclosure with respect to the threshold levels. This also rules out potential equilibria where there is disclosure among center intervals, i.e., where the Revolver might disclose on $[a_R, b_R]$, for $0 < a_R < b_R < 1$ and similarly for

parts of the proposition being invariant to θ. While this multiplicative structure does not fundamentally alter my conclusions, it allows me to more clearly represent the main results. Even with this simplification, however, there is no closed-form solution for the regulator's optimal manipulation and the firm's disclosure thresholds y_R, y_N as a function of the model's parameters.

the Non-Revolver.

I now characterize the equilibrium in question further. The relation given in Part (1), $y_N = m^{-1}(ND) = y_R$, follows from indifference at equilibrium thresholds and the fact that m^{-1} is constant. This gives a relation between the equilibrium thresholds y_R and y_N, and also allows us to write the posterior probability q of the regulator being a revolver, conditional on non-disclosure, as $q = \dfrac{\gamma(\overline{y} - y_R)}{\gamma(\overline{y} - y_R) + (1-\gamma)(wy_R - \underline{y})}$. The relationship between y_R and y_N also provides a bound of $\frac{\overline{y}}{w}$ on y_R. This means that when revolving becomes more lucrative (w increases), the result is a decrease of the bound on y_R (less disclosure). This comes from the expression for the firm's expected costs of manipulation: when w is higher, the regulator has incentive to pursue the firm with greater intensity, leading to an increase in expected costs and as a consequence a decrease in manipulation. Since w is common knowledge, a Revolver attempts to balance out higher values of w (which lead to higher probability of detection from the firm's perspective) by hiding his type for more possible values of y.

Equation (6) also allows us to write down an expression to solve for y_R (and hence y_N as well) given the parameters γ and w. We can write

$$m^{-1}(ND) = c \cdot \theta \cdot (wq + 1 - q) \left(q \left(\frac{y_R + \overline{y}}{2} \right) + (1-q) \frac{y_N + \underline{y}}{2} \right) \tag{8}$$

Setting $m^{-1}(ND)$ equal to y_R gives a cubic equation in y_R. While I do not explicitly solve Equation (8), implicit differentiation in conjunction with the Envelope Theorem can provide insights into the effects of w and γ. I discuss this in more detail in Section 5.

4.2 Full Model: When θ is Private Information

Let $\hat{y}$ denote $\theta \cdot y$. I show in Appendix A.1 that the structure of the equilibrium characterized in Proposition 1 is invariant to θ when θ is known, in the sense that the values of y for which the regulator discloses does not change when θ changes; changes in $\hat{y}$ are driven entirely by changes in θ. Consider now the case where θ is instead the regulator's private information. I show the following:

Proposition 2. *When regulatory talent θ is private information that cannot be credibly disclosed, there is an equilibrium in which the regulator's disclosure strategy for y and the firm's manipulation strategy are as in Proposition 1, with the unconditional expectation $\mathbb{E}[\theta]$ in place of θ.*

To show that this is an equilibrium, note first that when the regulator follows a disclosure strategy for y that does not depend on his talent level θ, then no information about θ is revealed and the firm bases its decision on the disclosure or nondisclosure of y only. As such, $\mathbb{E}[\theta]$ can be separated from $\mathbb{E}[z \cdot y|s]$ in the firm's manipulation decision, i.e., we can write $\mathbb{E}[z \cdot y \cdot \theta|s] = \mathbb{E}[z \cdot y|s] \cdot \mathbb{E}[\theta]$. Hence, given y_R and y_N the firm plays analogously with $c \cdot \mathbb{E}[\theta]$ in place of $c \cdot \theta$ in the common-knowledge case.

Consider now the regulator's behavior. Recall that the firm's manipulation level is given by $\dfrac{1}{c \cdot \mathbb{E}[zy\theta|s]}$. If the firm believes the regulator's disclosure decision is invariant to θ, then this can be written as $\dfrac{1}{c \cdot \mathbb{E}[\theta] \cdot \mathbb{E}[z \cdot y|s]}$. This quantity is invariant to the actual realization θ, since no information about θ can be credibly communicated. Given this, the regulator's ex ante choice of y_R, y_N are governed by

$$y_N = m^{-1}(ND) = w \cdot y_R \tag{9}$$

where $c \cdot \mathbb{E}[\theta]$ replaces $c \cdot \theta$ in the expression for $m^{-1}(ND)$. This condition is unchanged because disclosure reveals nothing about θ to the firm; as such, only $\mathbb{E}[z \cdot y|s]$ is affected by the disclosure decision. While $m^{-1}(ND)$ is now a function of the distribution of θ, it is unaffected by the realization of θ. Given that the firm does not infer anything about θ from the disclosure or nondisclosure of y, and since the likelihood of detection is consistently scaled by θ across all strategies, the regulator's disclosure strategy is unchanged from the case where θ was common knowledge.

Intuitively, this occurs because the regulator's incentives are no different than in the common-knowledge case. The only difference in this setting is the likelihood of ex-post success, but when θ cannot be credibly disclosed and the firm does not take θ into account, the firm's actions are unaffected. This also provides a rationale for why the law firm would base its hiring decision on the outcome of the regulator's investigation. Regulators with high θ will choose a higher level of b given any disclosure policy and therefore be more likely to catch the firm cheating. From the law firm's perspective, therefore, a regulator who detects fraud is in expectation more talented than a regulator who does not detect fraud.

5 Expected Manipulation

I compare the base model (in which unraveling occurs) with the full model (in which the regulator's equilibrium strategy may involve nondisclosure). To begin, note that when z and y are public information, we have

$$c\mathbb{E}[m(z,y)] = \mathbb{E}\left[\frac{1}{z \cdot y \cdot \theta}\right] = \frac{\gamma}{(\overline{y}-\underline{y})w\mathbb{E}[\theta]}\int_{\underline{y}}^{\overline{y}}\frac{dy}{y} + \frac{1-\gamma}{(\overline{y}-\underline{y})\mathbb{E}[\theta]}\int_{\underline{y}}^{\overline{y}}\frac{dy}{y} = \left[\frac{\gamma+(1-\gamma)w}{w\mathbb{E}[\theta]}\right]\log\frac{\overline{y}}{\underline{y}} \tag{10}$$

whereas when z and y can be withheld by the regulator in equilibrium, we instead have

$$c\mathbb{E}[m(z,y)] = \frac{\gamma}{(\overline{y}-\underline{y})\mathbb{E}[\theta]}\left(\frac{1}{w}\int_{\underline{y}}^{y_R}\frac{dy}{y}+\int_{y_R}^{\overline{y}}\frac{dy}{\mathbb{E}[z\cdot y|ND]}\right)+\frac{1-\gamma}{(\overline{y}-\underline{y})\mathbb{E}[\theta]}\left(\int_{y_N}^{\overline{y}}\frac{dy}{y}+\int_{\underline{y}}^{y_N}\frac{dy}{\mathbb{E}[z\cdot y|ND]}\right) \tag{11}$$

I show in Appendix B that (11) is always smaller than (10), the unraveling case. This is summarized in the following:

Proposition 3. *In the setting of Proposition 2, where the regulator has discretion over disclosure along both dimensions, expected manipulation in equilibrium is lower than in the setting where the regulator's type $\tilde{z}$ is common knowledge ex ante (leading to disclosure of y by unraveling)*

Proposition 3 suggests that additional information asymmetry in favor of the regulator can actually benefit investors in a firm, in the sense that it manipulate its earnings less on average, even when the regulator might with some probability hope that the firm engages in a higher level of earnings fraud. Also apparent from (11) is the fact that the amount of manipulation is decreasing in the strength of the revolver's outside option w. As Revolvers' incentives to leave for the private sector become stronger, they invest more into trying to catch firms manipulating. This investment leads to firms choosing to manipulate less due to increased likelihood of detection. Put another way, the deterrence effect of a highly-motivated revolver in a monitoring setting outweighs the revolver's initial incentive to mislead the firm. The firm is aware that a revolver has incentives to mislead the firm into falsely believing that he is weak and ineffective, and responds accordingly via a reduction in its optimal manipulation amount; doing so in turn leads the regulator to exert less effort than he would under a high level of manipulation. It is important to caveat that this result may be driven by the fact that the model setting is static. This means that there is no notion of switching costs to the market in the form of temporarily reduced monitoring capabilities; an incoming regulator will likely be less effective at first (in the context of the model, lower ability level θ) than the outgoing experienced regulator. This temporary reduction in θ could lead to increased manipulation shortly after a Revolver leaves for the private sector. To this end, one natural extension to the model would be to introduce a two period setting in which Non-Revolvers stay for both periods while Revolvers only stay if detection is unsuccessful.

Another interpretation of $\frac{\partial \mathbb{E}[m]}{\partial w}$ relates to barriers to revolving (for example, more stringent or lengthier non-compete agreements). The revolving door is commonly criticized[16] for leading to regulators with "impure" incentives, and one frequently suggested remedy is to create more stringent barriers for regulators to revolve. There are several ways to model barriers to revolving, but many of these can be absorbed into the parameter γ; under barriers to revolving, it is likely that fewer potential Revolvers would choose to enter a regulatory role, thereby driving down γ. As described above, a reduction in γ leads to an increase in expected manipulation in the static setting.

6 Conclusion

In this paper I show that regulatory incentives to revolve may actually have beneficial side effects in the form of deterring earnings management, and that the extent to which these side effects are beneficial is a function of both the regulator's available resources as well as his ability to exercise discretion in his disclosures. In particular, the practice of allowing a regulator the ability to occasionally disclose a desire to move to the private sector can

[16] For example, `http://www.huffingtonpost.com/john-harrington/the-revolving-door-at-the-sec_b_6785568.html`

have deterrence effects, so long as the private-sector job in question is not related to the firm that the regulator is tasked with overseeing. Given the frequency with which bank regulators and SEC lawyers revolve to the private sector, understanding conditions under which such revolving may be beneficial could help in the development of future policies that implement restrictions on revolving.

However, there are several caveats. I do not consider the effect of other externalities resulting from regulators who revolve; it is possible that those who wish to revolve may ignore certain types of fraud or allow more leeway to certain firms. This behavior could alter the main results provided in Propositions 1, 2, and 3 by allowing a solution where the optimal policy is to ban revolving outright. Che (1995) also considers two types of revolving door, one procurement contracting-based and the other monitoring-based. I focus on regulatory monitoring of firms and in the process assume that regulators are not revolving to the firms they are tasked with overseeing, and in general have no incentive to help the firms they oversee. This assumption eliminates the potential for one of the most common criticisms of the revolving door: the associated regulatory capture. Given the differences in regulatory behavior in Che's two settings, I cannot generalize beyond a monitoring setting; Che in fact shows that the monitoring setting and contracting setting lead to opposite outcomes. It is therefore likely that an otherwise similar model to mine in which the regulator revolved directly to the overseen firm[17] would exhibit this same property, namely that the presence of revolving can lead to a higher degree of inefficiency.

In practice, many regulators' true duties contain both monitoring and contracting roles;

[17] A simple way to implement this would be to preserve most of the structure of the model, but to assume that the regulator could only revolve if the firm was *not* caught cheating – the immediate result would be as little regulatory oversight of the firm as possible

and in many cases, regulators may have the choice of revolving either to a third-party law or consulting firm or to a directly overseen firm. As such, an informative extension to this paper could introduce a dual-duty (monitoring and contracting) regulator and/or a regulator with options to revolve either to a law firm or the overseen firm in order to characterize feasible allocations of duties for which allowing revolving is a beneficial policy. One way to implement this under the current framework would be to assume that successful detection of revolving leads to a third-party law firm offer with some probability p_L, while unsuccessful detection leads to the directly overseen firm making an offer to the regulator with probability p_O, and characterizing the set of points $\{p_L, p_O\}$ for which allowing revolving is preferred to forbidding it. Such a result would allow for a greater appreciation of context in policy debates about revolving, both on the supply side (when should regulators be allowed to revolve?) and the demand side (to what companies is it permissible for a regulator to revolve to?). For example, former SEC chairwoman Mary Schapiro revolved immediately to a consulting position at Promontory Financial Group that could best be described as a hybrid contracting-monitoring role. Did the allure of a future employer like Promontory lead to a better or worse SEC under Schapiro's direction?

Appendix A Proof of Proposition 1

For ease of exposition I first provide the proof when θ is normalized to unity (and so, given its multiplicative role, can be omitted). I then reintroduce θ and demonstrate that the equilibrium disclosure strategies remain unchanged.

To start, note that under the proposed equilibrium formulation we would have

$$q = \frac{\gamma(\overline{y} - y_R)}{\gamma(\overline{y} - y_R) + (1-\gamma)(y_N - \underline{y})} \tag{12}$$

$$\mathbb{E}[\tilde{y}|ND] = q\left(\frac{\overline{y} + y_R}{2}\right) + (1-q)\frac{y_N + \underline{y}}{2} \tag{13}$$

The following expressions will also be useful:

$$\frac{\partial q}{\partial y_R} = -\frac{\gamma(1-\gamma)(y_N - \underline{y})}{\left[\gamma(\overline{y} - y_R) + (1-\gamma)(y_N - \underline{y})\right]^2} < 0$$

$$\frac{\partial q}{\partial y_N} = -\frac{\gamma(1-\gamma)(\overline{y} - y_R)}{\left[\gamma(\overline{y} - y_R) + (1-\gamma)(y_N - \underline{y})\right]^2} < 0$$

We also need to compute the conditional expectation of $\tilde{z}$ given disclosure (there is no need to compute $\mathbb{E}[y]$ when y is disclosed obviously). If y is such that both types of regulator disclose y, then the firm learns nothing and its expectation of $\tilde{z}$ continues to be $w\gamma + (1-\gamma)$. If y is such that only revolvers disclose y, then the firm knows that $\tilde{z} = w$; and if y is such that only nonrevolvers disclose y, then the firm knows that $\tilde{z} = 1$. Generally, revolvers would prefer the firm not know that $\tilde{z} = w$ (they won't cheat enough) while nonrevolvers would prefer that the firm not know that $\tilde{z} = 1$ (they will cheat more).

Consider the behavior of the quantity of interest the regulator would like to maximize or minimize, $\mathbb{E}[\tilde{z} \cdot y|ND]$. Given the interval formulation above, with nondisclosure this is equal to

$$\begin{aligned}
\frac{m^{-1}(ND)}{c} &= (wq + (1-q))\left(q\left(\frac{\overline{y}+y_R}{2}\right) + (1-q)\frac{y_N + \underline{y}}{2}\right) && (14)\\
&= (w-1)\left(\frac{\overline{y}+y_R - y_N - \underline{y}}{2}\right)q^2 + \left(\frac{(w-2)(y_N+\underline{y})\overline{y} + y_R}{2}\right)q + \frac{\underline{y}+y_N}{2} && (15)
\end{aligned}$$

where of course q is a function of y_R, y_N. This gives

$$\begin{aligned}
\frac{1}{c}\frac{\partial m^{-1}}{\partial y_R} &= \frac{w-1}{2}\left[q^2 + 2(\overline{y}+y_R - y_N - \underline{y})q\frac{\partial q}{\partial y_R}\right] + \frac{q}{2} + \frac{[(w-2)(y_N+\underline{y}) + \overline{y} + y_R]}{2}\frac{\partial q}{\partial y_R}\\
\frac{1}{c}\frac{\partial m^{-1}}{\partial y_N} &= \frac{w-1}{2}\left[-q^2 + 2(\overline{y}+y_R - y_N - \underline{y})q\frac{\partial q}{\partial y_N}\right] + \frac{(w-2)q}{2} + \frac{[(w-2)(y_N+\underline{y}) + \overline{y} + y_R]}{2}\frac{\partial q}{\partial y_N} + \frac{1}{2}
\end{aligned}$$

Note that $\dfrac{\partial m^{-1}}{\partial y_R}$ is negative at $y_R = \overline{y}$. Recall also that $\frac{\partial q}{\partial y_R}$ and $\frac{\partial q}{\partial y_N}$ are both negative.

There are multiple potential cases. If $y_R < y_N$, then disclosure fully reveals the regulator's type; while if $y_R > y_N$ then disclosure is uninformative about type on $[y_N, y_R]$ and fully revealing otherwise. Also note the assumption that $w > 1$ (revolvers have greater monetary payoff).

Would we ever have $y_R < y_N$? That is, would the regulator ever *want* the firm to know his true type with certainty? Consider first the revolver. Suppose the revolver follows a strategy of disclosing whenever $y \leq y_R$ and not disclosing otherwise. For this to be an equilibrium we must have $wy_R = m^{-1}(ND)$. Note that wy_R is strictly increasing in y_R. However, $\frac{\partial m^{-1}}{\partial y_R}$ is not always negative. For example, if $\underline{y} = 0$, observe that at $y_N = 0, y_R = 0$

(that is, the revolver discloses fully and the nonrevolver does not disclose at all), we have

$$\begin{aligned}
\frac{\partial m^{-1}}{\partial y_R} &= c\frac{w-1}{2}(\gamma^2 - \gamma(1-\gamma)) + \frac{\gamma c}{2} \\
&= \frac{\gamma c}{2}\left[(w-1)(2\gamma - 1) + 1\right]
\end{aligned}$$

so that if $\gamma > \frac{w-2}{2(w-1)}$, m^{-1} is increasing in y_R.

Note also that $m^{-1}(y_R = \overline{y}) = c\frac{y_N + y}{2}$ (since $q = 0$ in this case), while $m^{-1}(y_R = \underline{y})$ strictly exceeds $c\frac{y_N+y}{2}$ as long as $y_N > 0$. Because m^{-1} is continuous, is smaller at $\underline{y}$ than at $\overline{y}$, and is decreasing at $y_R = \overline{y}$, this means that m^{-1} obtains its maximum value away from $y_R = \overline{y}$ and its minimum value away from $y_R = \underline{y}$. Note also that the second derivative $\frac{\partial^2 m^{-1}}{\partial y_R^2}$ is strictly less than zero (regardless of y_R, y_N), so m^{-1} is reasonably well-behaved in that it switches from increasing to decreasing at most once. That is, there is some k (possibly zero) such that m^{-1} is either strictly increasing or strictly decreasing on $y_R < k$ and then strictly decreasing for $y_R \geq k$. Further, k cannot be $\overline{y}$.

Because m^{-1} is weakly increasing in y_R when disclosure occurs, this means that on $(y_N, 1)$ there is at most one y_R that solves $w \cdot y_R = m^{-1}(y_R)$. In general, if $y_R > y_N$, then we would have

$$m^{-1}(x|D) = \begin{cases} wcx & x < y_N \\ (1 + (w-1)\gamma)cx & x \in [y_N, y_R] \end{cases}$$

By indifference, y_R is such that $m^{-1}(ND) = m^{-1}(y_R|D)$. The potential issue in this case is that with the discontinuity at y_N, there could be two points of crossing. As a visual example, consider Figure 1. The upward-sloping blue line on the left is the line $y = wcx$, while the upward-sloping green line on the right is the line $y = (1 + (w-1)\gamma)cx$. The

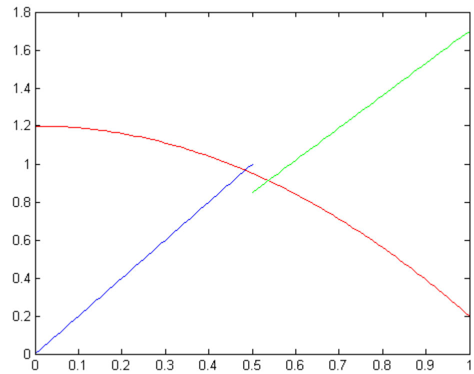

Figure 1: $m^{-1}(y)$ under disclosure/nondisclosure

downward-sloping red curve represents the function $m^{-1}(y|ND)$. The point of discontinuity in the linear function represents y_N. Where the blue line is less than the red line, the regulator is better off disclosing y; when the red line is below the blue or green line, the regulator should not disclose. But in this figure, we see that the blue line is initially below the red line (regulator discloses); then the red line briefly falls below the blue line (regulator does not disclose); then at y_N, when the piecewise linear function jumps downward, the red line is once again on top (regulator discloses) before finally falling below the green line (regulator does not disclose). But the red line, in this case, is dependent upon the conjectured type of equilibrium disclosure, i.e., the fact that nondisclosure only occurs for $y > y_R$.

Could a situation like that in Figure 1 above actually occur? No; consider what the definition of equilibrium cutoffs implies. If y_N, y_R form an equilibrium cutoff, then $m^{-1}(ND) = (1 + (w - 1)q)cy_N = (1 + (w - 1)q)cy_R$ (i.e. indifference at the thresholds). But since $w > 1$ and $y_N \neq y_R$ this cannot be possible! Thus there is no equilibrium with $y_N < y_R$, i.e., if there is equilibrium with one disclosure cutoff for each type of regulator, then when there is disclosure it is fully informative.[18] That is, it is either beneficial for him to leave the firm with total uncertainty or total certainty, but never partial uncertainty (y known but type unknown).

Hence consider a strategy where $y_N \geq y_R$, i.e. there is no disclosure no matter what on (y_R, y_N), disclosure on $[0, y_R]$ reveals that the regulator is a revolver, and disclosure on $[y_N, 1]$ reveals that the regulator is a nonrevolver. Under this formulation we will have uniquely determined cutoffs y_R, y_N (similar to the graph above, but now the linear function is not piecewise; this means that there will only be one point of crossing) with $y_R \leq y_N$. Further, since disclosure reveals everything, we will have $w \cdot y_R = m^{-1}(ND) = y_N$; combined with the fact that $w > 1$ it must be the case that y_N is strictly greater than y_R (and in fact, gives us the equilibrium relation $y_N = w \cdot y_R$).

It is easy to verify graphically that y_N, y_R form an equilibrium; note that the single-crossing and the shape of m^{-1} and the full-disclosure payoff imply a threshold where deviation on either side would be suboptimal.

A.1 Invariance to θ

Recall that the regulator's optimal strategy when θ is known is to set $b = \theta \cdot \mathbb{E}[m] \cdot z \cdot y$. Let $\hat{y}$ denote $y \cdot \theta$. In the context of the proof presented above (when θ was normalized to one) we can think of the regulator's disclosure decision as being with respect to $\hat{y}$, where $\hat{y}$ is distributed uniformly over $[\underline{\hat{y}}, \hat{\overline{y}}] = [\theta \cdot \underline{y}, \theta \cdot \overline{y}]$. From this, the second-period manipulation in the case of a regulator who does not disclose is analogous to Equation (11) with $[\underline{\hat{y}}, \hat{\overline{y}}]$ in place of $[\underline{y}, \overline{y}]$.

[18] This doesn't rule out an equilibrium where, say, neither type discloses for high enough y or low enough y; I discuss this in Section 4

The equilibrium disclosure cutoffs y_N and y_R can also be easily determined with respect to the full model when introducing θ. Let $\hat{y_N}$ and $\hat{y_R}$ be the new equilibrium cutoffs and let $\hat{q}$ be the analogue of q. Recall that $\hat{y_R}$ will be

$$\hat{y_R} = m^{-1}(ND) = c \cdot (w\hat{q} + 1 - \hat{q}) \left(\hat{q} \left(\frac{\hat{y_R} + \theta\overline{y}}{2} \right) + (1 - \hat{q}) \frac{\hat{y_N} + \theta\underline{y}}{2} \right) \tag{16}$$

Since $q = \dfrac{\gamma(\theta\overline{y} - \hat{y_R})}{\gamma(\theta\overline{y} - \hat{y_R}) + (1-\gamma)(\hat{y_N} - \theta\underline{y})}$, replacing $\hat{y_N}$ by θy_N in (16) allows for θ to cancel out of all other terms and gives $q = \dfrac{\gamma(\overline{y} - y_R)}{\gamma(\overline{y} - y_R) + (1-\gamma)(y_N - \underline{y})}$. Hence writing $\hat{y_R} = \theta y_R$ and $\hat{y_N} = \theta y_N$ is consistent with (16), and demonstrates that when the support of $\tilde{y}$ is scaled, the solution scales as well in the same manner (i.e. disclosure of y is based on y_N and y_R). This means that when the regulator only has the option of disclosure with respect to y, but when θ is known to both regulator and firm, the regulator's disclosure intervals as defined by y_N and y_R remain unchanged.

Appendix B Comparative Statics

I show in this section that in the one-period game, the full model leads to less expected manipulation than the non-full model. I begin with the following lemma:

Lemma 1. *Let $x, y,$ and z be positive with $x \geq y$, and let $\alpha, \beta \in [0, 1]$. The following inequality holds:*

$$\log x - \log y \geq 2\frac{x - y}{\alpha x + y + \beta z} \tag{17}$$

I show that $H(x, y, z) = \log x - \log y - 2\frac{x-y}{\alpha x+y+\beta z}$ is an increasing function in x given any y. Since $x \geq y$ by assumption, and $H(x, y, z) = 0$ for $x = y$, showing that this expression is increasing in x suffices to prove the inequality.

Differentiating H yields

$$\begin{aligned}
\frac{\partial H}{\partial x} &= \frac{1}{x} - 2\frac{\alpha x + y + \beta z - (x-y)\alpha}{(\alpha x + y + \beta z)^2} \\
&= \frac{(\alpha x + y + \beta z)^2 - 2x[(1+\alpha)y + \beta z]}{x(\alpha x + y + \beta z)^2} \\
&= \frac{\alpha^2 x^2 + 2\alpha x(y + \beta z) + (y + \beta z)^2 - 2x[(1+\alpha)y + \beta z]}{x(\alpha x + y + \beta z)^2} \\
&= \frac{\alpha^2 x^2 - 2[y + (1-\alpha)\beta z]x + (y + \beta z)^2}{x(\alpha x + y + \beta z)^2} \\
&\geq \frac{[\alpha x - (y + (1-\alpha)\beta z)]^2}{x(\alpha x + y + \beta z)^2} \\
&\geq 0
\end{aligned}$$

where the second to last line follows from the fact that $\alpha \in [0,1]$ and y, z, and β are all nonnegative.

I now apply Lemma 1 to the one-period game. Cancelling common portions of integrals and multiplying through by $\mathbb{E}[\theta]$ allows (10) - (11) to be written as

$$\frac{\gamma}{\overline{y} - \underline{y}}\left(\frac{1}{w}\int_{y_R}^{\overline{y}} \frac{dy}{y} - \int_{y_R}^{\overline{y}} \frac{dy}{\mathbb{E}[z \cdot y|ND]}\right) + \frac{1-\gamma}{\overline{y} - \underline{y}}\left(\int_{\underline{y}}^{y_N} \frac{dy}{y} - \int_{\underline{y}}^{y_N} \frac{dy}{\mathbb{E}[z \cdot y|ND]}\right) \tag{18}$$

Each of the two terms in Equation (18) above is positive by Lemma 1. To see this, consider first the first term in (18). Plugging in for $\mathbb{E}[z \cdot y|ND]$ and recalling the equilibrium relation

$y_N = w \cdot y_R$, this can be rewritten as

$$\begin{aligned}
\frac{\gamma}{\overline{y}-\underline{y}}\left(\int_{y_R}^{\overline{y}} \frac{dy}{y} - \int_{y_R}^{\overline{y}} \frac{dy}{\mathbb{E}[z \cdot y|ND]}\right) &= \frac{\gamma}{\overline{y}-\underline{y}}\left(\frac{1}{w}\left(\log \overline{y} - \log y_R\right) - 2\frac{\overline{y}-y_R}{wy_R + wq\overline{y} + (1-q)\underline{y}}\right) \\
&= \frac{\gamma}{(\overline{y}-\underline{y})w}\left(\log \overline{y} - \log y_R - 2\frac{\overline{y}-y_R}{y_R + q\overline{y} + \frac{(1-q)}{w}\underline{y}}\right) \quad (19)
\end{aligned}$$

Lemma 1 can be directly applied to the term inside parentheses to show that this is positive. Turning now to the second term in Equation (18), we have

$$\begin{aligned}
\frac{1-\gamma}{\overline{y}-\underline{y}}\left(\int_{\underline{y}}^{y_N} \frac{dy}{y} - \int_{\underline{y}}^{y_N} \frac{dy}{\mathbb{E}[z \cdot y|ND]}\right) &= \frac{1-\gamma}{\overline{y}-\underline{y}}\left(\log y_N - \log \underline{y} - 2\frac{y_N-\underline{y}}{y_N + wq\overline{y} + (1-q)\underline{y}}\right) \\
&\geq \frac{1-\gamma}{\overline{y}-\underline{y}}\left(\log y_N - \log \underline{y} - 2\frac{y_N-\underline{y}}{y_N + q\underline{y} + (1-q)\underline{y}}\right) \\
&= \frac{1-\gamma}{\overline{y}-\underline{y}}\left(\log y_N - \log \underline{y} - 2\frac{y_N-\underline{y}}{y_N + \underline{y}}\right) \quad (20)
\end{aligned}$$

Lemma 1 (with $\beta = 0, \alpha = 1$) can again be applied to show that the final line is positive. Thus both terms are positive and therefore Equation (18) is positive, meaning that under unraveling more manipulation occurs in expectation.

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