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Information Disclosure and Corporate Governance

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Information Disclosure and Corporate Governance

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Information Disclosure and Corporate Governance[*]

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Abstract

In public-policy discussions about corporate disclosure, more is typically judged better than less. In particular, better disclosure is seen as a way to reduce the agency problems that plague firms. We show that this view is incomplete. In particular, our theoretical analysis shows that increased disclosure is a two-edged sword: More information permits principals to make better decisions; but it can, itself, generate additional agency problems and other costs for shareholders, including increased executive compensation. Consequently, there can exist a point beyond which additional disclosure decreases firm value. We further show that larger firms will tend to adopt stricter disclosure rules than smaller firms, *ceteris paribus*. Firms with better disclosure will tend, all else equal, to employ more able management. We show that governance reforms that have imposed greater disclosure could, in part, explain recent increases in both CEO compensation and CEO turnover rates.

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A response to recent corporate governance scandals, such as Enron and Worldcom, has been the imposition of tougher disclosure requirements. For example, Sarbanes-Oxley (SOX) requires more and better information: More, for instance, by requiring reporting of off-balance sheet financing and special purpose entities; better, by its increasing the penalties for misreporting. In the public's (and regulators') view, improved disclosure is good.

This view is an old one, dating at least to Ripley (1927) and Berle and Means (1932). Indeed, there are good reasons why disclosure can increase the value of a firm. For instance, reducing the asymmetry of information between those inside the firm and those outside can facilitate a firm's ability to issue securities and consequently lower its cost of capital.[1] Fear of trading against those with privileged information could reduce willingness to trade the firm's securities, thereby reducing liquidity and raising the firm's cost of capital. Better disclosure presumably also reduces the incidences of outright fraud and theft by insiders.

But if disclosure is unambiguously value-increasing, why have calls for more disclosure—whether reforms advocated long ago by Ripley or Berle and Means or embodied in more recent legislation like SOX—been resisted by corporations? What is the downside to more disclosure?[2] The direct accounting costs of disclosure could lie behind some of this resistance. Some commentators have also noted the possibility that disclosure could be harmful insofar as it could advantage product-market rivals by providing them valuable information.[3] Although these factors likely play some role in explaining corporate resistance to disclosure, it seems unlikely that they are the complete story. In addition to direct costs and costs from providing information to rivals, we argue here that there are important ways in which disclosure affects firms through the governance channel.

This paper argues that disclosure, as well as other governance reforms, should be viewed as a two-edged sword. From a contracting perspective, increased information about the firm improves the ability of shareholders and boards to monitor their managers. However, the benefits of improved monitoring do not flow wholly to shareholders: If management has any bargaining power, then it will capture some of the increased benefit via greater compensation. Even absent any bargaining power, because better monitoring tends to affect managers adversely, managerial compensation will rise as a compensating differential. In addition, increased monitoring can give management incentives to engage in value-reducing activities intended to make them appear more able. At some level of disclosure, these costs could outweigh the benefits at the margin, so increasing disclosure beyond that level would reduce firm value.

We formalize this argument as follows. We start with a very general model of monitoring, governance, and bargaining. We show that *if* owners and management have opposing preferences with respect to disclosure, then increasing disclosure leads to greater equilibrium managerial compensation (although possibly lower managerial utility). We then present a series of monitoring models, both learning-based and agency-based ones, in which we prove that owners and managers will have opposing preferences regarding disclosure. Consequently, managerial compensation rising with increased disclosure is a characteristic of many models of governance.

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[1] Diamond and Verrecchia (1991) were the first to formalize this idea. For empirical evidence, see Leuz and Verrecchia (2000), who document that firms' cost of capital decreases when they *voluntarily* increase disclosure. The idea that asymmetric information can harm trade dates back to at least Akerlof's (1970) "lemons" model.

[2] Because, as we discuss later, information improves—in a way we make precise—with either the quantity or quality of information, we can think of more or better disclosure as equivalent notions for our purposes.

[3] See Leuz and Wysocki (2006) for a recent survey of the disclosure literature. Feltham et al. (1992), Hayes and Lundholm (1996), and Wagenhofer (1990) provide discussions of the impact of information disclosure on product-market competition.

An implication of this logic is that CEO compensation should increase following an exogenously imposed increase in the quantity or quality of information that needs to be disclosed about a firm and its managers. This increase would occur regardless of whether the reason for the increase was government regulation or intense public pressure created by, for instance, increased media attention to governance in light of scandals or economic conditions. A potential countervailing incentive is that greater regulation or public scrutiny could reduce CEO bargaining power, which one might expect would lower his compensation. We consider this possibility in a setting in which a CEO's threat-point in bargaining declines one for one with the decline in his utility due to greater disclosure. We show that, nonetheless, that CEO compensation still rises (unless he *initially* had no bargaining power). Of course, such exogenous changes are often not wholly limited to disclosure. For instance, public outrage in light of scandal or financial crisis could lead to both greater disclosure and make it politically infeasible to raise executive compensation immediately. Consequently, in situations such as the recent financial crisis in which much attention has been given to the actions and compensation of top managers of investment banks, our predicted effect of greater mandated disclosure on those managers' compensation is likely to operate with some lag (or possibly be offset completely depending on the nature and duration of these other effects).

Anticipating the uses that owners may make of what they learn, the CEO can have incentives to distort the owners' information. A particular example is where the CEO engages in myopic behavior to boost his short-term numbers at the expense of more valuable longer-term investments (*e.g.,* in a model along the lines of Stein, 1989).[4] We show that this is a downside to improving the disclosure regime; that is, better disclosure can perversely lead to greater agency problems.

In Section II, we extend our analysis in three ways. First, we show how our results are affected by firm characteristics, particularly size. We show, in particular, that larger firms will tend, *ceteris paribus*, to have better disclosure regimes, but also greater executive compensation. We then extend our analysis to encompass a general equilibrium analysis of the entire market for CEOs. We show, among other results, that there will be a positive correlation between a firm's disclosure regime and its CEO's ability in equilibrium. We further show that our partial equilibrium analysis carries over to a more general equilibrium model insofar as a reform that increases disclosure for some firms will result in greater compensation for *all* CEOs.

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[4] Consistent with this argument, several studies have documented that passage of the Sarbanes-Oxley Act has lead to a reduction in risk-taking by firms (see Bargeron et al., 2007 and Litvak, 2007). The existence of myopia in corporate investing seems evident from many corporate practices; for example, in a survey of 401 financial executives, Graham et al. (2005) find that over half state that they are willing to delay starting a new project even if it entails a decrease in value in order to meet an earnings target.

The third extension addresses the following. In our one-point-in-time model, there is no reason to predict that either owners or management would favor a government-imposed tightening of disclosure regimes. Who, then, is pushing governments to tighten disclosure? We show that in a more sequential model, in which there are lags in compensation increases (for, perhaps, the political reasons discussed above), the owners will in fact wish to lobby the government to tighten the disclosure regime. In the short run, this increases the owners' payoffs. Because there is no free lunch, *ex ante* the owners would, however, prefer to commit not to so lobby the government.

In Section III, we discuss some of the empirical implications of our analysis. One specific prediction is that an exogenously imposed increase in disclosure requirements should lead to an increase in executive compensation and turnover, which is consistent with the upward trend in CEO salaries and CEO turnover rates that have accompanied the increased attention given to corporate governance in recent years (see Kaplan and Minton, 2008).

Section IV contains a summary and conclusion. Proofs not given in the text can be found in the appendix.

Our paper is related to some other recent work concerning the CEO's ability to distort information and disclosure policy. Song and Thakor (2006) deal with the incentives of a CEO to provide less precise signals about the projects he proposes to the board. Here, in contrast, we assume it is the owners (principal) who determine the signal's precision. Hermalin and Katz (2000), Singh (2004), Goldman and Slezak (2006), and Axelson and Baliga (in press) assume there is no uncertainty about the CEO's ability, their focus being the CEO's incentives to distort information. Hermalin and Katz consider a situation in which the CEO chooses the information regime and investigate his incentives to choose a less informative regime than would be desired by the owners. In Singh's model, the issue is the board's ability to obtain accurate signals about the CEO's actions. The primary concern of Goldman and Slezak is how the use of stock-based compensation can induce the CEO to divert effort to manipulating the stock. In contrast, in our model the CEO can have incentives to manipulate information about his ability. In addition, unlike us, Goldman and Slezak treat disclosure rules as exogenous, whereas one of our objectives is to understand how owners *choose* the value-maximizing rules. Axelson and Baliga, like Goldman and Slezak, are interested in how compensation schemes can induce information manipulation by the CEO. In particular, they present a model in which long-term contracts are optimal because short-term measures can be manipulated. But it turns out to be optimal to allow some manipulation of information or lack of transparency because, otherwise, the long-term contracting equilibrium would break down due to *ex post* renegotiation.

Although our focus is on disclosure, we note that many of our results would carry over to consideration of other governance reforms. In particular, if owners and CEOs have opposing preferences with respect to the *direct* effect of these reforms (*i.e.,* Condition 1 below or its appropriate analogue holds), then the insights of Sections I.B and II would continue to apply.

I The Model

A Timing of the Model

The model has the following timing and features.

STAGE 1. The owners of a firm determine the disclosure regime. Such a regime determines the amount of information made available in Stage 3 as well as its quality.[5]

STAGE 2. The owners hire a CEO.

STAGE 3. Information is subsequently revealed to the owners.

STAGE 4. Based on the information revealed in the previous stage, the owners update their beliefs about payoff-relevant parameters. They then take an action.

STAGE 5. The CEO gets his payoff, which depends—in part—on the action taken by the owners.

Although bare bones, this model encompasses many situations, including:

1. The owners learn information about the CEO's ability. The consequent action is whether they keep or fire the CEO. The CEO suffers a loss if fired.

2. The owners learn information about the firm's prospects. The consequent action is whether to put resources into the firm or take them out. The

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[5] Because information could be discarded, more information (data) must yield weakly better information (estimates). Conversely, more precise information (estimates) can often be interpreted as having more information (data). In this sense, then, there is essentially an isomorphism between the amount and the quality of information. Hence, we will tend not distinguish between quality and quantity of information in what follows (*i.e.,* wherever we write "more informative," one can read "better informative" and *vice versa*). For instance, as is well known (see, *e.g.,* DeGroot, 1970, p. 167) if N random variables x_n are identically and independently distributed normally with unknown mean μ and variance σ^2, where μ is a normally distributed random variable with mean M and variance η^2, then a sufficient statistic for μ is

$$\frac{M\sigma^2 + \eta^2 \sum_{n=1}^{N} x_n}{\sigma^2 + N\eta^2}$$

and its precision is

$$\frac{\sigma^2 + N\eta^2}{\sigma^2\eta^2}$$

So the precision is a function of N, the amount of information revealed. Alternatively, suppose one statistic, x, is more informative than a second, y, in that there exists a third random variable ε, independent of the parameter to be estimated, such that $y = x + \varepsilon$. Observe that if one saw both y and ε, one could construct x; in this sense, x can be seen as having more data (observing both y and ε) and y as less (observing y only).

CEO's utility increases with the amount of resources under his control (he prefers to manage a larger empire to a smaller one; he can skim more the more resources under his control; etc.).

3. The owners obtain information that offsets the informational advantage of the CEO. The consequent action is adjustment of the CEO's compensation plan. The CEO suffers a loss of information rents.
4. The owners' information is reflected in the precision of the performance measures used to provide the CEO incentives. The consequent action is adjustment of the CEO's compensation plan. The CEO suffers a loss of quasi-rents.

B Bargaining

Let $\pi(\mathcal{D})-w$ and $U(\mathcal{D})+v(w)$ be, respectively, the expected payoffs to the owners and CEO as a function of disclosure regime, $\mathcal{D}$, and compensation, w. The assumption that the CEO's utility is additively separable in wage and disclosure—to be precise, wage and owners' action—is a property satisfied by the models considered below. More money is preferred to less; hence, $v(\cdot)$ is strictly increasing. There is, thus, little further loss of generality in our assuming that it is differentiable everywhere. We assume that the CEO cannot be made to pay for his job; so, $w \geq 0$.[6]

We indicate that disclosure regime $\mathcal{D}$ is more informative than $\mathcal{D}'$ by writing $\mathcal{D} \succ \mathcal{D}'$. By "more informative," we mean in terms of some recognized notion of informativeness, such as Blackwell informativeness. A condition that we will *prove* holds true of the models considered in subsections I.C and D is the following:

Condition 1 *If $\mathcal{D}$ and $\mathcal{D}'$ are two disclosure regimes such that $\mathcal{D} \succ \mathcal{D}'$, then $\pi(\mathcal{D}) \geq \pi(\mathcal{D}')$ and $U(\mathcal{D}) < U(\mathcal{D}')$.*

In words: Given a more informative disclosure regime and a less informative regime, then the owners prefer the more informative regime and the CEO strictly prefers the less informative regime *ceteris paribus*.

Now consider the setting of the CEO's compensation, w, at stage 2. We assume that w is set through some bargaining procedure that can be captured by generalized Nash bargaining.[7] That is, w is chosen to maximize

$$\lambda \log\Big(\pi(\mathcal{D}) - w\Big) + (1-\lambda)\log\Big(U(\mathcal{D}) + v(w) - \bar{u}\Big), \tag{1}$$

where $\lambda \in [0,1]$ is the owners' bargaining power and $1-\lambda$ the CEO's. The quantity $\bar{u}$ is the CEO's reservation utility (outside opportunity). For the moment, consider it to be exogenous to the model (*e.g.,* if the CEO retired, he would enjoy utility $\bar{u}$). The owners' outside option is normalized to zero. Unless bargaining is extreme ($\lambda = 1$ or $= 0$), both parties' expected payoffs exceed their outside options.

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[6] Throughout the paper, we rule out the CEO's being compelled to make payments to the firm. This assumption can be justified by appeals to limited liability or liquidity on the part of the CEO, the nature of labor law, and the law's general reluctance to enforce penalty clauses.

[7] Other bargaining games would yield similar results.

A key result of this section is

Proposition 1 *Assume wage bargaining is generalized Nash and Condition 1 holds. Then the* CEO*'s compensation, as determined by the bargaining process, is non-decreasing in how informative is the disclosure regime. Moreover, if the* CEO*'s compensation is positive under a given disclosure regime and either he does not have all the bargaining power (i.e.,* $\lambda > 0$*) or the owners' expected payoff is strictly increasing in the informativeness of the disclosure regime, then his compensation will be strictly greater under a more informative regime.*

To keep the analysis as straightforward as possible, we henceforth assume conditions are such that the CEO's compensation is, as in reality, always positive in equilibrium.[8] The reader can readily see how the statements of the following propositions and their proofs should be modified for the case in which the CEO receives zero compensation.

To gain intuition for Proposition 1, consider the two bargaining extremes. If the owners have all the bargaining power, they will hold the CEO to his reservation utility. Hence, any reduction in $U(\mathcal{D})$ must be offset with an increase in w to keep the CEO at his reservation utility. Conversely, if the CEO has all the bargaining power, then he captures all the owners' expected profit through his compensation. If the owners' expected profit goes up, as would follow if information is improved, then there is more for the CEO to capture and, hence, the greater is his compensation. In between these extremes, the result follows because both forces are at work: An increase in quality of information generates more expected profit, which will be divided between owners and the CEO through the bargaining process, and directly harms the CEO, which warrants some offsetting compensation for the CEO. The two forces act in tandem to boost the compensation that the CEO receives.

Therefore, when the owners choose the disclosure regime (*i.e.,* $\mathcal{D}$), they will take into account its impact on the CEO's compensation. A naïve analysis that considered only the direct effect on the owners' profits from a change in disclosure regime would overstate the benefit to the owners from improving disclosure. In particular, if the owners have chosen a *net* expected profit-maximizing disclosure regime, then a disclosure reform that raised $\pi(\mathcal{D})$ would necessarily make the owners worse off because the resulting increase in the CEO's compensation would exceed the increase in $\pi(\mathcal{D})$.[9]

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[8] If $v'(w) \to \infty$ as $w \to 0$, then the CEO's compensation would always be positive in equilibrium.

[9] Suppose $\mathbf{D}$ is the set of possible disclosure regimes. Proposition 1 does *not* determine which element of $\mathbf{D}$ the owners will choose in equilibrium. Rather it offers an explanation for why it could be that their choice is not $\text{argmax}_{\mathcal{D}\in\mathbf{D}}\,\pi(\mathcal{D})$. On the other hand, Proposition 1 does not rule out their choosing $\text{argmax}_{\mathcal{D}\in\mathbf{D}}\,\pi(\mathcal{D})$.

What would be the effect of such a reform on the CEO? From Proposition 1, it would, as noted, increase his compensation. What about his expected *utility*? The following proposition provides conditions under which the CEO's expected utility is sure to fall.

Proposition 2 *Assume wage bargaining is generalized Nash and Condition 1 holds. Assume, too, that neither party has all the bargaining power (i.e., assume $\lambda \in (0,1)$). Finally, assume the* CEO *is either risk neutral or risk averse in income. If there is a reform to disclosure that results in a disclosure regime that is more informative than the one the owners would have chosen, then the* CEO*'s expected total utility is reduced. (That is, if $\mathcal{D}^*$ would be the owners' unconstrained choice, $\mathcal{D}^{\text{R}}$ the reform level, $\mathcal{D}^{\text{R}} \succ \mathcal{D}^*$, and $w(\mathcal{D})$ denotes equilibrium compensation given disclosure regime, then $U(\mathcal{D}^*) + v\big(w(\mathcal{D}^*)\big) > U(\mathcal{D}^{\text{R}}) + v\big(w(\mathcal{D}^{\text{R}})\big)$.)*

What if we have extreme bargaining in which one side has all the bargaining power? If the owners do, then the CEO is always held to $\bar{u}$ and he is, thus, indifferent to changes in the disclosure regime. If the CEO has all the bargaining power, then the owners are indifferent to disclosure regime and are, thus, willing to choose any regime (*i.e.,* $\mathcal{D}^*$ is not well defined). Given this indifference, there is no reason for them not to choose the regime most preferred by the CEO, in which case a binding reform would again lower the CEO's utility.

Proposition 2 explains why CEOs are likely to resist increases in disclosure rules even though their compensation will increase as a consequence. Unless they have no bargaining power—in which case they would have no reason to be resistant—they are made worse off by an increase in disclosure that pushes disclosure beyond the level the owners would desire.

It has been suggested to us that an exogenous increase in disclosure, either through new regulations or increased attention by the media to a particular industry, is likely to affect many firms simultaneously. Such a change is likely to lower CEOs' outside option, $\bar{u}$, if their outside option is to work for another firm. While it is not necessarily true that a reform would affect all firms equally nor that the outside option for every CEO is to work for another firm (some might, for instance, be on the margin between work and retirement), we nevertheless consider that possibility now as a shorthand way of dealing with such general equilibrium effects (we pursue an alternative approach in Section II.B). Specifically, let $\bar{u}(\mathcal{D})$ be the outside option when the disclosure regime is $\mathcal{D}$. In keeping with the idea that all firms are being similarly affected, suppose that $U(\mathcal{D}) - \bar{u}(\mathcal{D}) \equiv \Delta$, where Δ is a constant. In other words, the inherent utility of the job, $U(\mathcal{D})$, decreases one-for-one with the outside option as disclosure becomes more informative. In such a world, the consequence of stricter disclosure will again be an increase in CEO compensation:

Proposition 3 *Assume the owners' gross expected profit, $\pi(\cdot)$, is strictly increasing in the informativeness of the disclosure regime (i.e., $\mathcal{D} \succ \mathcal{D}' \Rightarrow \pi(\mathcal{D}) > \pi(\mathcal{D}')$) and that bargaining is generalized Nash. Suppose that the* CEO*'s gross expected utility from the job, $U(\cdot)$, decreases one-for-one with his outside option as disclosure is made universally more informative (i.e., $U(\mathcal{D}) - \bar{u}(\mathcal{D}) \equiv \Delta$, Δ a* *constant). Then an increase in the level of disclosure causes an increase in the* CEO*'s compensation unless the owners have all the bargaining power, in which case his compensation is unaffected.*

Intuitively, in Proposition 1, there were two forces leading to an increase in compensation in response to greater disclosure: the compensation differential necessary to keep the CEO from slipping below his reservation utility level and the fact than an increase in profit is partially captured by the CEO through the bargaining process. In Proposition 3, we assume away the compensating-differential effect, but the ability of the CEO to capture a share of the increased profits via bargaining means his income still rises with greater disclosure.

Proposition 3 can also be read as stating that if one observes a decline in CEO compensation following a governance reform, then the reform is likely to have reduced gross profits (*i.e.,* $\pi(\mathcal{D})$).

This analysis suggests that changes to disclosure requirements, while directly beneficial to owners also carry indirect costs. As such, the optimal level of disclosure could be less than maximal disclosure even if disclosure were otherwise free (*i.e.,* if one were free to ignore the actual costs arising from stricter accounting rules, more record keeping, etc.). Going beyond that level would then reduce firm value. However, as the analysis also indicates, executive compensation is not solely a function of managers' distaste for greater scrutiny; in particular, the managers' bargaining power and the firm's profitability also matter. Consequently, reforms that affect all three factors, such as those proposed in response to the Financial Crisis of 2008, affect executive compensation through multiple channels. To the extent that such reforms independently reduce firm profits or reduce managerial bargaining power, our predicted result of greater compensation could be mitigated or reversed.

C Learning Models of Governance

Condition 1 is crucial to the analysis so far. This then begs the questions of whether Condition 1 is, indeed, a characteristic of governance. This and the next subsection present a series of alternative models of governance and prove they satisfy Condition 1 under mild conditions.

Suppose the the owners' payoff has the form $r\gamma(a) - c(a)$, where $a \in \mathcal{A}$ is the owners' Stage-4 action, r is a random variable, and $\gamma : \mathcal{A} \to \mathbb{R}_+$ and $c : \mathcal{A} \to \mathbb{R}_+$.[10] The timing is that the owners choose their action *before* the realization of r. We assume that r has some mean θ, which is an *unknown* parameter. For instance, θ could be the CEO's ability or some attribute of the firm. Based on the information they learn at Stage 3, the owners update their prior estimate of θ. Let $\hat{\theta}$ denote the owners' posterior estimate of r conditional on the information learned at Stage 3. Observe, at the earlier Stage 1, $\hat{\theta}$ is a random variable with a mean equal to the mean of the unknown parameter (*i.e.,* $\mathbb{E}\{\hat{\theta}\} = \mathbb{E}\{\theta\}$).

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[10] There is no gain in generality to assuming the owners' payoff is $\rho(r)\gamma(a)-c(a)$, $\rho(\cdot)$ strictly monotone, because the random variable could be redefined as $\tilde{r} = \rho(r)$.

As one example fitting these assumptions, let $\mathcal{A} = \{0, 1\}$, keep or fire the CEO, respectively. The random variable r is the payoff if the incumbent CEO, of ability θ, is retained (so $\gamma(a) = 1 - a$). If they fire the CEO, they incur a firing cost (*i.e.,* $c(0) = 0$ and $c(1) > 0$). The firing cost can be seen as the cost of dismissal, including the cost of disruption, less the expected payoff from a replacement CEO.

As a second example, let $\mathcal{A} = \mathbb{R}$ and suppose a is capital (resources, more generally) invested in the firm (so $\gamma(a) = a$). Assume quadratic adjustment costs, so $c(a) = a^2/2$.[11]

Other examples fitting this general framework exist. Moreover, the two examples given are isomorphic to other situations, such as deciding whether to agree to a takeover bid (the first example) or deciding on acquisitions or spinoffs (the second example).

Of importance to the owners is the question of how good an estimator $\hat{\theta}$ is of the parameter θ; that is, how informative is the information used by the owners to form $\hat{\theta}$. To understand the way in which informativeness affects the owners, we must model their decision making. Given their payoff function and information, the owners will choose a to maximize their expected profit, $\hat{\theta}\gamma(a) - c(a)$. Let $a^*(\hat{\theta})$ denote the solution. Define

$$\Pi(\hat{\theta}) = \hat{\theta}\gamma\big(a^*(\hat{\theta})\big) - c\big(a^*(\hat{\theta})\big) .$$

In words, $\Pi(\hat{\theta})$ is the owners' expected payoff (ignoring payments to the CEO) if their estimate is $\hat{\theta}$.

Lemma 1 *The owners' payoff function* $\Pi(\cdot)$ *is convex.*

Lemma 1 implies the owners are risk *loving* with respect to the estimator $\hat{\theta}$. Given that the mean of $\hat{\theta}$ is always the same (*i.e.,* the mean of the underlying parameter), it follows that the owners would prefer, *ceteris paribus*, a disclosure regime in which the distribution of $\hat{\theta}$ was riskier to one in which it was less risky in the sense of second-order stochastic dominance. As shown in Baker (2006), an estimator based on better information (in the Blackwell sense) is a riskier estimator (in the sense of second-order stochastic dominance).[12] To aid intuition, suppose no information were received (obviously the least information possible). Then $\hat{\theta}$ would be invariant as it would equal whatever the prior estimate was. Hence, adding information, which results in an estimate that varies, must increase risk. A consequence of Lemma 1 and Baker is

Proposition 4 *If* $\mathcal{D}$ *is a more informative disclosure regime than* $\mathcal{D}'$*, then the owners prefer* $\mathcal{D}$ *to* $\mathcal{D}'$*, ceteris paribus.*

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[11] To be precise, the owners' payoff in this example is $rK + ra - c(a)$, where K is existing capital in the firm. The rK component is, however, irrelevant to the analysis at hand, so we may ignore it going forward.

[12] Specifically, Baker's Lemma 2 states that if signal s is more informative than signal s' about a parameter θ, then estimates of θ based on s are riskier than estimates based on s'.

What about the CEO's preferences concerning the properties of $\hat{\theta}$ and, thus, disclosure regimes? We will show, via examples, that situations exist in which the CEO prefers that $\hat{\theta}$ be based on less information, rather than more.

To that end, consider the example in which the owners are deciding whether to keep or fire the CEO. It is readily seen that $a^*(\hat{\theta}) = 1$ if and only if $\hat{\theta} < -c(1)$. Assume the CEO suffers a utility loss of $\ell > 0$ if fired. The CEO's utility, as a function of $\hat{\theta}$, is thus

$$u(\hat{\theta}) = \begin{cases} -\ell\,, & \text{if } \hat{\theta} < -c(1) \\ 0\,, & \text{if } \hat{\theta} \geq -c(1) \end{cases} \tag{2}$$

(plus, possibly, an additive constant that we are free to ignore). The CEO's *ex ante* expected utility is thus $-\ell F\left(-c(1)\middle|\mathcal{D}\right)$, where $F(\cdot|\mathcal{D})$ is the distribution of the estimate $\hat{\theta}$ conditional on disclosure regime $\mathcal{D}$. If $\mathcal{D} \succ \mathcal{D}'$, then $F(-x|\mathcal{D}) > F(-x|\mathcal{D}')$ for a positive measure of $x \in \mathbb{R}_+$ because $F(-x|\mathcal{D}) \leq F(-x|\mathcal{D}')$ generically is inconsistent with $F(\cdot|\mathcal{D}')$ dominating $F(\cdot|\mathcal{D})$ in the sense of second-order stochastic dominance ($\underset{\text{SSD}}{\geq}$), a property that, as just noted, follows if $\mathcal{D} \succ \mathcal{D}'$.[13] This and Proposition 4 establish:

Proposition 5 *Consider the* CEO*-dismissal model. Suppose the owners have a discrete set of disclosure regimes from which to choose. Then there exists a positive measure of firing costs, $c(1)$, such that the* CEO *always prefers one disclosure regime more than a second if the first is less informative than the second. In other words, Condition 1 holds.*

A similar result holds if we assume that, for any two disclosure regimes $\mathcal{D}$ and $\mathcal{D}'$, either $F(\cdot|\mathcal{D})$ dominates $F(\cdot|\mathcal{D}')$ in the dispersive order (denoted $F(\cdot|\mathcal{D}) \underset{\text{disp}}{\geq} F(\cdot|\mathcal{D}')$) or *vice versa.* Recall $F(\cdot|\mathcal{D}') \underset{\text{disp}}{\geq} F(\cdot|\mathcal{D})$ if

$$F^{-1}(\xi|\mathcal{D}') - F^{-1}(\xi'|\mathcal{D}') < F^{-1}(\xi|\mathcal{D}) - F^{-1}(\xi'|\mathcal{D})$$

whenever $1 > \xi > \xi' > 0$, where $F\big(F^{-1}(\xi|\mathcal{D})\big|\mathcal{D}\big) \equiv \xi$. Because all distributions of $\hat{\theta}$ have the same mean (namely, $\mathbb{E}\{\theta\}$), we can employ Theorem 2.B.10 of Shaked and Shanthikumar (1994) to conclude that $F(\cdot|\mathcal{D}') \underset{\text{disp}}{\geq} F(\cdot|\mathcal{D})$ implies $F(\cdot|\mathcal{D}') \underset{\text{SSD}}{\geq} F(\cdot|\mathcal{D})$; hence, by Lemma 1, $F(\cdot|\mathcal{D}') \underset{\text{disp}}{\geq} F(\cdot|\mathcal{D})$ implies the owners prefer $\mathcal{D}$ to $\mathcal{D}'$. The CEO has the opposite preferences:

Proposition 6 *Consider the* CEO*-dismissal model. Suppose the median of the estimate $\hat{\theta}$ equals the mean and the mean exceeds $-c(1)$. Then $F(\cdot|\mathcal{D}') \underset{disp}{\geq} F(\cdot|\mathcal{D})$ implies the owners prefer $\mathcal{D}$ to $\mathcal{D}'$ and the* CEO *prefers $\mathcal{D}'$ to $\mathcal{D}$. In other words, Condition 1 holds.*

The requirement that the mean and median of the estimate $\hat{\theta}$ coincide is met by many estimation procedures. The condition that the mean of $\hat{\theta}$ (*i.e.,* $\mathbb{E}\{\theta\}$) exceed the firing cost may be justified by noting that were that not the case, then the owners would always wish to fire the CEO in the absence of any new information, which then begs the question of why they would have hired the CEO in the first place.

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[13] Recall that $F(\cdot|\mathcal{D}') \underset{\text{SSD}}{\geq} F(\cdot|\mathcal{D})$ if and only if $\int_{-\infty}^{x} \big(F(z|\mathcal{D}') - F(z|\mathcal{D})\big)dz \leq 0$ for all x and < 0 for a positive measure of x. This couldn't hold if $F(-x|\mathcal{D}) \leq F(-x|\mathcal{D}')$ for almost every $x \in \mathbb{R}_+$.

The intuition behind Proposition 6 is straightforward: $F(\cdot|\mathcal{D}') \underset{\text{disp}}{\geq} F(\cdot|\mathcal{D})$ means $F(\cdot|\mathcal{D})$ has a fatter left tail than $F(\cdot|\mathcal{D}')$. Because it is left-tail outcomes that get him fired, the CEO naturally prefers thinner left tails to fatter left tails, *ceteris paribus.*

To see that regimes can be ordered by the dispersive order in a conventional model of learning, consider the normal-learning model (see, *e.g.,* DeGroot, 1970, §9.5), which has often been employed in the study of corporate governance.[14] Specifically, suppose that CEO ability, θ, is distributed normally with mean 0 and precision τ (*i.e.,* variance $1/\tau$).[15] At stage 3, the owners observe a signal s, which is distributed normally with a mean equal to the CEO's ability and a precision δ. Hence, $\delta > \delta'$ means the signal given δ is more informative than the signal given δ'; that is, $\delta > \delta'$ corresponds to $\mathcal{D} \succ \mathcal{D}'$ (with the obvious pairing of precisions and regimes). A result for the normal-learning model is

Corollary 1 *Consider the* CEO*-dismissal model. Suppose the estimate $\hat{\theta}$ is formed according to the normal-learning model.*[16] *Then the mean and median of $\hat{\theta}$ coincide. If $\mathcal{D}$ is a more informative disclosure regime than $\mathcal{D}'$ (the signal has higher precision under the former than the latter), then $F(\cdot|\mathcal{D}') \underset{disp}{\geq} F(\cdot|\mathcal{D})$. Hence, the owners prefer $\mathcal{D}$ to $\mathcal{D}'$ and the* CEO *prefers $\mathcal{D}'$ to $\mathcal{D}$. In other words, Condition 1 follows.*

If the CEO's payoff is such that he is risk *averse* in $\hat{\theta}$, then Condition 1 would necessarily follow and the analysis of the previous subsection validated. To illustrate such a model, consider the investment model sketched above.[17] Executives are often painted as empire builders. They, for instance, derive status or otherwise improved reputations from running a larger enterprise. In addition, a larger firm presents greater opportunities to consume perquisites. One could even envision an entrenchment story: As resources are put into the firm, the CEO utilizes them in ways that help entrench him or permit him to pursue pet projects. If resources are taken out of the firm, the CEO must give up

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[14] A partial list such models is Holmstrom(1999 [1982]) on agency problems due to career concerns; Stein (1989) on managerial myopia; Hermalin and Weisbach (1998) on board behavior and structure; and Hermalin (2005) as a means to tie together trends in governance.

[15] The analysis merely requires that the expected value of θ exceed $-c(1)$. A mean of zero is convenient and without further loss of generality.

[16] As is well known,

$$\hat{\theta} = \frac{\delta s}{\delta + \tau}$$

(see, *e.g.,* DeGroot, 1970, p. 167, for a proof).

[17] Another model that would have this property is one in which $\hat{\theta}$ is a posterior estimate of the CEO's ability and the CEO's future wage is a function of his estimated ability. If the composite function of his utility for income and income as a function of estimated ability is concave in estimated ability (this would be true, for instance, if the CEO captures a constant share of his estimated ability and he is risk averse in income), then the CEO is risk averse in $\hat{\theta}$.

pet projects or become less entrenched. Consequently, suppose that the CEO's utility is $u(K+a)$, where K is the current size of the firm and a are resources the owners add to the firm (subtract if $a<0$). We can further speculate that $u(K+a)$ could be concave (at least locally) in a: A standard assumption is that preferences exhibit diminishing margins. Alternatively, one could adopt a loss-aversion model with a reference point at K; that is, the CEO loses more by having the firm reduced by some amount than he gains by having it expanded by the same amount.

Recall the owners have a quadratic adjustment cost, $c(a)=a^2/2$. It is readily seen that their best response to the estimate $\hat{\theta}$ is $a^*(\hat{\theta})=\hat{\theta}$. Hence, the CEO's utility, as a function of $\hat{\theta}$, is $u(K+\hat{\theta})$. Because his payoff is concave in a, the CEO exhibits risk aversion in $\hat{\theta}$. It follows from Baker (2006) and Proposition 4:

Proposition 7 *Consider the investment model. Suppose the CEO's utility is increasing and concave in capital. Then if $\mathcal{D}$ is a more informative disclosure regime than $\mathcal{D}'$, then the owners prefer $\mathcal{D}$ to $\mathcal{D}'$ and the CEO prefers $\mathcal{D}'$ to $\mathcal{D}$. In other words, Condition 1 holds.*

This last model lends itself to simple examples that can, when given plausible numbers, offer some sense of the economic significance of this analysis. To that end, suppose the CEO's utility is $w+u(K+a)$, where $u(K+a)=-\exp(-a-K)$, and that $\bar{u}=0$. Suppose the owners form the estimate $\hat{\theta}$ according to the normal-learning model given above. Given $\hat{\theta}$, the owners' expected profit is $\hat{\theta}^2/2$. Hence, prior to learning $\hat{\theta}$, their expected profit is $\operatorname{Var}(\hat{\theta})/2$. Given $\hat{\theta}$, the CEO's utility is $-\exp(-K)\exp(-\hat{\theta})$. His expected utility prior to $\hat{\theta}$'s realization is, therefore, $-\exp(-K)\exp\big(\operatorname{Var}(\hat{\theta})/2\big)$. It is readily shown that Nash bargaining yields

$$w=(1-\lambda)\frac{\operatorname{Var}(\hat{\theta})}{2}+\lambda\exp(-K)\exp\left(\frac{\operatorname{Var}(\hat{\theta})}{2}\right).$$

Because $\partial\big(\partial w/\partial\operatorname{Var}(\hat{\theta})\big)/\partial K<0$, the sensitivity of CEO compensation to greater disclosure is less at large firms than at small firms.

Under the normal-learning model,[18]

$$\operatorname{Var}(\hat{\theta})=\frac{\delta}{\tau(\delta+\tau)}\,, \tag{3}$$

which is an increasing function of δ, the precision of the signal. Hence, we can view the owners' problem as one of choosing $\operatorname{Var}(\hat{\theta})$ to maximize $\operatorname{Var}(\hat{\theta})/2-w$ or, equivalently, to maximize

$$\frac{\operatorname{Var}(\hat{\theta})}{2}-\exp(-K)\exp\left(\frac{\operatorname{Var}(\hat{\theta})}{2}\right).$$

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[18] Observe $\operatorname{Var}(s)=\operatorname{Var}(s-\theta)+\operatorname{Var}(\theta)=1/\delta+1/\tau$. Expression (3) follows from footnote 16 *supra*. See the proof of Corollary 1 for further details.

Provided $K \leq \frac{1}{2\tau}$, this program has a unique interior maximum:[19] $\text{Var}(\hat{\theta}) = 2K$. Observe this implies that larger firms will have a higher level of disclosure in equilibrium. Calculations reveal that equilibrium compensation is

$$w = (1-\lambda)K + \lambda\,,$$

so CEOs of larger firms enjoy greater compensation.

To get a sense of magnitudes suppose—working in millions of dollars—that the standard deviation of underlying productivity parameter θ was $\sqrt{10}$ (*i.e.,* $\tau = 1/10$); the firm's current working capital, K, is \$4 million; and the owners have the lion's share of the bargaining power, $\lambda = .95$. From above, the owners maximize their expected profit by setting $\text{Var}(\hat{\theta}) = 8$; that is, $\delta = 2/5$. Further calculations reveal that the owners' expected profit is \$2.85 million. The CEO's compensation is \$1.15 million. At this equilibrium, calculations show that the elasticity of compensation with respect to disclosure is approximately .696 (*i.e.,* a 1% greater level of disclosure increases the CEO's compensation by 0.696%). As a comparison, suppose that disclosure were set at its maximum (*i.e.,* $\delta = \infty$), then the owners' expected profit is approximately \$2.16 million. The CEO's compensation would be \$2.83 million.

A possible objection to Proposition 7 is that it relies on the difficult-to-verify assumption that the CEO is risk averse with respect to capital levels. As an alternative model, suppose the CEO's utility for size is simply $K + a$; that is, risk neutral. Suppose now that the CEO can take an action $x \in [1, \infty)$ that causes the owners to misperceive the estimate $\hat{\theta}$ as $x\hat{\theta}$ whenever $\hat{\theta} \geq 0$. If $\hat{\theta} < 0$, their perception is correct. There are numerous actions that CEO's can take to boost earnings or other measures of performance in the short run and such signal jamming is often seen as a potential agency problem (see, *e.g.,* Stein, 1989 for a discussion). The owners, understanding the structure of the game, will divide $x\hat{\theta}$, when positive, by x_e, the value of x they anticipate the CEO has chosen in equilibrium. Hence, their choice of a will be $x\hat{\theta}/x_e$. The condition for equilibrium is that $x = x_e$; that is,

$$x_e = \underset{x}{\operatorname{argmax}} \int_0^\infty \frac{x}{x_e}\hat{\theta}dF(\hat{\theta}|\mathcal{D}) - g(x)\,,$$

where $g : [1, \infty) \to \mathbb{R}_+$ is the CEO's cost of effort function, which we assume is convex and satisfies $g(1) = g'(1) = 0$ and $\lim_{x\to\infty} g'(x) = \infty$ (these assumptions ensure the existence of unique interior maxima in what follows). Employing integration by parts, it follows that x_e is defined by

$$\int_0^\infty \big(1 - F(\hat{\theta}|\mathcal{D})\big)d\hat{\theta} = x_e g'(x_e)\,.$$

An increase in the left-hand side implies an increase in x_e. If $\mathcal{D} \succ \mathcal{D}'$ in the Blackwell sense, then $F(\cdot|\mathcal{D}') \underset{\text{SSD}}{\gtrsim} F(\cdot|\mathcal{D})$, which implies

$$\int_0^\infty \big(1 - F(\hat{\theta}|\mathcal{D})\big)d\hat{\theta} > \int_0^\infty \big(1 - F(\hat{\theta}|\mathcal{D}')\big)d\hat{\theta}\,.$$

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[19] For $K > \frac{1}{2\tau}$, the solution is the corner $\text{Var}(\hat{\theta}) = 1/\tau$ (corresponding to $\delta = \infty$).

It follows that the value of x_e increases as disclosure becomes more informative. Given the CEO's equilibrium utility is $-g(x_e)$, it follows that the CEO prefers a less informative regime to a more informative regime *ceteris paribus.* We have shown:

Proposition 8 *Consider the investment model. Suppose the* CEO *can engage in costly-to-him signal jamming that inflates the estimate of the underlying parameter when that estimate is non-negative. Then if $\mathcal{D}$ is a more informative disclosure regime than $\mathcal{D}'$, then the owners prefer $\mathcal{D}$ to $\mathcal{D}'$ and the* CEO *prefers $\mathcal{D}'$ to $\mathcal{D}$. In other words, Condition 1 holds.*

It is worth remarking that this analysis identifies another cost to improved disclosure: If, as in many models (*e.g.,* Stein, 1989), the CEO's action is directly costly to the owners (*e.g.,* apparent profitability today is boosted at the expense of true profits tomorrow), then a more informative disclosure regime means more of this undesired action in equilibrium.[20] Our model thus reinforces a more general point in the economics of monitoring: The greater the monitoring (*e.g.,* the better is disclosure), the greater is the agent's marginal benefit from concealing or distorting information and, thus, the greater the effort he will expend on these undesired activities. These efforts represent an additional cost to improving monitoring.[21]

One possibility we have not considered is the use of a richer set of contracts for owners and the CEO to use to mitigate some of the tension between them. In particular, in these learning models, the consequence of better disclosure is exposing the CEO to greater risk. One might, therefore, think of providing him insurance. Given the owners have been assumed to be risk neutral in money, efficiency dictates they bear all the risk—fully insure the CEO—*ceteris paribus.* Were the owners to do so, the consequence would be to eliminate any motive to have the signal be less than maximally informative. In a simple model, for instance when the owners are deciding between keeping or dismissing the incumbent CEO and $u(\cdot)$ is given by (2), then a golden parachute equal to the CEO's loss should he be dismissed is optimal and—in the normal-learning model—the owners should choose to make the signal maximally informative (see Proposition A.1 in the appendix).

On other hand, it seems unreasonable to predict that the owners would want to fully insure the CEO. After all, if they fully insure him, then they are in a position of paying him more the worse he performs (*i.e.,* low values of the signal are more rewarded than high values). This would create rather perverse incentives for the CEO; in particular, if there is any moral hazard at all, then full insurance would backfire on the owners. In addition, one can conceive of situations in which the owners' information is not verifiable. For instance, suppose it reflects sensitive or proprietary information, is difficult to quantify, or is difficult to describe *ex ante*. In such cases, it would be infeasible to base an insurance contract on it. Another reason the information could be private is that the agent in question is at a level at which public information is not released or is otherwise not available; he could be, for example, a plant manager and it is top management that is playing the owners' role.

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[20] Stein (1989, p. 663) makes a similar observation about increased informativeness and greater efforts at signal jamming. The structures of our two models are, though, somewhat different and changes in informativeness in his model are assumed to be exogenous and not tied to the choice of disclosure regime.

[21] It is worth noting that even if such effort is not directly costly to the principal, she may still pay for it because the agent could require greater pay to compensate him for the disutility of this effort.

D Agency Models of Governance

We now illustrate that "classic" agency models can cause owners and CEO to hold different preferences over disclosure regimes.

In what follows, the owners' stage-4 action will be an adjustment to the CEO's bonus plan. The events in the stages after the first are

STAGE 2. The owners hire the CEO and his base salary, w, is set.

STAGE 3. The owners learn information relevant to the design of the CEO's bonus plan.

STAGE 4. The owners fix the the bonus plan.

STAGE 5. The CEO takes an action and receives a bonus, b, according to the plan.

Because our focus is on what happens at stage 3 and later (*i.e.,* after w is sunk), we are free to reduce notational clutter by omitting w from the payoff functions.

Consider, first, a hidden-information agency problem. The CEO's utility is $b - C(x, \theta)$, where $x \in \mathbb{R}_+$ is the CEO's stage-5 action and $\theta \in \{B, G\}$ is an attribute of the firm or CEO that affects the CEO's cost of taking action, $C(x, \theta)$. Assume the CEO learns θ after he is hired, but before he chooses x. The precise value of θ is his private information. Assume, for both θ, that $C(0, \theta) = 0$, $\partial C(0, \theta)/\partial x = 0$, and $\partial^2 C(x, \theta)/\partial x^2 > 0$. Assume, for $x > 0$, that $\partial C(x, B)/\partial x > \partial C(x, G)/\partial x$; that is, attribute (type) G represents a lower marginal cost of action than attribute (type) B.

The prior probability that $\theta = G$ is $1/2$. An information structure is a $\delta \in (0, 1/2)$. At stage 3, the owners learn, with equal likelihood, whether the probability $\theta = G$ is $\delta + 1/2$ or $-\delta + 1/2$. Observe an increase in δ means the owners have better information. The owners then set the bonus scheme.[22] Assume the owners' payoff is $R(x) - b$, where $R(\cdot)$ is increasing, concave, and $\lim_{x \to \infty} R'(x) = 0$. We rule out negative bonuses (*i.e.,* $b \not< 0$).

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[22] We assume the owners unilaterally set the bonus scheme. This is effectively without loss of generality because the anticipated actions of the owners will be taken into account in the Stage 2 bargaining over base salary.

Let $I(x) = C(x,B) - C(x,G)$. Note $I(\cdot)$ is the CEO's information-rent function. If ψ is the posterior probability that $\theta = B$, then the solution in terms of actions and bonuses is:[23]

$$x(\theta) = \begin{cases} \operatorname{argmax}_x R(x) - C(x,B) - \frac{1-\psi}{\psi} I(x)\,, & \text{if } \theta = B \\ \operatorname{argmax}_x R(x) - C(x,G)\,, & \text{if } \theta = G \end{cases}$$
$$\text{and } b(\theta) = \begin{cases} C\big(x(B),B\big)\,, & \text{if } \theta = B \\ C\big(x(G),G\big) + I\big(x(B)\big)\,, & \text{if } \theta = G \end{cases}.$$

Observe that $x(G)$ is independent of ψ and the CEO's utility if $\theta = B$ is always 0. Hence, with respect to those aspects of his expected utility that change with δ, his preferences over δ are fully reflected by

$$u(\delta) = \left(\frac{1}{2} - \delta\right) I(x_+) + \left(\frac{1}{2} + \delta\right) I(x_-)\,,$$

where $x_+ = x(B)$ when $\psi = \delta + 1/2$ and $x_- = x(B)$ when $\psi = -\delta + 1/2$. Similarly, with respect to terms that change with δ, the owners' preferences over δ are fully reflected by

$$\begin{aligned} \Pi(d) = \left(\frac{1}{2} - \delta\right) &\left(R(x_-) - C(x_-,B) - \frac{\frac{1}{2}+\delta}{\frac{1}{2}-\delta} I(x_-)\right) \\ &+ \left(\frac{1}{2} + \delta\right)\left(R(x_+) - C(x_+,B) - \frac{\frac{1}{2}-\delta}{\frac{1}{2}+\delta} I(x_+)\right) \\ = \left(\frac{1}{2} - \delta\right)&(R(x_-) - C(x_-,B)) + \left(\frac{1}{2} + \delta\right)(R(x_+) - C(x_+,B)) - u(\delta)\,. \end{aligned} \tag{4}$$

Expression (4) suggests—but does not prove—the owners and CEO have opposing preferences with respect to δ. The following proposition provides sufficient conditions for opposing preferences to hold.[24] In what follows define $X(\psi) = x(B)$ when $\Pr\{\theta = B\} = \psi$.

Proposition 9 *Consider the hidden-information agency model. If $\mathcal{D}$ is a more informative disclosure regime than $\mathcal{D}'$ (i.e., $\delta > \delta'$), then the owners prefer $\mathcal{D}$ to $\mathcal{D}'$. There exists a $\underline{\delta} < 1/2$ such that $\delta > \delta' > \underline{\delta}$ implies the* CEO *prefers $\mathcal{D}'$ to $\mathcal{D}$. If the function mapping $[0,1]^2 \to \mathbb{R}$ defined by*

$$(\psi,\psi') \mapsto \psi I\big(X(\psi')\big) + \psi' I\big(X(\psi)\big) \tag{5}$$

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[23] Because this model has been much studied, we leave the derivation to an online appendix.

[24] We have constructed numerous examples for which opposing preferences hold for all δ and $\delta' \in (0,1/2)$ and failed to construct any for which this is not true. On the other hand, we have failed to prove that opposing preferences hold for all δ and $\delta' \in (0,1/2)$.

is Schur concave, then $\underline{\delta} = 0$*; that is, owners and* CEO *have opposing preferences over the entire space of disclosure regimes.*[25]

Proposition 9 thus shows that there exist a non-empty space of disclosure regimes for which Condition 1 holds.

Corollary 2 *Consider the hidden-information agency model. If* $R(x) = x$ *and* $C(x, \theta) = x^2/k_\theta$*,* $k_G > k_B > 0$*, then the owners and* CEO *have opposing preferences over the entire space of disclosure regimes.*

As shown in the appendix, for these oft-used functional forms, the function defined by (5) is Schur concave.

Another consequence of a more informative disclosure regime is the following:

Proposition 10 *Consider the hidden-information agency model. The maximum bonus that can occur in equilibrium is greater the more informative is the disclosure regime.*

Proposition 10 indicates that one consequence of improved disclosure regimes is that the *top* incentive-pay awards grow even bigger.

Now consider a hidden-action model. The CEO's utility is $b - \chi(x)$, where b is again his bonus, $x \in \{0, 1\}$ his stage-5 action, and $\chi : \{0, 1\} \to \mathbb{R}_+$ his disutility of action function, where $\chi(1) > \chi(0) = 0$. Assume the owners' payoff is $R(x) - b$, $R(1) > R(0)$. The value $R(x)$ is not verifiable (it could, *e.g.,* be an expected value).

In what follows, consider $x = 0$ to represent some sort of undesired action by the CEO. Assume that should the CEO pursue the undesired action, the owners detect this with probability δ. Assume such detection is verifiable (*i.e.,* can serve as grounds to deny the CEO a bonus). In other words, all indicators suggest the CEO is working properly unless the owners should receive evidence to the contrary. A greater value of δ corresponds to a more informative information structure.[26]

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[25] A function $f : \mathbb{R}^2 \to \mathbb{R}$ is Schur concave if $f(z, y) > f(z', y')$ whenever $z > y$, $z' > y'$, $z' - y' > z - y$, and $z + y = z' + y'$. See, *e.g.,* Chapter 3 of Marshall and Olkin (1979) for the general definition. A symmetric function $f : \mathbb{R}^2 \to \mathbb{R}$ is Schur concave if $(z - y)\big(\partial f(z, y)/\partial z - \partial f(z, y)/\partial y\big) < 0$ (Marshall and Olkin, Theorem A.4, p. 57). Such a function is also Schur concave if it is quasi-concave (Marshall and Olkin, p. 69).

[26] This can be shown formally in terms of Blackwell informativeness. Consider two regimes with $\tilde{\delta} < \delta$. Let $\mathbf{p}(x)$ denote the vector $\big(p(x), 1 - p(x)\big)^\top$, where $p(x) = \Pr\{\text{evidence CEO chose } x = 0|x\}$ under regime δ. Notation with tildes represents corresponding values for regime $\tilde{\delta}$. The δ regime is more informative in the Blackwell sense if there exists a garbling matrix $\mathbf{G}$ such that $\tilde{\mathbf{p}}(x) = \mathbf{G}\mathbf{p}(x)$ for both x. Observe the matrix defined below is such a garbling matrix:

$$\begin{pmatrix} \tilde{\delta} & 0 \\ 1 - \tilde{\delta} & 1 \end{pmatrix} = \underbrace{\begin{pmatrix} \frac{\tilde{\delta}}{\delta} & 0 \\ \frac{\delta - \tilde{\delta}}{\delta} & 1 \end{pmatrix}}_{\mathbf{G}} \begin{pmatrix} \delta & 0 \\ 1 - \delta & 1 \end{pmatrix}.$$

A bonus contract is a pair $\langle b_0, b_1 \rangle$ such that the CEO is paid b_0 if the evidence indicates he took the undesired action and he is paid b_1 otherwise. As before, we assume bonus payments must be non-negative.

If the owners wish to induce the CEO to choose action 0, the best contract for them is clearly $\langle 0, 0 \rangle$. If the owners wish to induce him to choose action 1, the best contract for them can be shown to be $\langle 0, \chi(1)/\delta \rangle$ (see online appendix). The owners will implement action 1 if and only if

$$R(1) - \frac{\chi(1)}{\delta} \geq R(0) \,. \tag{6}$$

Suppose that $R(1)$ is sufficiently greater than $R(0)$ that (6) holds for all δ in the set of possible disclosure regimes; that is, it is always in the owners' interest to induce the CEO to choose the harder action. Because the left-hand side of (6) is the owners' expected equilibrium payoff, while $-\chi(1) + \chi(1)/\delta$ is the CEO's equilibrium payoff, the following is immediate.

Proposition 11 *Consider the hidden-action agency model. Suppose, over the set of possible disclosure regimes, the owners wish to induce hard work from the* CEO*(i.e.,* $x = 1$*). If* $\mathcal{D}$ *is a more informative disclosure regime than* $\mathcal{D}'$ *(i.e.,* $\delta > \delta'$*), then the owners prefer* $\mathcal{D}$ *to* $\mathcal{D}'$ *and the* CEO *prefers* $\mathcal{D}'$ *to* $\mathcal{D}$*. That is, Condition 1 holds.*

It is conceivable that if the disclosure regime is sufficiently uninformative, the owners do better allowing the CEO to take the undesirable action (*i.e.,* $x = 0$). This is worse for the CEO than a regime in which the desirable action is induced. Hence, the owners and CEO can have coincident preferences for some pairs of disclosure regimes if going from the less informative to the more informative means going from inducing the undesirable action to inducing the desirable action. To be concrete, suppose $\delta \in [0, 1]$ and $R(1) - \chi(1) > R(0)$. Then there exists $\bar{\delta} \in (0, 1)$ such that the owners prefer to induce the easier action if $\delta < \bar{\delta}$. In this case, both owners and CEO prefer $\delta > \delta'$ if $\delta \geq \bar{\delta} > \delta'$. However, if $1 > \delta > \delta' \geq \bar{\delta}$, then owners and CEO again have differing preferences; the owners prefer δ and the CEO prefers δ'.

II Extensions: Size, Markets, and Politics

A Firm Size and Other Heterogeneity

Firms vary in many ways and it is, therefore, worth considering how such heterogeneity—particularly with regard to size—affects the analysis. To that end, we explore how the owners of firms that differ along certain dimensions optimally determine disclosure and what, if any, implication that has for the CEO's compensation. Suppose that the owners' payoff is $\pi(\beta, \delta)$, where β is an attribute of the firm (*e.g.,* size) and δ is a continuous measure of the informativeness of the disclosure regime (*e.g.,* as used in the models of the previous section). We assume that Condition 1 holds (*e.g.,* this is one of the learning or agency models considered above), which, among other implications, means $\partial\pi(\beta,\delta)/\partial\delta \geq 0$. We assume that $\partial\pi(\beta,\delta)/\partial\beta > 0$ (at least over the relevant domain of β).

The following relation between pay and attribute exists:

Lemma 2 *Assume the owners' gross profit is strictly increasing in the firm attribute (e.g., size) and the disclosure regime is held constant. Then an increase in the attribute leads to an increase in the* CEO*'s pay unless the owners have all the bargaining power.*

It is unlikely, however, that the choice of disclosure regime is independent of the firm's attribute. For instance, larger firms could have a greater marginal benefit for information than smaller firms, as would, for example, be true in the CEO-dismissal model if we assume that both return and the cost of dismissal increase in firm size.[27] For models such as this, we can show the following:

Proposition 12 *Suppose the owners' marginal return to greater information is increasing in firm attribute (i.e., $\partial^2\pi(\beta,\delta)/(\partial\beta\partial\delta) > 0$). Suppose, too, the* CEO *is risk neutral in income. Assume bargaining is not extreme (i.e., $\lambda \in (0,1)$). Then the equilibrium level of the disclosure regime's informativeness is non-decreasing in the firm attribute and the* CEO*'s equilibrium level of compensation is strictly increasing in the attribute.*

If the owners have all the bargaining power (*i.e.,* $\lambda = 1$), then the result still holds, except the CEO's compensation would be constant if the optimal disclosure regime represents a corner solution. If the CEO has all the bargaining power, then owners are indifferent as to the choice of disclosure regime and, thus, all regimes are optimal from their perspective. If, however, the owners choose the CEO's most preferred disclosure regime in that situation, then the result would also hold.

B A General Equilibrium Analysis

Proposition 3 offered a simple analysis of how a universal change in disclosure policy could affect CEO compensation. Here, we consider a more nuanced model, along the lines of Terviö (2008), that explicitly considers general equilibrium effects.

Suppose there is a continuum of firms, with each firm being indexed by β. Suppose there is an equal measure of CEOs, indexed by α. Let $\alpha_{[i]}$ and $\beta_{[i]}$ be, respectively, the $i \times 100$ percentile of CEO type and firm type. That is, for example, the probability that a randomly drawn CEO has an ability not exceeding $\alpha_{[i]}$ is i. Assume $\alpha_{[0]} > 0$. Assume the distributions of α and β are twice continuously differentiable; hence, $\alpha_{[\cdot]}$ and $\beta_{[\cdot]}$ are also twice continuously differentiable functions. By construction, both functions are strictly increasing.

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[27] Hence, the firm's payoff could be $\beta \times \big(r\gamma(a) - c(a)\big)$, where β is firm size. The firm's payoff would then be $\pi(\beta,\delta) = \beta\Pi(\hat{\theta})$. Given $\partial\Pi(\hat{\theta})/\partial\delta > 0$, it is readily seen that $\partial^2\pi(\beta,\delta)/(\partial\beta\partial\delta) > 0$.

Assume the CEO's index (type), α, is observable. Let the profit, gross of CEO compensation, of a firm of type β that employs a type α CEO and adopts a disclosure regime δ be $\alpha\Omega(\delta,\beta)$, where $\Omega : \mathbb{R}^2 \to \mathbb{R}_+$ is twice continuously differentiable in each argument. As, essentially, a definition of firm type, assume:

$$\frac{\partial^2\Omega(\delta,\beta)}{\partial\delta\partial\beta} > 0\,. \tag{7}$$

As will be seen, (7) is consistent with the analysis of the previous subsection, particularly the complementarity assumption in Proposition 12. Assume better disclosure raises gross profit; that is, $\partial\Omega/\partial\delta > 0$. Assume higher type firms have greater profit *ceteris paribus*: $\partial\Omega/\partial\beta > 0$.

Assume the utility of a CEO who works for a firm with disclosure level δ and receives compensation w is $w + h(d)$. Assume $h(\cdot)$ is a twice continuously differentiable function. Consistent with the models above and Condition 1, assume $h'(\delta) < 0$. For all α and β, assume the function defined by

$$\delta \mapsto \alpha\Omega(\delta,\beta) + h(\delta)$$

is globally concave in δ and has an interior maximum. Global concavity implies this maximum is unique.

In addition to working for one of the firms, a CEO can retire or pursue some vocation other than being a CEO. Let his utility if he does that be $\underline{u}$.[28]

Observe that there are complementarities between CEO type and either firm type or disclosure. This means that the value a firm's owners place on a CEO of a given type rises with either the firm's type or its level of disclosure. Consequently, if disclosure level is increasing in firm type, we can expect to see assortative matching in equilibrium: The highest type firm hires the highest type CEO, the ith highest type firm hires the ith highest type CEO, and so forth. In fact, such an equilibrium exists as the following lemma establishes:

Lemma 3 *An assortative-matching equilibrium of the market described above exists in which a firm of type $\beta_{[i]}$ chooses disclosure regime $\delta_{[i]}$, where $\delta_{[i]}$ solves*

$$\max_{\delta} \alpha_{[i]}\Omega\bigl(\delta,\beta_{[i]}\bigr) + h(\delta)\,. \tag{8}$$

In this equilibrium, the ith most productive CEO *is paid*

$$w_{[i]} = \underline{u} - h(\delta_{[i]}) + \int_0^i \Omega\bigl(\delta_{[j]},\beta_{[j]}\bigr)\dot{\alpha}_{[j]}dj\,, \tag{9}$$

where $\dot{\alpha}_{[j]} = d\alpha_{[j]}/dj$.

An almost immediate consequence of Lemma 3, particularly expressions (8) and (9), is

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[28] Alternatively, it could be assumed that a CEO must be a CEO—he is a slave to the profession—but requires some minimum utility to survive.

Proposition 13 *In the assortative-matching equilibrium of the market described above, a higher-type firm (e.g., a larger firm) has a greater level of disclosure than a lower-type firm. Furthermore, a more able* CEO *earns greater compensation, has greater utility, and works for a firm with more stringent disclosure than a less able* CEO*.*

As the proof of Lemma 3 makes clear, the owners of any given firm take into account the potential impact on the type of CEO with whom they will be "matched," as well as how much they will need to pay him, when deciding on their disclosure regime. Notably, these considerations do not cause an efficiency distortion: In equilibrium, the owners choose the regime that maximizes welfare. Hence, any disclosure-increasing reform is necessarily welfare reducing. Ironically, it is the owners who would suffer from reform and the CEOs who would benefit. This is hinted at by (9): If $\delta_{[\cdot]}$ shifts up for a positive measure of firm types, then the integral in (9) increases. Because, as can be seen from (9), any increase in disutility is offset by an increase in compensation, the overall effect would seem to be an increase in CEO utility. This is not, however, a proof because we need to verify what the new equilibrium will be. As it turns out, the result goes through for essentially the reason just given:

Proposition 14 *Consider a market for* CEO*s as set forth above. Let* $\delta_{[\cdot]}$ *be the equilibrium disclosure schedule absent reform. If a reform is imposed such that disclosure must be at least* $\delta_{[\hat{\imath}]}$*, where* $\hat{\imath} \in (0,1)$*, and this reform causes no firms to go out of business, then all* CEO*s will see their compensation increase in equilibrium and all but the least able* CEO *will see his utility increase.*

Expression (9) also makes clear why the result could depend on no firm shutting down: If firms shutdown, then the lower limit of integration rises, which is a countervailing effect.

Proposition 14 reaches a different conclusion than Proposition 2 about the impact of a disclosure reform on CEO utility. The difference lies in the different assumptions about the compensation-setting process. Here, for assortative matching to occur, a higher ability CEO must earn a rent (*i.e.,* $u_{[i]} > \bar{u}$ for $i > 0$). The size of this rent is effectively a function of the compensation paid lower ability CEOs. Because the lowest ability CEOs must see a rise in their compensation to satisfy their participation constraints, this translates into greater compensation (and, thus, utility) for more able CEOs—even if disclosure at the firms at which they work doesn't change. Recall, in Proposition 2, that there would be no change to CEOs' utilities if they had no bargaining power. This result is reflected in the fact that the lowest ability CEO sees no increase in utility in Proposition 14.

Note that if the gross profit function, $\Omega(\cdot,\beta)$, were hump-shaped, so that marginal gross profit, $\partial\Omega/\partial\delta$, was negative for a significantly large reform, then such a reform reduces the integral in (9). In this case, a large enough reform would, thus, reduce CEO utility. The effect on CEO compensation is ambiguous: On the one hand, the rent to being high ability would be reduced, but the direct compensation for a worse job would increase.

C The Political Economy of Disclosure Reform

In light of the analysis to this point, a relevant question is what would be the impetus for disclosure reform? Given that owners should set disclosure optimally, accounting for its consequent impact on executive compensation, they have no reason to desire disclosure reform if it will further increase executive compensation. At least in some settings, such as those behind Proposition 2, executives have no reason to desire disclosure reform. To whom, then, are legislatures, agencies, or exchanges responding when they tighten disclosure?

In this subsection we offer possible answers to that question. Although a complete analysis of the political economy of corporate governance is beyond the scope of this paper, we consider three possible answers here, albeit the first two in somewhat cursory fashion.

One explanation is that legislatures simply pander to public outrage.[29] The consequent legislative response could, thus, be more "feel good" than "do good."

A second, related, explanation is that, as noted by Tirole (2001), corporate governance has effects on actors other than just shareholders and executives. To the extent these other stakeholders have no direct say in governance, the level of governance that arises from the bargaining between shareholders and executives modeled above could be socially suboptimal with respect to the externalities imposed on these other shareholders. Legislative or administrative action could be intended to correct this externality problem.

A third explanation, which we explore in some depth here, is that there is a commitment problem with respect to owners seeking to increase disclosure. Specifically, if $\mathcal{D} \succ \mathcal{D}'$ implies $\pi(\mathcal{D}) > \pi(\mathcal{D}')$, then, once CEO compensation has been fixed, the owners have an incentive to raise disclosure. We have heretofore assumed implicitly that the owners either cannot alter disclosure at this point or can commit not to do so. A possible justification for such commitment is that were the owners to seek raise disclosure requirements, they would need to obtain the agreement of the CEO, which presumably could be had only at the expense of further increasing his compensation. Suppose, instead, the owners can lobby the legislature to impose higher disclosure. Provided this did not trigger an immediate increase in the CEO's compensation, such lobbying could prove profitable for the owners. The CEO should, of course, anticipate such lobbying and bargain for greater initial compensation in anticipation of the owners' future lobbying; hence, in equilibrium, it could be that successful lobbying by the owners does not lead to increased compensation for the CEO.

The timing of the game is shown in Figure 1. Suppose there is a lobbying cost $L(y)$, where $L : \mathbb{R}_+ \to \mathbb{R}_+$ is a twice continuously differentiable function satisfying $L(0) = L'(0) = 0$ and $L''(y) > 0$ for all y. Suppose the CEO's utility is $w + u$. Assume the functions $\pi(\cdot)$ and $u(\cdot)$ are twice continuously differentiable.

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[29] For instance, at the time of our writing during the "Great Recession," roughly two-thirds of Americans wanted tougher regulations. A *Washington Post*-ABC News poll released April 26, 2010 reports that 65% of Americans want tighter regulations on financial institutions (United Press International). An *Economist* poll released the same week finds support ranging between 65% and 79% support for various possible reforms.

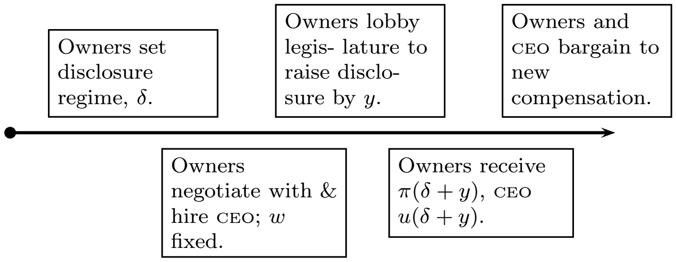
Owners set disclosure regime, δ.
Owners negotiate with & hire CEO; w fixed.
Owners lobby legis- lature to raise disclo- sure by y.
Owners receive $\pi(\delta + y)$, CEO $u(\delta + y)$.
Owners and CEO bargain to new compensation.

Figure 1: Timing of Lobbying Model

Further assume (i) $\pi(\cdot)$ is increasing and concave with $\lim_{z\to\infty} \pi'(z) = 0$; and (ii) $u(\cdot)$ is concave and decreasing with $u'(0) = 0$.

We continue to assume bargaining is generalized Nash. We treat bargaining power as fixed. Because a full model of a lobbying game is beyond the scope of this paper, we limit attention to a world in which the owners can lobby only once. For convenience, assume an infinite horizon. Let ι be the common interest rate.

Because the solution to generalized Nash bargaining is independent of multiplicative scaling of the parties' surpluses, we can either view the parties setting the CEO's compensation for every period thereafter or we can model them as bargaining each period over that period's compensation. The resulting per-period level of compensation will be the same. Hence, the CEO's future per-period compensation is the solution to

$$\max_{w} \lambda \log\big(\pi(\delta + y) - w\big) + (1-\lambda)\log\big(u(\delta + y) + w - \bar{u}\big)\,.$$

Hence, per-period compensation in the future, w_f, is given by

$$w_f = (1-\lambda)\pi(\delta + y) - \lambda\big(u(\delta + y) - \bar{u}\big)\,. \tag{10}$$

The owners' choice of lobbying is, thus, made to maximize the NPV of profits:

$$\begin{aligned}\max_{y} \pi(\delta + y) - w_o - L(y) + \frac{1}{\iota}\big(\pi(\delta + y) - w_f\big)\\ = \max_{y} \pi(\delta + y) - w_o - L(y) + \frac{\lambda}{\iota}\big(\pi(\delta + y) + u(\delta + y) - \bar{u}\big)\,,\end{aligned} \tag{11}$$

where w_o is the originally set compensation. The assumptions made above ensure that (11) has a unique solution for all δ. Call it $y^*(\delta)$.

At the time the parties bargain over w_o, they know δ. Moreover, they can anticipate $y^*(\delta)$. So w_o will be the solution to

$$\max_{w} \lambda \log\Big(\pi\big(\delta + y^*(\delta)\big) - L\big(y^*\big) - w\Big) + (1-\lambda)\log\Big(u\big(\delta + y^*(\delta)\big) + w - \bar{u}\Big)\,.$$

Hence,

$$w_o\big(\delta, y^*(\delta)\big) = (1-\lambda)\Big(\pi\big(\delta + y^*(\delta)\big) - L\big(y^*\big)\Big) - \lambda\Big(u\big(\delta + y^*(\delta)\big) - \bar{u}\Big)\,. \quad (12)$$

The owners' choice of δ will, therefore, maximize

$$\begin{aligned}\pi\big(\delta + y^*(\delta)\big) - w_o\big(\delta, y^*(\delta)\big) - L\big(y^*(\delta)\big) + \frac{\lambda}{\iota}\Big(\pi\big(\delta + y^*(\delta)\big) + u\big(\delta + y^*(\delta)\big) - \bar{u}\Big) \\ = -\lambda L\big(y^*(\delta)\big) + \frac{\lambda(1+\iota)}{\iota}\Big(\pi\big(\delta + y^*(\delta)\big) + u\big(\delta + y^*(\delta)\big)\Big) - \frac{\bar{u}\lambda}{\iota}\,. \quad (13)\end{aligned}$$

The results of this analysis are given by the following.

Proposition 15 *For the lobbying model just presented, there will be reform in equilibrium (i.e., $y > 0$). Unless the* CEO *has no bargaining power, the reform will eventually lead to an increase in* CEO *compensation (i.e., $w_f > w_o$). If the* CEO *has no bargaining power, then his compensation will be unaffected by the reform. The post-reform disclosure regime exceeds the welfare-maximizing regime (i.e., $\delta + y^*(\delta)$ exceeds the welfare-maximizing value).*

The possibility that the CEO sees no increase in compensation post reform if he has no bargaining power might, at first, appear at odds with the prediction of Proposition 1. Appearances here are deceiving: The logic is the same as in Proposition 1, the only difference is that compensation is set anticipating the reform. The CEO's initial compensation will reflect the disutility the future reform will impose. If he has bargaining power, then his compensation will be lower initially because the owners' cost of lobbying means there is less surplus for him to capture when bargaining for his first-period compensation.

For convenience, we have modeled lobbying as deterministic. In reality, the outcomes of lobbying are likely stochastic. If reform is uncertain, then this analysis yields a number of predictions. First, owners have an *ex post* incentive to lobby for reform. Enactment will be a positive surprise from the perspective of the market, so the stock price should rise if reform occurs. This does not, however, mean reform should be encouraged: Were the owners able to commit not to lobby, the expected NPV of their profits would be greater than it is when they cannot so commit. Hence, if the probability of reform falls, then, in the long run, firm values should be higher than they would otherwise have been.

III Implications for Empirical Work

We have presented a series of models suggesting that a firm's disclosure policy is fundamentally connected to its governance. Improved disclosure provides benefits, but it also entails costs. These costs are both direct, in terms of greater managerial compensation, and indirect, in terms of the distortions they induce in managerial behavior (*e.g.,* management's actions aimed at signal distortion).

This analysis has a number of implications for empirical analysis. First, consider a reform that, holding other things constant, increases the formal disclosure requirements—or any kind of exogenous change in the quantity of information that is available about a firm (*e.g.,* greater coverage of the firm in the news media). Our analysis predicts that, for those firms for which the reform is binding, we should observe (i) increases in their CEO's compensation; (ii) increases in their CEO's turnover rates; and (iii) a decreases in firm value. There has been an enormous increase in interest in top management compensation and turnover in recent years (see Huson et al., 2001, and Kaplan and Minton, 2008, for evidence on changes in turnover and compensation); our model suggests that the increased regulation and media attention of recent years could have contributed to these trends. In fact, this pattern holds not only in recent U.S. data: Bayer and Burhop (in press) finds that German bank executives became more vulnerable to dismissal after a major reform in 1884, which increased reporting requirements. In addition, Bayer and Burhop (2007) finds that executive compensation also increased following that 19th-century reform.

Another prediction is that stronger disclosure rules and greater scrutiny of firms should be associated with an increase in actions aimed at signal distortion (a past example of such actions being, perhaps, Enron's use of special-purpose entities, which led to its financial statements being particularly uninformative). In addition to accounting-related actions, our model suggests that increased disclosure requirements could lead to changes in real investments, specifically an increase in myopic behavior (*e.g.,* substitution away from longer-term investments, such as R&D, toward shorter-term investments or actions that affect reported numbers sooner).[30]

A second category of empirical implications concerns cross-sectional comparisons of similarly regulated firms. Differing underlying structures of businesses can lead to essentially exogenous differences in disclosure and transparency. For example, the relatively transparent nature of information disclosure in the mutual-fund industry means more information is available about a mutual-fund manager than is available about managers in industries where information is less clear cut and harder to assess. Our model suggests that in greater or more informative disclosure industries, managerial pay and turnover rates will be greater than in industries with less or less informative disclosure.

There should also be cross-sectional variation in firm activities across industries with different inherent levels of transparency. For instance, consider again a mutual-fund manager. His job, which is to pick securities whose identity is publicly available, is highly transparent. In contrast, a manager of a technology firm has a job that is fundamentally less transparent; his investments are harder to assess and often less observable to an outsider. Our analysis suggests, all else equal, that in more transparent industries, managers should be more tempted to manipulate numbers or otherwise engage in signal distortion.

Our analysis also makes predictions about the relation between firm size and disclosure regime. *Ceteris paribus*, larger firms should choose stronger regimes than smaller firms. Indeed, they should have better governance generally.

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[30] See Stein (1989) for more discussion of such negative NPV investments due to managerial myopia, and Graham et. al (2005) for survey evidence suggesting that executives claim to engage in such myopic behavior.

Another potential test of our model is to consider (i) whether firms with more disclosure or higher quality disclosure pay their executives more; and (ii) whether executives at these firms have shorter tenures once other factors have been controlled for. The amount of disclosure (information revealed) could be measured, for instance, by the amount of press coverage a firm receives or the number of analysts following a firm. The quality of the information disclosed could be measured directly as was done, for instance, by the Financial Analysts Federation's Committee on Financial Reporting.[31] Another possible measure of the quality of reporting could be the precision of analysts' forecasts; the better the quality of reporting, the less variance there should be across the forecasts of different analysts.

IV Conclusion

Corporate disclosure is widely seen as an unambiguous good. This paper shows this view is, at best, incomplete. Greater disclosure tends to raise executive compensation and can create additional or exacerbate existing agency problems. Hence, even ignoring the direct costs of disclosure (*e.g.,* meeting stricter accounting rules, maintaining better records, etc.), there could well be a limit on the optimal level of disclosure.

The model used to study disclosure reflects fairly general organizational issues. A principal desires information that will improve her decision making (*e.g.,* whether or not to fire the agent, tender her shares, move capital from the firm, adjust the agent's compensation scheme, etc.). In many situations, the agent prefers the status quo to change imposed by the principal (*e.g.,* he prefers employment to possibly being dismissed). Hence, better information is view asymmetrically by the parties: It benefits the principal, but harms the agent. If the principal did not need to compensate the agent for this harm and if she could prevent the agent from capturing, through the bargaining process, any of the surplus this better information creates, the principal would desire maximal disclosure. In reality, however, she will need to compensate the agent and she will lose some of the surplus to him. These effects can be strong enough to cause the principal to optimally choose less than maximal disclosure.

The notion that the principal directly benefits from better information is fairly general (recall Lemma 1 and Proposition 4). Whether or not the agent is harmed is more dependent on the specifics of the model. Nevertheless, we show, for a number of alternative learning and agency models, that having a better informed principal is not in the agent's interest.

We extend the analysis to consider the consequences of firm size, showing through a number of analyses that larger firms will tend, all else equal, to adopt more stringent disclosure regimes than smaller firms. We also extend the analysis to consider general equilibrium effects. We show that, in a model of assortative matching, there is a positive correlation between the stringency of a firm's disclosure regime and the ability of the manager it employs. A potentially interesting finding of that model is that an increase in the disclosure requirements that bind on only a subset of firms could, nevertheless, result in all executives earning more.

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[31] See Lang and Lundholm (1993) or Shaw (2003) for examples of work using these measures of disclosure quality.

Finally, we addressed the political economy of disclosure reform. Our analysis suggests that shareholders could have an incentive to lobby for disclosure regime ex post, although they would wish they commit not to do so ex ante.

Although our analysis has focused on disclosure, many of our insights apply more broadly to any governance reforms. In particular, much of the analysis in Section II would apply to any reform that gave shareholders a direct benefit, but imposed a direct cost on management.

This paper also extends the bargaining approach to the study of governance (see, *e.g.,* Hermalin and Weisbach, 1998). Once it is recognized that governance does not descend *deus ex machina* or is something that shareholders can impose any way they wish, it is clear that important tensions exist: Shareholders must, in essence, buy better governance from management at the price of higher managerial compensation. This creates tradeoffs that are not immediately apparent from a *deus ex machina* view or a view that ignores the existence of a labor market for managerial talent. Our analysis also contributes to a growing literature that demonstrates that better information is not always welfare improving.

Many issues, however, remain. We have abstracted away from any of the concerns about revealing information to rivals or to regulators that other work has raised. Because we have focussed on settings in which principal and agent have opposing preferences concerning improved information, we have largely ignored those settings in which they have coincident preferences (although see our analysis of hidden action where we note that if information is initially very bad, both principal and agent benefit from its improvement). We have also ignored the mechanics of how the information structure is actually improved; what accounting rules should be used, what organizational structures lead to more or less informative information, etc.? While future attention to such details will, we believe, shed additional light on the subject, we remain confident that our general results will continue to hold.

Appendix A: Technical Details and Proofs

Proof of Proposition 1: First suppose $\lambda \in (0,1)$. From Topkis's monotonicity theorem (Topkis, 1978; Milgrom and Roberts, 1990), the first part of the proposition follows if

$$\mathcal{N}(w,\mathcal{D}) \equiv \lambda \log\Big(\pi(\mathcal{D}) - w\Big) + (1-\lambda)\log\Big(U(\mathcal{D}) + v(w) - \bar{u}\Big)$$

exhibits increasing differences; that is, if $\mathcal{D} \succ \mathcal{D}'$ and $w > w'$ implies

$$\mathcal{N}(w,\mathcal{D}) - \mathcal{N}(w',\mathcal{D}) > \mathcal{N}(w,\mathcal{D}') - \mathcal{N}(w',\mathcal{D}')\,. \tag{14}$$

To that end, observe

$$\frac{\partial \mathcal{N}(w,\mathcal{D})}{\partial w} = -\frac{\lambda}{\pi(\mathcal{D}) - w} + \frac{(1-\lambda)v'(w)}{U(\mathcal{D}) + v(w) - \bar{u}}\,. \tag{15}$$

Suppose $\mathcal{D}$ becomes more informative. The denominator of the negative term in (15) weakly increases and the denominator of the positive term decreases; hence, we can conclude that $\mathcal{D} \succ \mathcal{D}'$ implies

$$\frac{\partial \mathcal{N}(w,\mathcal{D})}{\partial w} > \frac{\partial \mathcal{N}(w,\mathcal{D}')}{\partial w}$$

for all w. Integrating, we see

$$\int_{w'}^{w} \frac{\partial \mathcal{N}(z,\mathcal{D})}{\partial z} dz > \int_{w'}^{w} \frac{\partial \mathcal{N}(z,\mathcal{D}')}{\partial z} dz\,. \tag{16}$$

By the fundamental theorem of calculus, the left-hand side of (16) is the left-hand side of (14) and similarly for the right-hand sides. Hence, (14) has been proved. To prove the second (the "moreover") part of the proposition, note that if $w > 0$, we have an interior solution to the problem of maximizing (1) with respect to w. Hence, (15) must equal zero. Since, as shown, the right-hand side of (15) increases as disclosure becomes more informative, it cannot be that different disclosure regimes yield the same interior solution. Given we showed w is non-decreasing in informativeness, it follows that it must be increasing when it is an interior solution.

Suppose $\lambda = 1$ (*i.e.,* the owners have all the bargaining power), then the CEO's participation constraint,

$$U(\mathcal{D}) + v(w) \geq \bar{u}\,, \tag{17}$$

either binds or is slack if it holds at $w = 0$. When it is slack, the result is obvious (w can go in only one direction). When it binds, an increase in informativeness lowers $U(\mathcal{D})$, which must be offset by an increase in w to maintain (17) as an equality.

Suppose $\lambda = 0$ (*i.e.,* the CEO has all the bargaining power), then the owners' participation constraint,

$$\pi(\mathcal{D}) - w \geq 0\,, \tag{18}$$

binds. Because an increase in informativeness raises $\pi(\mathcal{D})$ (weakly), it must be offset by an increase in w to maintain (18) as an equality. ■

Proof of Proposition 2: Recall we have restricted attention to settings in which the CEO's compensation is positive. Hence, given $\mathcal{D}$, $w(\mathcal{D})$ satisfies the first-order condition for maximizing (1) with respect to w:

$$-\frac{\lambda}{\pi(\mathcal{D}) - w(\mathcal{D})} + \frac{(1-\lambda)v'\big(w(\mathcal{D})\big)}{U(\mathcal{D}) + v\big(w(\mathcal{D})\big) - \bar{u}} = 0\,. \tag{19}$$

Because $\mathcal{D}^{\text{R}} \neq \mathcal{D}^*$,

$$\pi(\mathcal{D}^{\text{R}}) - w(\mathcal{D}^{\text{R}}) < \pi(\mathcal{D}^*) - w(\mathcal{D}^*)\,. \tag{20}$$

Because $\mathcal{D}^{\text{R}} \succ \mathcal{D}^*$, $w(\mathcal{D}^{\text{R}}) > w(\mathcal{D}^*)$. This implies the numerator of the second term in (19) is no greater when $\mathcal{D} = \mathcal{D}^{\text{R}}$ than when $\mathcal{D} = \mathcal{D}^*$ because $v'(\cdot)$ is a non-increasing function. By (20), the denominator of the first term in (19) is smaller when $\mathcal{D} = \mathcal{D}^{\text{R}}$ than when $\mathcal{D} = \mathcal{D}^*$. The only way, then, that the equality (19) can be maintained is if the denominator of the second term gets smaller. Given that $\bar{u}$ is a constant, the result follows. ■

Proof of Proposition 3: Consider, first, $\lambda \in (0,1)$. The proof is similar to that of Proposition 1; in particular, expression (15) is

$$\frac{\partial \mathcal{N}(w,\mathcal{D})}{\partial w} = -\frac{\lambda}{\pi(\mathcal{D}) - w} + \frac{(1-\lambda)v'(w)}{v(w) + \Delta} \tag{21}$$

Suppose $\mathcal{D}$ becomes more informative. The denominator of the negative term in (21) increases and the second term is unchanged; hence, $\mathcal{D} \succ \mathcal{D}'$ implies

$$\frac{\partial \mathcal{N}(w,\mathcal{D})}{\partial w} > \frac{\partial \mathcal{N}(w,\mathcal{D}')}{\partial w}\,.$$

The rest follows immediately as shown in the proof of Proposition 1. (Recall we have now restricted attention to settings in which the CEO's compensation is positive.) The case $\lambda = 0$ is identical to that in the proof of Proposition 1. Finally, $\lambda = 1$ implies $v(w) \geq -\Delta$ always. It follows that $w = \max\{0, v^{-1}(-\Delta)\}$, which is invariant with $\mathcal{D}$, as claimed. ■

Proof of Lemma 1: Consider $\hat{\theta} \neq \hat{\theta}'$. Without loss of generality, take $\hat{\theta} > \hat{\theta}'$. Fix $\mu \in (0,1)$ and define $\hat{\theta}_\mu = \mu\hat{\theta} + (1-\mu)\hat{\theta}'$. We wish to show

$$\Pi(\hat{\theta}_\mu) \leq \mu\Pi(\hat{\theta}) + (1-\mu)\Pi(\hat{\theta}')\,. \tag{22}$$

By definition of a maximum:

$$\Pi(\hat{\theta}) \geq \hat{\theta}\gamma\big(a^*(\hat{\theta}_\mu)\big) - c\big(a^*(\hat{\theta}_\mu)\big) = \Pi(\hat{\theta}_\mu) + \gamma\big(a^*(\hat{\theta}_\mu)\big)(\hat{\theta} - \hat{\theta}_\mu)\,, \tag{23}$$

where the equality follows by adding and subtracting $\gamma\big(a^*(\hat{\theta}_\mu)\big)\hat{\theta}_\mu$ and the definition of $\Pi(\cdot)$. Expression (23) similarly holds with $\hat{\theta}'$ in place of $\hat{\theta}$. Call (23) with $\hat{\theta}'$ instead of $\hat{\theta}$ (23′). Multiplying (23) by μ and (23′) by $1-\mu$, then adding the two expressions yields:

$$\mu\Pi(\hat{\theta}) + (1-\mu)\Pi(\hat{\theta}') \geq \Pi(\hat{\theta}_\mu) + \gamma\big(a^*(\hat{\theta}_\mu)\big)\big(\mu\hat{\theta} + (1-\mu)\hat{\theta}' - \hat{\theta}_\mu\big) = \Pi(\hat{\theta}_\mu)\,;$$

that is, (22), as was to be shown. ■

Proof of Proposition 6: The claim about the owners was proved in the text. The result follows if we can show $F(\cdot|\mathcal{D}') \underset{\text{disp}}{\geq} F(\cdot|\mathcal{D})$ implies $F\left(-c(1)\middle|\mathcal{D}\right) > F\left(-c(1)\middle|\mathcal{D}'\right)$. The assumption $F(\cdot|\mathcal{D}') \underset{\text{disp}}{\geq} F(\cdot|\mathcal{D})$ implies

$$F^{-1}\bigl(1/2\big|\mathcal{D}'\bigr) - F^{-1}\bigl(\xi\big|\mathcal{D}'\bigr) < F^{-1}\bigl(1/2\big|\mathcal{D}\bigr) - F^{-1}\bigl(\xi\big|\mathcal{D}\bigr) \tag{24}$$

for all $\xi < 1/2$. Because mean and median coincide, $F^{-1}\bigl(1/2\big|\mathcal{D}'\bigr) = F^{-1}\bigl(1/2\big|\mathcal{D}\bigr)$; hence (24) implies, for all $\xi < 1/2$,

$$F^{-1}\bigl(\xi\big|\mathcal{D}\bigr) < F^{-1}\bigl(\xi\big|\mathcal{D}'\bigr) \Longrightarrow F^{-1}\Bigl(F\left(-c(1)\middle|\mathcal{D}'\right)\Big|\mathcal{D}\Bigr) < -c(1) \Longrightarrow F\left(-c(1)\middle|\mathcal{D}'\right) < F\left(-c(1)\middle|\mathcal{D}\right)\,,$$

where the first implication follows because $F\left(-c(1)\middle|\mathcal{D}'\right) < F\bigl(\mathbb{E}\{\hat{\theta}\}\big|\mathcal{D}'\bigr) = 1/2$ and the second because distributions are increasing functions. ■

Proof of Corollary 1: The corollary follows from Proposition 6 if the conditions for the latter can be shown to hold. Because the distribution of s *given* θ is normal with mean θ and variance $1/\delta$, the distribution of s given the *prior* estimate of θ, 0, is normal with mean 0 and variance $1/\delta + 1/\tau$.[32] Because

$$\hat{\theta} = \frac{\delta s}{\delta + \tau}$$

(DeGroot, 1970, p. 167), it follows that the prior distribution of $\hat{\theta}$ is normal with mean zero and variance

$$\operatorname{Var}(\hat{\theta}) = \frac{\delta^2}{(\delta+\tau)^2}\operatorname{Var}(s) = \frac{\delta}{\tau(\delta+\tau)}\,. \tag{25}$$

The mean and median of a normal distribution coincide. Observe we have $\mathbb{E}\{\hat{\theta}\} = 0 > -c(1)$. It only remains to establish the dispersive order. From (25), we have

$$\frac{\partial \operatorname{Var}(\hat{\theta})}{\partial \delta} = \frac{1}{(\delta+\tau)^2} > 0\,. \tag{26}$$

The result follows from (26) given Lemma A.1 proved below. ■

Lemma A.1 *Consider two normal random variables, X and Y, with common mean, μ, and variances σ_X^2 and σ_Y^2, where $\sigma_X^2 < \sigma_Y^2$. Then the distribution of X dominates the distribution of Y in the dispersive order.*

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[32] The random variable s is the sum of two independently distributed normal variables $s - \theta$ (*i.e.,* the error in s) and θ; hence, s is also normally distributed. The means of these two random variables are both zero, so the mean of s is, thus, 0. The variance of the two variables are $1/\delta$ and $1/\tau$ respectively, so the variance s is $1/\delta + 1/\tau$.

Proof: Let Ξ and Ψ denote the distribution functions for X and Y, respectively. By definition $\Xi \underset{\text{disp}}{\geq} \Psi$ if and only if

$$\Xi^{-1}(\zeta'') - \Xi^{-1}(\zeta') < \Psi^{-1}(\zeta'') - \Psi^{-1}(\zeta') \tag{27}$$

for any ζ'' and ζ' such that $1 > \zeta'' > \zeta' > 0$. Expression (27) is equivalent to

$$\Psi^{-1}(\zeta') - \Xi^{-1}(\zeta') < \Psi^{-1}(\zeta'') - \Xi^{-1}(\zeta'')\,;$$

hence, $\Xi \underset{\text{disp}}{\geq} \Psi$ if and only if $\Psi^{-1}(\zeta) - \Xi^{-1}(\zeta)$ is increasing in ζ. Replacing ζ with $\Xi(z)$ reveals that $\Xi \underset{\text{disp}}{\geq} \Psi$ if and only if $\Psi^{-1}\big(\Xi(z)\big) - z$ is increasing in z. Let $\Phi(\cdot)$ be the distribution function for the standard normal random variate (*i.e.,* with mean 0 and variance 1). As is well known,

$$\Xi(x) = \Phi\left(\frac{x-\mu}{\sigma_X}\right) \quad \text{and} \quad \Psi(y) = \Phi\left(\frac{y-\mu}{\sigma_Y}\right).$$

It follows that $\Psi^{-1}(\zeta) = \mu + \sigma_Y \Phi^{-1}(\zeta)$. Therefore,

$$\Psi^{-1}\big(\Xi(z)\big) - z = \mu + \sigma_Y \Phi^{-1}\left(\Phi\Big(\frac{z-\mu}{\sigma_X}\Big)\right) - z = \frac{\sigma_Y - \sigma_X}{\sigma_X}(z-\mu)\,,$$

which, because $\sigma_Y > \sigma_X$, is an increasing function of z. ■

Proof of Proposition 9: It is readily verified that $x_+ > x_-$. The envelope theorem implies

$$\Pi'(\delta) = \big(R(x_+) - C(x_+, B)\big) - \big(R(x_-) - C(x_-, B)\big) + I(x_+) - I(x_-)\,. \tag{28}$$

By assumption

$$I'(x) = \frac{\partial C(x,B)}{\partial x} - \frac{\partial C(x,G)}{\partial x} > 0\,.$$

Due to owners' concern about the information rent the CEO earns,

$$x(B) < \underset{x}{\operatorname{argmax}}\, R(x) - C(x,B) \equiv x_B^*\,.$$

By assumption $R(x) - C(x,B)$ is concave in x. Hence, $R(x) - C(x,B)$ is increasing in x for $x < x_B^*$. It follows that the sign of (28) is positive. Let $X(\psi) = x(B)$ when $\Pr\{\theta = B\} = \psi$. Observe

$$u(\delta) = \psi_- I\big(X(\psi_+)\big) + \psi_+ I\big(X(\psi_-)\big)\,, \tag{29}$$

where $\psi_- = -\delta + 1/2$ and $\psi_+ = \delta + 1/2$. Differentiating (29) with respect to δ yields

$$u'(\delta) = \underbrace{I\big(X(\psi_-)\big) - I\big(X(\psi_+)\big)}_{(-)} + \psi_- I'\big(X(\psi_+)\big)X'(\psi_+) - \underbrace{\psi_+ I'\big(X(\psi_+)\big)X'(\psi_-)}_{(+)}\,,$$

where the terms are signed as indicated because $X(\cdot)$ is an increasing function and it was earlier shown $I(\cdot)$ is also increasing. As $\delta \to 1/2$, $\psi_- \to 0$; hence, the unsigned term goes to zero as $\delta \to 1/2$. The signed terms do not go to zero as $\delta \to 1/2$. By continuity, therefore, there exists a $\underline{\delta} < 1/2$ such that $u'(\delta) < 0$ for all $\delta > \underline{\delta}$. Finally, to establish the last claim, consider $\delta > \delta'$. Observe

$$\psi_+ - \psi_- = 2\delta > 2\delta' = \psi'_+ - \psi'_- \quad \text{and} \quad \psi_+ + \psi_- = 1 = \psi'_+ + \psi'_- \,.$$

Because (5) is Schur concave, the result follows from the definition of Schur concavity. ■

Proof of Corollary 2: Straightforward calculations reveal

$$I(x) = \frac{(k_G - k_B)x^2}{k_G k_B} \quad \text{and} \quad X(\psi) = \frac{k_G k_B \psi}{2(k_G - (1-\psi)k_B)} \,.$$

Using Theorem A.4 of Marshall and Olkin (1979, p. 57), (5) is Schur concave if

$$(\psi - \psi')\Big(I\big(X(\psi')\big) - I\big(X(\psi)\big) + \psi' I'\big(X(\psi)\big)X'(\psi) - \psi I'\big(X(\psi')\big)X'(\psi')\Big) < 0 \,. \tag{30}$$

Given that $I(\cdot)$ and $X(\cdot)$ are increasing, a sufficient condition for (30) is

$$(\psi - \psi')\Big(\psi' I'\big(X(\psi)\big)X'(\psi) - \psi I'\big(X(\psi')\big)X'(\psi')\Big) < 0 \,. \tag{31}$$

Without loss of generality, assume $\psi > \psi'$. A sufficient condition for (31) is, therefore,

$$\frac{\psi'}{\psi} < \frac{I'\big(X(\psi')\big)X'(\psi')}{I'\big(X(\psi)\big)X'(\psi)} \,. \tag{32}$$

Straightforward calculations reveal

$$I'\big(X(\psi)\big)X'(\psi) = \frac{\psi k_G k_B (k_G - k_B)^2}{2(k_G - (1-\psi)k_G)^3} \,.$$

Hence (32) holds if

$$\frac{k_G - (1-\psi)k_G}{k_G - (1-\psi')k_G} > 1 \,,$$

which is readily seen as true. ■

Proof of Proposition 10: The maximum bonus is $C\big(x(G), G\big) + I\big(X(\delta + 1/2)\big)$. Given that $I(\cdot)$ and $X(\cdot)$ are increasing, the result follows. ■

Proof of Lemma 2: Suppose bargaining is not extreme; that is, $\lambda \in (0,1)$. The proof is similar to the proof of Proposition 1. In particular, we need to show $\partial\mathcal{N}(w,\beta)/\partial w$ is increasing in β, where

$$\mathcal{N}(w,\beta) \equiv \lambda \log\big(\pi(\beta,\delta) - w\big) + (1-\lambda)\log\big(U(\delta) + v(w) - \bar{u}\big) \,. \tag{33}$$

The cross-partial derivative of (33) is

$$\frac{\partial^2 \mathcal{N}(w,\beta)}{\partial\beta\partial w} = \lambda \frac{\partial \pi(\beta,\delta)}{\partial\beta} \frac{1}{\left(\pi(\beta,\delta) - w\right)^2} > 0\,.$$

Hence, $\partial\mathcal{N}(w,\beta)/\partial w$ is increasing in β. When CEO has all the bargaining power, the claim is immediate given that $w = \pi(\beta,\delta)$ in that case. ■

Proof of Proposition 12: Because the CEO is risk neutral in income, his utility is $v(w) = \nu_0 + \nu_1 w$, where ν_0 and ν_1 are constants, with $\nu_1 > 0$. Generalized Nash bargaining yields a w satisfying the first-order condition:

$$\frac{-\lambda}{\pi(\beta,\delta) - w} + \frac{(1-\lambda)\nu_1}{U(\delta) + \nu_0 + \nu_1 w - \bar{u}} = 0\,.$$

Hence,

$$w(\beta,\delta) \equiv (1-\lambda)\pi(\beta,\delta) - \frac{\lambda}{\nu_1}\big(U(\delta) + \nu_0 - \bar{u}\big)\,. \tag{34}$$

The owners' equilibrium payoff is

$$\lambda\pi(\beta,\delta) + \frac{\lambda}{\nu_1}\big(U(\delta) + \nu_0 - \bar{u}\big)\,. \tag{35}$$

The cross-partial derivative of (35) with respect to β and δ is

$$\lambda\frac{\partial^2 \pi(\beta,\delta)}{\partial\beta\partial\delta} > 0\,.$$

It follows from the usual comparative statics that the owners' choice of δ is non-decreasing in β.[33] The result about the CEO's compensation follows from Lemma 2 and Proposition 1 (alternatively, it follows directly from (34) using the envelope theorem). ■

Proof of Lemma 3: We will show that the owners' choosing the $\delta_{[i]}$s defined by program (8) leads to an assortative-matching equilibrium. By assumption, that program has a unique maximum, so $\delta_{[i]}$ is well defined for all i. Because the marginal return to δ increases in i, $\delta_{[\cdot]}$ is an increasing function. By the implicit function theorem, it is differentiable. We first show that if the owners are collectively playing the $\delta_{[\cdot]}$ what the assortative-matching equilibrium is. We then show that given the equilibrium of that subgame, it is indeed an equilibrium for the owners to choose those $\delta_{[i]}$s. Assume the owners have chosen the $\delta_{[i]}$s defined by program (8). The function $i \mapsto \Omega\big(\delta_{[i]}, \beta_{[i]}\big)$ is increasing in i. Hence, the equilibrium of the market subgame will exhibit assortative matching. To define that equilibrium, let $u_{[i]}$ denote the equilibrium utility of the ith most able CEO and let $w_{[i]}$ denote his compensation. Because the equilibrium exhibits assortative matching, we have $u_{[i]} = w_{[i]} + h\bigl(\delta_{[i]}\bigr)$, where $\delta_{[i]}$ is the level of disclosure chosen by the ith highest type firm. We can follow Terviö (2008) and characterize the assortative matching equilibrium of the subgame by

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[33] Actually strictly increasing unless δ is at a corner.

$$\alpha_{[i]}\Omega\bigl(\delta_{[i]},\beta_{[i]}\bigr) \underbrace{+h\bigl(\delta_{[i]}\bigr) - u_{[i]}}_{-w_{[i]}} \geq \alpha_{[j]}\Omega\bigl(\delta_{[i]},\beta_{[i]}\bigr) + \underbrace{h\bigl(\delta_{[i]}\bigr) - u_{[j]}}_{-\text{inducement}} \quad \text{and} \tag{36}$$

$$u_{[i]} \geq \underline{u}\,, \tag{37}$$

for all i. Expression (36) is the requirement that a firm prefer to hire the CEO "intended" for it rather than lure a CEO "intended" for another type of firm. Observe, such luring means paying at least enough that the CEO in question is indifferent between working for his match—which yields him utility $u_{[j]}$—and the luring firm—which yields him utility $h(\delta_{[i]}) + w$; that is, the inducement wage must be at least $u_{[j]} - h\bigl(\delta_{[i]}\bigr)$. Condition (37) is the CEO participation constraint.

Expression (36) is a statement of revealed preference. Hence, employing the usual revealed-preference argument, we obtain:

$$\bigl(\alpha_{[i]} - \alpha_{[j]}\bigr)\Omega\bigl(\delta_{[i]},\beta_{[i]}\bigr) \geq u_{[i]} - u_{[j]} \geq \bigl(\alpha_{[i]} - \alpha_{[j]}\bigr)\Omega\bigl(\delta_{[j]},\beta_{[j]}\bigr)\,. \tag{38}$$

Expression (38) implies that CEO utility is increasing in type. In addition, by setting $j = i - \varepsilon$, dividing all sides by ε, and taking limits as $\varepsilon \to 0$, we arrive at:

$$\frac{du_{[i]}}{di} = \Omega\bigl(\delta_{[i]},\beta_{[i]}\bigr)\dot{\alpha}_{[i]}\,.$$

Integration reveals

$$u_{[i]} = u_{[0]} + \int_0^i \Omega\bigl(\delta_{[j]},\beta_{[j]}\bigr)\dot{\alpha}_{[j]}dj\,. \tag{39}$$

Because we are assuming that firms make offers to CEOs, the lowest type firm could profitably deviate downward from any $w_{[0]}$ such that $w_{[0]} + h\bigl(\delta_{[0]}\bigr) > \bar{u}$, it follows that $u_{[0]} = \bar{u}$. The expression for the equilibrium wage schedule—*i.e.,* expression (9)—follows. We now show that it is an equilibrium for the owners to play the specified $\delta_{[i]}$s. Define $m(\delta,\beta)$ such that

$$\Omega\bigl(\delta_{[m(\delta,\beta)]},\beta_{[m(\delta,\beta)]}\bigr) = \Omega(\delta,\beta)\,.$$

The quantity $m\bigl(\delta,\beta_{[i]}\bigr)$ is the percentile of the CEO with which a type-$\beta_{[i]}$ firm will be matched if it chooses δ. Observe $m\bigl(\delta_{[i]},\beta_{[i]}\bigr) = i$. Because $\delta_{[\cdot]}$ is differentiable, so too is $m\bigl(\cdot,\beta_{[i]}\bigr)$ for all i. Suppose an owner expects all other owners to play according to the $\delta_{[\cdot]}$. We wish to show that doing the same is a best response for that owner; that is, we wish to show

$$\delta_{[i]} \in \operatorname*{argmax}_{\delta} \alpha_{[m(\delta,\beta_{[i]})]}\Omega\bigl(\delta,\beta_{[i]}\bigr) \underbrace{+h(\delta) - \int_0^{m(\delta,\beta_{[i]})} \Omega\bigl(\delta_{[j]},\beta_{[j]}\bigr)\dot{\alpha}_{[j]}dj}_{-\text{CEO compensation}}\,. \tag{40}$$

In other words, anticipating how the assortative-matching subgame will play out, the owners of a $\beta_{[i]}$ firm must wish to choose the disclosure regime expected of them in equilibrium, $\delta_{[i]}$. The first-order condition is

$$\begin{aligned} 0 &= \dot{\alpha}_{[m(\delta,\beta_{[i]})]}\Omega\big(\delta,\beta_{[i]}\big)\frac{\partial m}{\partial \delta} + \alpha_{[m(\delta,\beta_{[i]})]}\frac{\partial\Omega\big(\delta,\beta_{[i]}\big)}{\partial\delta} + h'(\delta) \\ &- \dot{\alpha}_{[m(\delta,\beta_{[i]})]}\Omega\big(\delta_{[m(\delta,\beta_{[i]})]},\beta_{[m(\delta,\beta_{[i]})]}\big)\frac{\partial m}{\partial\delta} = \alpha_{[m(\delta,\beta_{[i]})]}\frac{\partial\Omega\big(\delta,\beta_{[i]}\big)}{\partial\delta} + h'(\delta)\,, \end{aligned} \tag{41}$$

where the second equality follows from the definition of $m(\delta,\beta)$. Observe that $\delta=\delta_{[i]}$ solves (41). The result follows if we verify that this constitutes a global maximum. Consider $\delta<\delta_{[i]}$ (so $m\big(\delta,\beta_{[i]}\big)<i$). For notational simplicity, let $m=m\big(\delta,\beta_{[i]}\big)$. From the definition of $m\big(\delta,\beta_{[i]}\big)$, we know

$$\Omega\big(\delta,\beta_{[i]}\big)=\Omega\big(\delta_{[m]},\beta_{[m]}\big)\,.$$

Because $\beta_{[m]}<\beta_{[i]}$, $\delta_{[m]}>\delta$. Hence, we have the chain:

$$\begin{aligned} 0 = \alpha_{[m]}\frac{\partial\Omega(\delta_{[m]},\beta_{[m]})}{\partial\delta} + h'(\delta_{[m]}) &< \alpha_{[m]}\frac{\partial\Omega(\delta,\beta_{[m]})}{\partial\delta} + h'(\delta) \\ &< \alpha_{[m]}\frac{\partial\Omega(\delta,\beta_{[i]})}{\partial\delta} + h'(\delta) = \alpha_{[m(\delta,\beta_{[i]})]}\frac{\partial\Omega(\delta,\beta_{[i]})}{\partial\delta} + h'(\delta)\,; \end{aligned}$$

where the first inequality follows from the definition of $\delta_{[m]}$ and the fact that $\alpha\Omega(\delta,\beta)+h(\delta)$ is globally concave in δ; and the second inequality follows because the marginal return to disclosure is increasing in firm type. Hence, no $\delta<\delta_{[i]}$ can satisfy (41) and, moreover, (41) is increasing in δ for $\delta<\delta_{[i]}$. A similar analysis, omitted for the sake of brevity, shows that no $\delta>\delta_{[i]}$ can satisfy (41) and, moreover, (41) is decreasing in δ for $\delta>\delta_{[i]}$. ■

Proof of Proposition 13: It was shown as part of the proof of Lemma 3 that $\delta_{[\cdot]}$ is an increasing schedule. Because matching is assortative, a more able CEO therefore faces more stringent disclosure (*i.e.,* a greater δ) than a less able CEO. That a more able CEO enjoys greater utility is immediate from (39). To see that a more able CEO enjoys greater compensation than a less able CEO, use integration by parts to rewrite $w_{[i]}$ as

$$\underline{u} - h\big(\delta_{[i]}\big) + \Omega\big(\delta_{[i]},\beta_{[i]}\big)\alpha_{[i]} - \Omega\big(\delta_{[0]},\beta_{[0]}\big)\alpha_{[0]} - \int_0^i \left(\frac{\partial\Omega}{\partial\delta}+\frac{\partial\Omega}{\partial\beta}\right)\alpha_{[j]}dj\,. \tag{42}$$

Using the first-order condition for (8), the derivative of (42) with respect to i simplifies to

$$\alpha_{[i]}\frac{\partial\Omega}{\partial\delta}\frac{d\delta_{[i]}}{di} + \Omega\big(\delta_{[i]},\beta_{[i]}\big)\dot{\alpha}_{[i]} > 0\,.$$

■

Proof of Proposition 14: Given the monotonicity of $\beta_{[\cdot]}$, we will adopt the short hand of calling i a firm's type. The pre-reform equilibrium is described in the text. Consider equilibrium post reform. Because $\delta_{[\cdot]}$ is increasing, it follows that the requirement $\delta \geq \delta_{[\hat{\imath}]}$ must bind on all firm types $i < \hat{\imath}$ *vis-à-vis* their disclosure in the pre-reform equilibrium. We wish to verify that the new equilibrium disclosure schedule, $\tilde{\delta}_{[\cdot]}$, is given by

$$\tilde{\delta}_{[i]} = \begin{cases} \delta_{[\hat{\imath}]}\,, & \text{if } i < \hat{\imath} \\ \delta_{[i]}\,, & \text{if } i \geq \hat{\imath} \end{cases} . \tag{43}$$

Because $\Omega\big(\delta, \beta_{[\cdot]}\big)$ is increasing, the same analysis used in proving Lemma 3 demonstrates that, if the owners play the $\tilde{\delta}_{[\cdot]}$ schedule, then the equilibrium of the subgame exhibits assortative matching and $u_{[\cdot]}$ is given by (39) (with $\tilde{\delta}_{[j]}$ substituted for $\delta_{[j]}$). Consider an i-type firm, $i > \hat{\imath}$. Because $\beta_{[i]} > \beta_{[\hat{\imath}]}$, any *feasible* deviation for i would cause it to be matched to an $\alpha_{[j]}$ CEO where $j > \hat{\imath}$. Let $\hat{\delta}$ denote the deviation. Because $\tilde{\delta}_{[j]} = \delta_{[j]}$ for all $j > \hat{\imath}$, observe that the deviation $\hat{\delta}$ would cause the firm to match to the same $\alpha_{[j]}$ in the post-reform game as it would in the pre-reform game. Because $\delta_{[i]}$ was i's best response in the pre-reform game:

$$\begin{aligned} \alpha_{[i]}\Omega\big(\delta_{[i]}, \beta_{[i]}\big) + h\big(\delta_{[i]}\big) - \int_0^i \Omega\big(\delta_{[z]}, \beta_{[z]}\big)\dot{\alpha}_{[z]}dz \\ \geq \alpha_{[j]}\Omega\big(\hat{\delta}, \beta_{[i]}\big) + h\big(\hat{\delta}\big) - \int_0^j \Omega\big(\delta_{[z]}, \beta_{[z]}\big)\dot{\alpha}_{[z]}dz \end{aligned} \tag{44}$$

Suppose that i wished to so deviate in the post-reform game, then

$$\begin{aligned} \alpha_{[i]}\Omega\big(\delta_{[i]}, \beta_{[i]}\big) + h\big(\delta_{[i]}\big) - \int_0^i \Omega\big(\tilde{\delta}_{[z]}, \beta_{[z]}\big)\dot{\alpha}_{[z]}dz \\ < \alpha_{[j]}\Omega\big(\hat{\delta}, \beta_{[i]}\big) + h\big(\hat{\delta}\big) - \int_0^j \Omega\big(\tilde{\delta}_{[z]}, \beta_{[z]}\big)\dot{\alpha}_{[z]}dz \end{aligned} \tag{45}$$

Combining (44) and (45), we reach the contradiction:

$$\begin{aligned} \int_i^j \Omega\big(\delta_{[z]}, \beta_{[z]}\big)\dot{\alpha}_{[z]}dz \geq \alpha_{[j]}\Omega\big(\hat{\delta}, \beta_{[i]}\big) + h\big(\hat{\delta}\big) - \alpha_{[i]}\Omega\big(\delta_{[i]}, \beta_{[i]}\big) - h\big(\delta_{[i]}\big) \\ > \int_i^j \Omega\big(\tilde{\delta}_{[z]}, \beta_{[z]}\big)\dot{\alpha}_{[z]}dz = \int_i^j \Omega\big(\delta_{[z]}, \beta_{[z]}\big)\dot{\alpha}_{[z]}dz\,, \end{aligned} \tag{46}$$

where the last equality follows because i and j both exceed $\hat{\imath}$. The contradiction (46) establishes that the supposition that i wished to deviate in the post-reform game is false. The same reasoning can be used to show that the $\hat{\imath}$-type firm does not wish to deviate.

Consider an i-type firm, $i < \hat{\imath}$. Define $m(\delta,\beta)$ as in the proof of Lemma 3 (except the relevant schedule is $\tilde{\delta}_{[\cdot]}$). We need to show

$$\delta_{\hat{\imath}} \in \operatorname*{argmax}_{\delta \geq \delta_{\hat{\imath}}} \alpha_{[m(\delta,\beta_{[i]})]}\Omega\big(\delta,\beta_{[i]}\big) + h(\delta) - \int_0^{m(\delta,\beta_{[i]})} \Omega\big(\tilde{\delta}_{[j]},\beta_{[j]}\big)\dot{\alpha}_{[j]}dj\,. \tag{47}$$

Following a derivation similar to the one in (41), the derivative of (47) with respect to δ is

$$\alpha_{[m(\delta,\beta_{[i]})]}\frac{\partial\Omega\big(\delta,\beta_{[i]}\big)}{\partial\delta} + h'(\delta)\,. \tag{48}$$

Disclosure $\delta_{\hat{\imath}}$ will be a best response for i if (48) is negative for all $\delta \geq \delta_{\hat{\imath}}$. For notational simplicity, let $m = m(\delta,\beta_{[i]})$. From the definition of $m(\delta,\beta_{[i]})$, we know

$$\Omega\big(\delta,\beta_{[i]}\big) = \Omega\big(\tilde{\delta}_{[m]},\beta_{[m]}\big)\,.$$

Because $\beta_{[m]} > \beta_{[i]}$, $\tilde{\delta}_{[m]} < \delta$. Using (41) and the fact that $\alpha_{[j]}\Omega(\delta,\beta_{[j]}) + h(\delta)$ is globally concave in δ, we have the chain:

$$0 \geq \alpha_{[m]}\frac{\partial\Omega\big(\tilde{\delta}_{[m]},\beta_{[m]}\big)}{\partial\delta} + h'(\tilde{\delta}_{[m]}) > \alpha_{[m]}\frac{\partial\Omega\big(\delta,\beta_{[m]}\big)}{\partial\delta} + h'(\delta) > \alpha_{[m]}\frac{\partial\Omega\big(\delta,\beta_{[i]}\big)}{\partial\delta} + h'(\delta)\,.$$

Recalling that $m = m(\delta,\beta_{[i]})$, we have shown (48) is negative for all $\delta \geq \delta_{\hat{\imath}}$, so $\delta_{\hat{\imath}}$ is indeed an i-type firm's best response.

Given we have shown the schedule $\tilde{\delta}_{[\cdot]}$ is an equilibrium of the post-reform game, the result follows for the reasons given in the text. ■

Proof of Proposition 15: It is readily seen that $w_o \leq w_f$ (compare (10) to (12) noting both are to be evaluated at $\delta + y^*(\delta)$) with strict inequality if $y^*(\delta) > 0$ and $\lambda < 1$.

Because both $\pi(\cdot)$ and $u(\cdot)$ are concave, it follows from standard comparative-statics analysis that ${y^*}'(\delta) < 0$ whenever $y^*(\delta) > 0$. Because $\pi'(0) > 0$, it follows that $y^*(0) > 0$. The assumptions on $\pi(\cdot)$, $u(\cdot)$, and $L(\cdot)$ imply the derivative of (11) with respect to y is strictly negative for δ large enough. It follows from all this that there exists a unique $\bar{\delta} \in (0,\infty)$ such that

$$\pi'(\bar{\delta}) + \frac{\lambda}{\iota}\big(\pi'(\bar{\delta}) + u'(\bar{\delta})\big) = 0\,, \tag{49}$$

where the left-hand side of (49) is the derivative of (11) with respect to y evaluated at $y = 0$. Observe (49) implies

$$\pi'(\bar{\delta}) + u'(\bar{\delta}) < 0\,. \tag{50}$$

The concavity of $\pi(\cdot)$ and $u(\cdot)$ imply, therefore, that the derivative of (13) with respect to δ is negative for all $\delta > \bar{\delta}$. It follows the owners would never choose a $\delta > \bar{\delta}$. However, at $\bar{\delta}$, the left derivative of (13) is

$$-\lambda L'\big(y^*(\bar{\delta})\big){y^*}'(\bar{\delta}) + \frac{\lambda(1+\iota)}{\iota}\Big(\pi'\big(\bar{\delta} + y^*(\bar{\delta})\big) + u'\big(\bar{\delta} + y^*(\bar{\delta})\big)\Big) < 0\,, \tag{51}$$

where the inequality follows from (50) given $y^*(\bar{\delta}) = 0$ and $L'(0) = 0$. Hence, in equilibrium, it must be optimal for the owners to choose a δ such that $y^*(\delta) > 0$.

The first-order condition for maximizing (13) is

$$-\lambda L'\big(y^*(\delta)\big)y^{*\prime}(\delta) + \frac{\lambda(1+\iota)}{\iota}\Big(\pi'\big(\delta + y^*(\delta)\big) + u'\big(\delta + y^*(\delta)\big)\Big) = 0\,.$$

The first term on the left-hand side is positive (recall $y^{*\prime}(\delta) < 0$), so the second must be negative. But the second term is a constant times the derivative of welfare. Given welfare is globally concave in total disclosure, if follows that $\delta + y^*(\delta)$ must exceed the welfare-maximizing level. ■

Proposition A.1 *Consider the model of Section I. Suppose the (expected) payoff to the owners if they retain the incumbent* CEO *equals his ability and their payoff if they fire him is* $-f-g$*, where* $f > 0$ *is a firing cost and* $g \geq 0$ *is a golden parachute. Assume the* CEO*'s utility is given by (2); that is, he loses* ℓ *if fired. Finally, suppose the owners possess all the bargaining power. Then the optimal golden parachute equals* ℓ *and the optimal precision of the signal is maximal.*

Proof: Observe

$$\Pi(\hat{\theta}) = \begin{cases} -f-g\,, & \text{if } \hat{\theta} < -f-g \\ \hat{\theta}\,, & \text{if } \hat{\theta} \geq -f-g \end{cases}\,.$$

Hence,

$$\begin{aligned}\mathbb{E}\big\{\Pi(\hat{\theta})\big\} &= -\Phi\left(\frac{-f-g}{\sigma}\right)(f+g) + \int_{-f-g}^{\infty}\frac{\hat{\theta}}{\sigma\sqrt{2\pi}}\phi\left(\frac{\hat{\theta}}{\sigma}\right)d\hat{\theta} \\ &= -\Phi\left(\frac{-f-g}{\sigma}\right)(f+g) + \sigma\phi\left(\frac{-f-g}{\sigma}\right)\,, \qquad (52)\end{aligned}$$

where $\sigma = \sqrt{\mathrm{Var}(\hat{\theta})}$.

The CEO's expected utility is

$$(g-\ell)\Phi\left(\frac{-f-g}{\sigma}\right) + w\,, \qquad (53)$$

where w is his non-contingent compensation. For the CEO to be willing to accept employment (53) cannot be less than the CEO's reservation utility, $\bar{u}$. Because w is a pure expense, the owners optimally set it as low as possible, hence the participation constraint is binding. The owners' expected profit is, therefore,

$$-\Phi\left(\frac{-f-g}{\sigma}\right)(f+\ell) + \sigma\phi\left(\frac{-f-g}{\sigma}\right) - \bar{u}\,.$$

The first-order conditions with respect to g and σ are, respectively,

$$\frac{1}{\sigma}\phi\left(\frac{-f-g}{\sigma}\right)(f+\ell)-\frac{1}{\sigma}\phi\left(\frac{-f-g}{\sigma}\right)(f+g)=0 \text{ and } \tag{54}$$

$$\left(1+\frac{(f+g)^2}{\sigma^2}-\frac{(f+g)(f+\ell)}{\sigma^2}\right)\phi\left(\frac{-f-g}{\sigma}\right)>0 \tag{55}$$

Clearly, the only solution to (54) is $g=\ell$. Given that solution, the left-hand side of (55) becomes ϕ, verifying the indicated inequality. Because σ is monotone in q, this implies that the optimal q is the largest possible q. ■

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