A Framework for Assessing Corporate Governance Reform*

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Abstract

In light of recent corporate scandals, numerous proposals have been introduced for reforming corporate governance. This paper provides a theoretical framework through which to evaluate these reforms. Unlike various *ad hoc* arguments that have been made, this framework recognizes that governance structures arise *endogenously* in response to the constrained optimization problems faced by the relevant parties. Contract theory provides a set of *necessary* conditions under which governance reform can be welfare-improving: 1) There is asymmetric information at the time of contracting; or 2) Governance failures impose externalities on third parties; or 3) The state has access to remedies or punishments that are not available to private parties. We provide a series of models that illustrate the importance of these conditions and what can go wrong if they're not met.

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1 Introduction

Corporate governance is again an area of interest. After the scandals at Enron, Worldcom, and other firms, many authors, politicians and even practitioners have called for regulatory changes designed to "improve" governance. Reforms such as Sarbanes-Oxley (SOx), the Cadbury recommendations, and numerous other proposals emphasize the attention that corporate governance has received in the public policy arena. Yet, the issue is in fact a very old one; if Smith (1776) did not write in such an elegant style, some of his *Wealth of Nations* could have come from a recent issue of *Fortune* or *Business Week*.[1] That complaints about corporate governance being "ineffective" have been heard since the beginnings of the corporate form suggest that corporate governance is not easily "fixed."

Much of the confusion concerning corporate governance likely arises because discussion of the issues typically, but implicitly, assumes governance is "out of equilibrium." That is, unlike other economic activity, commentators talk as if the invisible hand has yet to guide governance to an equilibrium point. With such a mind set, "reforms," which consist of requiring all firms to adopt what seems to be a good idea or has been shown historically to be a trait associated with good-performing firms, can seem a sensible course of action. For example, the SOx reform requires a powerful audit committee on the board, and heightened personal consequences for directors if the firm engages in financial "misconduct." Yet, the consequences of firms voluntarily adopting these measures are likely to be quite different from the involuntary imposition of these measures on firms. Just as the labor-market equilibrium is quite different when firms voluntarily raise wages as opposed to when wages rise because of a government-imposed minimum wage, the resulting "improvement" in governance from a regulatory-imposed change could be very different from a voluntarily adopted change.

The paper takes a Coasian (Coase, 1960) perspective, insofar as we view governance arrangements as constrained-optimal contracts within the firm. Given this view, "reforms" are simply restrictions on these contracts imposed by an outside authority. In other words, governance reforms are just a special case of contract regulation. We therefore begin our analysis with a review of the contract theory literature on regulation of contracts. This literature identifies three conditions under which restrictions on contracts can be welfare improving. In particular, for externally imposed governance reforms to have the *potential* to improve welfare, there must be asymmetric information *at the time of contracting*, or externalities on a third party, or access by the regulator (state) to penalties or other contractual provisions that are not available to private parties, or some combination of these conditions. This insight from contract theory provides a framework for understanding when governance regulations have the

[1] "The directors of [joint stock] companies, however, being the managers rather of other people's money than of their own, it cannot well be expected, that they should watch over it with the same anxious vigilance [as owners] ... Negligence and profusion, therefore, must always prevail, more of less, in the management of the affairs of such a company" (Smith, 1776, p. 700).

potential to improve welfare, and as such, potentially provide guidance to both academics wishing to understand governance, and to policy-makers wishing to improve practice.

We illustrate this principle with two models designed to study the effect of potential regulatory reforms similar to those recently adopted in Sarbanes-Oxley and other regulations. Each starts with a model of what governance would look like in the absence of regulations and derives the implications of alternative regulatory regimes. In each model, governance is derived *endogenously*, so that changes in the regulatory environment can be traced through the governance structure to their impact on real decisions made by firms. In each case, the models illustrate the usefulness of the contract theory framework that derives which types of reforms could potentially (but not necessarily) lead to welfare improvements.

We first extend Hermalin and Weisbach (1998) and Hermalin's (2005) adaptation of Holmstrom's (1999) career-concerns model to consider the question of optimal transparency. Sections 3 through 5 lay out the basics of this model, in which the company chooses the "quality" of the performance measure that directors use to assess the CEO's ability. The CEO can exert effort at distorting this information.[2] In this setup, a reform that increases transparency can be thought of as increasing the minimum acceptable level of reporting quality. We show that the consequence of such a reform will be to actually increase the CEO's incentives to distort information about the firm. In addition, it will also lead to an increase in the probability that the CEO will be fired and, because of both these consequences, an increase in the CEO's compensation. Moreover, the combination of these effects can actually be to decrease expected profits. Thus, the model implies that regulations stipulating better disclosure decreases efficiency, despite the fact that the improved information is put to good use in employing better quality CEOs on average.

In Section 6, we consider reforms that raise the cost to the CEO of concealing information about the firm. This version of the model is intended to capture the provision of the Sarbanes-Oxley act that makes the CEO personally liable for accounting misrepresentations. This type of reform can increase welfare if the penalties for misreporting are sufficiently high. We view this finding as consistent with the overall framework, since the state has access to penalties (*e.g.,* incarceration) that are not available to private parties.

We conclude in Section 7.

[2]Inderst and Mueller (2005), Singh (2004), and Goldman and Slezak (in press) are three other recent papers concerned with the CEO's incentives to distort information. Like us, the first is concerned with the board's making inferences about the CEO's ability. Inderst and Mueller's approach differs insofar as they assume the CEO possesses information not available to the board, which the board needs to induce the CEO to reveal. There is no uncertainly about the CEO's ability in Singh's model; he is focused on the board's obtaining accurate signals about the CEO's actions. Goldman and Slezak are concerned primarily with the design of stock-based compensation.

2 Implications of Contract Theory for Governance Reform

Consider a proposed reform of corporate governance that is to be imposed on firms by the state. Can such a reform be welfare enhancing? The question is, in essence, equivalent to one that has been raised in contract theory: Is there scope for welfare-improving restrictions on private contracts? In the contract theory literature, three cases have been identified in which an affirmative answer can be given: (i) there is asymmetric information between the parties at the time of contracting (Aghion and Hermalin, 1990; Spier, 1992); (ii) the contract between the two parties has an externality on a third party (Aghion and Bolton, 1987); or (iii) the courts can impose a remedy or penalty not available to the parties privately (Hermalin and Katz, 1993, in passing). Moreover, extending the results of Coase (1960), Hermalin and Katz establish that these are the only three possible cases in which outside interference in private contracting has the potential to be welfare improving when agents are rational.[3] It is worth noting that the Hermalin and Katz result applies regardless of whether the contracts in question are complete or incomplete.

To the extent that corporate governance can be thought of as a set of contracts among the relevant actors, this result provides a useful framework for evaluating potential reforms to corporate governance. In particular, when evaluating a proposed regulation, any potential scope for improvement must come from the regulation's corrective effect on asymmetry of information *at the time of contracting*;[4] externalities on third parties; or the contracting technology (which could be altered by potential regulations; for example, jail terms for failure to comply with contractual provisions). While these conditions are not, in some sense, new—they are among the implicit conditions under which the Coase theorem holds—they are often ignored in analyses of corporate governance. These conditions, while fairly general, limit the scope for beneficial corporate governance reform. In particular, it is not obvious how many ostensibly sensible reforms actually fulfill them.

One case in which governance reforms offer benefits is when a new regulation extends the set of feasible contracts. Certainly the existence of criminal penalties in certain circumstances goes beyond that to which private parties could agree. In addition, the establishment of a regulatory body and case law, which helps to eliminate uncertainty about how contractual provisions will be interpreted in court, could conceivably make it possible for the parties to use a wider range of provisions than they might otherwise be able to use.

[3] Hermalin and Katz's result depends on the private parties being able to bargain to a constrained efficient solution. For instance, if bargaining is alternating-offer bargaining, then there is no scope for efficiency-enhancing restrictions provided (i) the parties are symmetrically informed *ex ante*; (ii) there is no externality on a third party; and (iii) the state does not have access to more remedies than the parties (see Proposition 4 of Hermalin and Katz).

[4] While shareholders generally possess less information than management, this asymmetry of information usually arises *post* contracting (*i.e.,* once management has already been hired).

Externalities undoubtedly exist but it is not obvious how they are relevant to corporate governance. While massive governance failures appear to have spillovers, as for instance evidenced by the market's apparent reaction to the Enron and Worldcom debacles, the vector of contagion is unclear and, therefore, it is unclear how they should influence governance reform.[5]

Finally, asymmetric information could conceivably justify regulatory interference with private contracting. However, the asymmetric information would have to exist at the time of contracting. While it is possible that such asymmetric information could exist in some firms, in general, the most commonly analyzed cases of asymmetric information are those that occur *after* management is in place and has a chance to learn more about their firms than shareholders. The existence of *ex post* asymmetric information (*i.e.,* learned after contracts are in place) is not sufficient to justify regulations; rather, the asymmetry must exist at the time of contracting to fulfill the condition.

3 Optimal Transparency and Corporate Governance

Among the key elements of Sarbanes-Oxley and other reform proposals are increased disclosure requirements. Sarbanes-Oxley, for example, requires increased reporting of off-balance-sheet financing and special-purpose entities (*e.g.,* the activities that Enron allegedly used to deceive investors). Intuitive arguments, formalized by Diamond and Verrecchia (1991), suggest that the cost of capital should decrease when firms provide better information about their companies. Indeed, Leuz and Verrecchia (2000) find evidence suggesting that firms' cost of capital does decrease when they *voluntarily* switch to a reporting regime that requires greater disclosure.

However, it is not obvious that just because firms appear to benefit when they *voluntarily* increase disclosure that all firms should be required to have higher disclosure. In particular, higher disclosure likely leads to a behavioral response by market participants; the overall welfare change will incorporate the impact of these responses. To evaluate the effect of mandated changes in transparency, it is important to have a model of disclosure in which participants'

[5]Presumably the Enron and Worldcom fiascos either conveyed news to the market or they spooked naïve traders. If the latter, then the consequence, in the short term at least, is essentially distributional—sophisticated traders simply profited from naïve traders' mistakes—and hence irrelevant to welfare. If the former, then the news might be of the form that some governance feature is not as strong as previously thought, but then this (i) is not precisely an externality that Enron or Worldcom have imposed on other firms; (ii) is potentially remediable through *private* action; and (iii) presumably was an *unforeseen* event that those writing regulations would have been no more likely to anticipate than the private parties. Another possible bit of "news" is that these scandals could have caused sophisticated investors to anticipate costly government reaction. In this case, Enron and Worldcom could be seen as having imposed an externality by not exercising sufficient precaution, but it is a peculiar externality because it is due to an essentially irrational political reaction that is precisely contrary to this paper's arguments.

responses to disclosure changes are endogenously determined inside the model.[6]

We present such a model below. The focus of the model is the relationship between the CEO and the board. The board's function is to assess the CEO's ability based on the information available to it, and to replace him if the assessment is too low. The CEO receives private benefits from controlling the company, so he has incentives to do what he can to influence the board's decision in his favor, which, in the model, consists of distorting, favorably, the information to which the board has access. Exogenous regulatory changes that affect disclosure quality thus affect both the information available to the board, and the CEO's response to the information.

3.1 Timing of the Model

The model has the following timing, which is adapted from Hermalin (2005).

Stage 1. The board of directors (firm) establishes a level of reporting quality, q (its choice may be constrained by legal restrictions—*e.g.,* SEC requirements). The board also hires a CEO from a pool of *ex ante* identical would-be CEOs. A given CEO's ability, α, is an independent random draw from a normal distribution with mean 0 and variance $1/\tau$. Normalizing the mean of the ability distribution to zero is purely for convenience and is without loss of generality.

Stage 2. The CEO takes private actions that affect the board's perception of how he (the firm) is doing. Assume these actions can be summarized by a uni-dimensional variable, $e \in \mathbb{R}_+$.[7]

Stage 3. After the CEO has worked for some point and has taken actions designed to improve the board's perception of him, the board acquires a private signal, y, about the CEO's ability. The signal is distributed normally with a mean equal to $\alpha + e$ and a variance equal to $1/q$. Letting the precision, q, of the distribution be the same as the quality of reporting, q, is without loss of generality as we are free to normalize "reporting quality" using whatever metric we wish.[8]

Stage 4. On the basis of the signal, the board updates its estimate of the CEO's ability. Based on this posterior estimate, the board may decide to fire

[6]The *endogenous* determination of disclosure is one of the dimensions that differentiates this paper from Goldman and Slezak (in press); in their article they treat disclosure rules as being set exogenously.

[7]Specifically, if $\mathbf{a}$ is a vector of activities, we are assuming that there is a function $e(\mathbf{a})$ that maps their collective influence on to the board's perception of how the firm is doing. If $\tilde{k}(\mathbf{a})$ is the CEO's disutility from pursuing those activities, then the function $k(\cdot)$, introduced *infra*, is defined as $k(e) = \min \tilde{k}(\mathbf{a})$ subject to $e(\mathbf{a}) = e$.

[8]Hermalin and Weisbach (1998) and Hermalin (2005) adopt an alternative formulation in which the precision is fixed, but the variable in question (*i.e., q*) is simply the probability that the board observes the signal. As Hermalin shows, however, the two approaches lead to essentially the same analysis (see his §VI).

the CEO and hire a replacement. A replacement CEO's ability is a random draw from a normal distribution with mean 0 and variance $1/\tau$. Hiring a replacement incurs a firing cost of $f > 0$. This can be seen as the cost of the disruption that occurs if the CEO is fired or the cost of searching for a new CEO or both.

Stage 5. Revenues are realized. Revenues equal $\alpha + \varepsilon$, where $\mathbb{E}\{\varepsilon\} = \mathbb{E}\{\varepsilon|\alpha\} = 0$ and α is the ability of the CEO in place at this final stage.[9] The random variables y and ε are independently distributed.

3.2 Preferences and Ability

If the CEO in hired at Stage 1 survives to Stage 5, he receives a control benefit of $b > 0$. If he is dismissed prior to this stage (or not hired at all), then he receives a benefit of 0.

The CEO hired at Stage 1 is also compensated with a wage, w.[10] This wage is paid *regardless* of whether the CEO survives to Stage 5. The wage paid a replacement CEO is assumed to be embedded in f, the disruption cost.

A CEO's ability is fixed throughout his career. We follow Holmstrom (1999) by assuming that the CEO, like the board, knows only the *distribution* of his ability. We justify this assumption by noting that the uncertainty about a CEO's ability in a *particular* job is largely uncertainty about the match between him and the job, which is similarly unknown to both the board and the CEO.

The expected utility of a CEO hired at Stage 1 is

$$w + b\Pr\{\text{not fired}\} - k(e)\,, \tag{1}$$

where $k(\cdot)$ is a strictly convex and twice differentiable function. Assume $k(0) = k'(0) = 0$ and that $k'(e) > 0$ for $e > 0$. To ensure existence of a pure-strategy equilibrium, we maintain the following:

Assumption 1 $\inf_{e\in\mathbb{R}_+} k''(e) > b\tau\exp(-1/2)/\sqrt{2\pi}$.

The initially hired CEO has a reservation utility, $u_R \geq b$. That is, (1) cannot be less than u_R. Requiring that u_R not be less than b rules out a negative wage.

We assume that individual directors like higher earnings. Following Hermalin and Weisbach (1998), we assume the preferences of the individual directors can be aggregated in such a way that the board acts as if it is a single risk-neutral decision maker with respect to firm profits. Without further loss of generality, we can, thus, take the board's utility as equal to firm profits.

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[9] It would not change the analysis—other than to complicate the notation—to add a positive constant to revenues so that the probability of negative revenues was arbitrarily small. Similarly, the analysis would be unaffected if we assumed $\alpha+\varepsilon$ were earnings net of production costs but gross of the CEO's compensation and governance costs.

[10] Because the signal y is private, it cannot be the basis of compensation. Because final revenues are not a function of managerial action, there is no reason to tie this compensation to final revenues (*i.e.,* to use an incentive contract). If the CEO were are at all risk averse, it would be strictly better to pay him a flat wage.

3.3 Updating Beliefs and Monitoring

As we detail later, in equilibrium the board will correctly infer what level of distortionary effort, e, the CEO has spent. Hence, it can subtract out that inferred level, $\hat{e}$, from y to get a pure signal of ability, $\hat{y} \equiv y - \hat{e}$. Define $\tilde{y} = y - e$. As noted, in equilibrium, $\tilde{y} = \hat{y}$. As a benchmark, we will work with $\tilde{y}$ in this section.

Suppose, for the time being, that the board either observed e (rather than inferred it) or that e was constant. After the signal, y, is observed, the players update their beliefs about the CEO's ability. The posterior estimates of the mean and precision of the distribution of the CEO's ability are

$$\mu' = \frac{q\tilde{y}}{q+\tau} \text{ and } \tau' = \tau + q\,, \tag{2}$$

respectively (see, *e.g.,* DeGroot, 1970, p. 167, for a proof). The posterior distribution of ability is also normal.

We assumed that the distribution of the signal $\tilde{y}$ given the CEO's *true* ability, α, is normal with mean α and variance $1/q$; hence, the distribution of $\tilde{y}$ given the *prior* estimate of the CEO's ability, 0, is normal with mean 0 and variance $1/q + 1/\tau$.[11] Define

$$H = \frac{q\tau}{q+\tau}$$

to be the precision of $\tilde{y}$ given the prior estimate of ability, 0.[12]

Observe that the board's posterior estimate of a CEO's ability is also expected revenues. After fixing (sinking) the CEO's wage and any other costs, it is also expected profits.

The alternative to retaining the incumbent CEO at stage 4 is to replace him. The expected revenues from a replacement are, by assumption, zero. The expected profit from a *replacement* CEO is, therefore, $-f$ (*i.e.,* expected revenue less disruption costs). Subsequent to obtaining a signal, $\tilde{y}$, the incumbent CEO will, thus, be dismissed if $\mu' < -f$. Using expression (2), we can restate the dismissal condition as

$$\tilde{y} < -\frac{(q+\tau)f}{q} \equiv Y\,. \tag{3}$$

Given this option of dismissal, the firm's expected value *prior* to receiving a signal with precision p is

$$\begin{aligned} V &= \int_{-\infty}^{\infty} \max\left\{-f, \frac{q\tilde{y}}{q+\tau}\right\} \sqrt{\frac{H}{2\pi}} \exp\left(-\frac{H}{2}\tilde{y}^2\right) d\tilde{y} \\ &= \frac{\sqrt{H}}{\tau}\phi\big(Y\sqrt{H}\big) - f\Phi\big(Y\sqrt{H}\big)\,, \end{aligned}$$

[11] The random variable $\tilde{y}$ is the sum of two independently distributed normal variables $\tilde{y} - \alpha$ (*i.e.,* the error in $\tilde{y}$) and α; hence, $\tilde{y}$ is also normally distributed. The means of these two random variables are both zero, so the mean of $\tilde{y}$ is, thus, 0. The variance of the two variables are $1/q$ and $1/\tau$ respectively, so the variance $\tilde{y}$ is $1/q + 1/\tau$.

[12] As a convention, functions of many variables, such as H, will be denoted by capital letters.

where $\phi(\cdot)$ is the density function of a standard normal random variable (*i.e.,* with mean zero and variance one) and $\Phi(\cdot)$ is the corresponding distribution function. The second line follows from the first using the change of variables $z \equiv \tilde{y}\sqrt{H}$. In what follows, it is useful to define

$$Z \equiv Y\sqrt{H} = \frac{-f\tau}{\sqrt{H}}\,.$$

Note that

$$1 - \Phi(Z) = \Phi(-Z) \tag{4}$$

is the probability that the CEO will be retained after the board observes the signal.

Lemma 1 *Taking* CEO *compensation, w, as fixed, the firm's expected value is increasing in the quality of reporting, q (i.e., $\partial V/\partial q > 0$).*

4 CEO Choice of Effort

As noted earlier, the board wishes to base its firing decision on $\tilde{y}$; that is, the signal y with the CEO's efforts subtracted out. To calculate $\tilde{y}$ from y, the board needs to know e, the CEO's efforts. Because, however, the board doesn't observe e, it can only subtract out the amount of effort it anticipates the CEO expended, $\hat{e}$ (in a pure-strategy equilibrium, $\hat{e}$ and e will be the same).

Based on its inference, the board bases its firing decision on $\hat{y} = y - \hat{e}$. It will, therefore, fire the CEO if

$$\hat{y} < Y\,; \tag{5}$$

that is, if

$$\begin{aligned} y - \hat{e} = \tilde{y} + e - \hat{e} < Y\,,\ &\text{or} \\ \tilde{y} < Y + \hat{e} - e\,. \end{aligned} \tag{6}$$

The Y in expressions (5) and (6) is the same as in (3).

Using (4), the CEO's expected utility as a function of e is

$$b\Phi\big(-(Y + \hat{e} - e)\sqrt{H}\big) - k(e)\,. \tag{7}$$

The CEO chooses e to maximize (7) given his anticipation of the board's belief about his effort, $\hat{e}$. The first-order condition is

$$b\phi\big(-(Y + \hat{e} - e)\sqrt{H}\big)\sqrt{H} - k'(e) = 0\,. \tag{8}$$

In a pure-strategy equilibrium, the board must correctly anticipate the CEO's effort; that is, $\hat{e} = e$ in equilibrium. The equilibrium value of effort, e^*, is, thus, the solution to

$$b\phi\big(-Y\sqrt{H}\big)\sqrt{H} - k'(e^*) = 0\,. \tag{9}$$

Because $k'(\cdot)$ is strictly monotonic, with a range of $[0, \infty)$, a unique e^* exists that solves (9). In other words, *if* a pure-strategy equilibrium exists, then it is unique and, in it, the CEO supplies effort e^*. Because $k'(0) = 0$, $e^* > 0$.

The one remaining step is, thus, to establish that a pure-strategy equilibrium exists:

Lemma 2 *Under Assumption 1, a pure-strategy equilibrium exists and is unique.*

Without Assumption 1 it is possible that no pure-strategy equilibrium exists. Fixing the board's expectation of the CEO's effort, the CEO's marginal benefit of trying to influence the board's beliefs about his ability is increasing in b and H. The reason it is increasing in b is obvious. The greater the conditional precision of the signal, H, the more weight the board places on the signal, which increases the CEO's motivation to distort it. In equilibrium, however, the board has to form correct expectations. If the CEO's incentives to distort the signal are large, then the board will expect the CEO to choose a high level of effort. Because of the cost he bears, at some point it ceases to be worth it to the CEO to "live up" to the board's expectations if those expectations are too great. In other words, it is possible that, absent Assumption 1, the only candidate pure-strategy equilibrium entails an expected level of effort that is so great that it does not maximize the CEO's expected utility to meet that expectation.[13] Assumption 1 effectively sets an upper bound on bH that ensures that board's expectation won't be so great as to induce the CEO not to live up to it.

An important issue is what is the effect of an increase in q, the quality of reporting, on e^*, the equilibrium level of distortionary effort?

Proposition 1 *The CEO's equilibrium effort at distortion increases with the quality of reporting; that is, $de^*/dq > 0$.*

Proposition 1 demonstrates that a potential unintended consequence of higher quality reporting is greater effort by management (the CEO) to distort information about performance.

The CEO's chance of dismissal is also increasing in q. To see this, differentiate (4) with respect to q. The derivative is

$$-\phi(-Z)\frac{f\tau}{2H^{3/2}} \times \frac{\tau^2}{(q+\tau)^2} < 0\,.$$

Hence,

Proposition 2 *The CEO's equilibrium probability of being fired increases with the quality of reporting.*

[13] Although $e = e^*$ is always a local maximum of the CEO's utility, it ceases to be a global maximum when bH gets too large. See Hermalin (2005) for details.

5 Optimal Reporting Quality

The CEO will accept employment in Stage 1 only if his expected utility exceeds his reservation utility; that is, only if

$$w + b\Phi(-Z) - k\big(e^*(q)\big) \geq u_R\,. \tag{10}$$

All else equal, the board prefers that w be as small as possible, which means the CEO's participation constraint, (10), binds. Substituting that constraint into expected profits net of CEO compensation, the firm's expected profit (and, thus, the board's expected utility) is

$$\underbrace{\frac{\sqrt{H}}{\tau}\phi(Z) - f\Phi(Z)}_{V} + \underbrace{b\Phi(-Z) - k\big(e^*(q)\big) - u_R}_{-w}\,. \tag{11}$$

There is no reason *a priori* to expect (11) to be concave in q or to have an interior maximum. For instance, consider the case in which the set of possible reporting qualities, q, is $[\underline{q}, \infty)$, $\underline{q} > 0$, and $k(e) = e^2/2$.[14] When $bf\tau \geq 1$, we have the following:

Proposition 3 *Suppose the lowest possible level of reporting quality, $\underline{q}$, is strictly positive and $k(e) = e^2/2$. Then, if $bf\tau \geq 1$, the level of reporting quality that maximizes expected firm profit subject to the* CEO*'s participation constraint is $q = \underline{q}$.*

The parameter $\underline{q}$ should be seen as the minimum possible quality of reporting. As such, it reflects the bounds imposed on the firm by SEC and other reporting requirements, as well as the fact that some information will be available to directors through press stories and other similar channels.

The intuition behind Proposition 3 is as follows. With a large private benefit, b, the CEO's motivation to invest in distorting behavior is also large. The firm (directors) must, in a sense, compensate the CEO for this investment. In addition, the firm must also compensate the CEO for the risk of losing that benefit. Combined, these two effects can be so large that the directors wish to commit as much as possible *ex ante* to keeping the CEO. They do this by choosing to have low-quality reporting, because this translates into the board's being less responsive to the signal (*i.e.,* y) than they it would be if y were a more precise signal.

Observe that, under the assumptions of Proposition 3, the profit-maximizing quality of reporting is the smallest allowed level, $\underline{q}$. That is, the benefits of more accurate information as identified by Lemma 1 can be dominated completely by the adverse consequences discussed above.[15] Consequently, if the effect of reforms such as Sarbanes-Oxley is to raise $\underline{q}$, then reforms will serve to reduce firms' profits.

[14] If $k(e) = e^2/2$, then Assumption 1 requires $b < \sqrt{2\pi\exp(1)}/\tau$ (*i.e.,* roughly, $b\tau < 4.133$).

[15] A large literature in accounting emphasizes the usefulness of accounting information for the purpose of improving contracts among parties, including bondholders, managers, and

Corollary 1 *Under the assumptions of Proposition 3, if the effect of externally imposed reforms is to raise the minimum permissible quality of reporting information, $\underline{q}$, then these reforms will cause (i) a fall in firm profits; (ii) an increase in the* CEO *turnover rate; and (iii) an increase in* CEO *compensation.*

Proof: Follows immediately from Lemma 1 and Propositions 2 and 3. ■

Proposition 3 and its corollary have clear implications for thinking about reforms that change reporting requirements. While such reforms leader to better information about managerial performance, they can also lead to higher management compensation and more—ultimately wasted—effort at distorting information by management. As such, these results illustrate the point made more generally in Section 2 about the cost of externally imposed restrictions on private contracting.

Point (iii) of the corollary is, in fact, quite general.

Proposition 4 *The* CEO*'s equilibrium compensation, w, is increasing in the level of reporting quality, q.*

The analysis has so far focused on the case when the CEO's private benefit, b, is relatively large. When it is small, the amount the CEO has at risk and, thus, his incentive to invest in distortionary effort is likewise small. Numerical calculations—see Figure 1—show that expected profit (*i.e.,* expression (11)) can start to rise in q once q is large enough. In contrast, for b large (*i.e.,* under the assumptions of Proposition 3), a graph similar to Figure 1 would show an everywhere decreasing $\Pi(q)$.

For the situation depicted in Figure 1, the optimal q depends on the value of $\underline{q}$. If, for example, $\underline{q}$ corresponds to the line ℓ_1 in Figure 1, then $\underline{q}$ is optimal. If, however, it corresponds to the line ℓ_2, then the largest possible value of q is optimal.

Figure 1 suggests the possibility of a tipping dynamic *vis-à-vis* regulation. For low levels of regulation (*e.g.,* those corresponding to ℓ_1), the regulations are binding insofar as the firm chooses the lowest quality reporting permitted. However, once the regulations go above a certain point—for instance, the point at which the $\Pi(q)$ curve crosses the asymptote line in Figure 1—the firm would optimal wish to make the quality of reporting as large as possible. For example, in the figure, suppose that a regulation raised the minimum level from $q = .05$ (approximately ℓ_1) to $q = .3$ (approximately the value that *minimizes* $\Pi(q)$). The firm would respond by, then, raising q as high as possible.

Observation 1 *The following scenario is possible: At a low enough minimum level of reporting quality, a firm optimally adopts this lowest permitted quality of reporting. At a high enough minimum, however, the firm jumps to requiring*

other firms (see Watts and Zimmerman, 1986, especially pages 312–317, for discussion and references). A more compete model, that incorporated these demands for more accurate information, could well lead to a higher optimal value for q. Alternatively, $\underline{q}$ could be seen as the lowest value of q consistent with meeting these other demands.

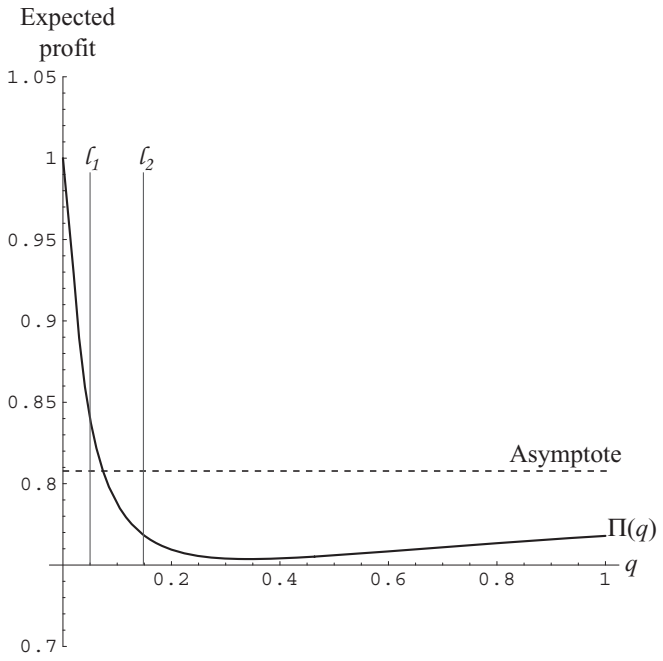

Figure 1: Plot of expected profit, $\Pi(q)$ (*i.e.,* expression (11)) under the assumptions that $k(e) = e^2/2$, $b = 1$, $f = 1/5$, $\tau = 1$, and $p(q) = q$. Observe the asymptote corresponds to $\lim_{q\to\infty} \Pi(q) \approx .81$.

the maximum possible level of reporting quality, a level strictly greater than the minimum required.

The intuition behind this insight is as follows. As discussed, in setting q the board is trading off two factors. On the one hand, as shown by Lemma 1, raising q increases firm value *ceteris paribus*. On the other hand, raising q lowers the CEO's utility, both because it increases the probability he will be dismissed and because it induces him to expend more effort in distortionary activities. The CEO must be compensated for this loss of utility, which means his wage rises. In the scenario illustrated in Figure 1, initially the marginal cost of increasing q exceeds the marginal benefit. At some point, however, q gets sufficiently large that the value $-Y\sqrt{H}$ is sufficiently far into the right tail of the normal distribution that a further push into the tail increases the CEO's incentive to distort the signal by only a small amount (see expression (9)) and raises the probability that he is fired by only a small amount, so the overall increase in disutility is small. Consequently, the firm's marginal cost of increasing q can fall below the firm's marginal benefit of doing so.

6 Raising the Cost of Concealment

One view of reforms, such as Sarbanes-Oxley, is that they raise the cost to management of distorting information by imposing *criminal* penalties on managers who misreport information. In doing so, SOx falls into the category of reforms that, according to contract theory, could potentially increase welfare. Recall, as noted in Section 2, private contracts cannot impose criminal penalties, which means there is a scope for such reforms to be welfare improving insofar as they represent the creation of a remedy not available privately to the parties in question.

To model the situation we suppose, now, that $q > 0$ is fixed exogenously. What is endogenous is the probability p that the board does *not* observe the signal, y. In this version of the model, p, is chosen by the CEO in Stage 2 along with e. The cost to the CEO is $c(p, r)$, where r is a parameter (*e.g.,* a reporting standard) that affects the CEO's cost of increasing the odds that the signal is hidden from the board. We assume

Assumption 2 *The cost function $c(\cdot,\cdot)$ satisfies*

(i) $c(0, r) = 0$ *and* $\partial c(0, r)/\partial p = 0$ *for all* r*;*

(ii) $\partial c(1, r)/\partial p = \infty$ *for all* r*;*

(iii) $\partial c(p, r)/\partial p \geq 0$ *and* $\partial^2 c(p, r)/\partial p^2 > 0$ *for all* r*; and*

(iv) $\partial c(p, r)/\partial r \geq 0$ *and* $\partial^2 c(p, r)/\partial p \partial r > 0$ *for all* r *and all* $p \in (0, 1)$.

In essence, Assumption 2 establishes that the cost function is well behaved and that an increase in r raises both the total cost and the marginal cost of efforts to hide the signal.

The cost $c(p,r)$ can be interpreted in a number of ways. One interpretation is that r is the probability that the CEO's efforts to hide the signal are detected, in which case his penalty is an increasing function of his efforts to hide the signal, p. Another interpretation is that r is the penalty if caught trying to conceal the signal and the probability of being caught is greater the more egregious the efforts to hide the signal. Yet another interpretation is that r is a parameterization of the nuisances, obstacles, or other costs (*e.g.,* signing certificates of having reviewed the financial accounts) associated with hiding the signal and that these costs are greater the more effort is going into hiding the signal.

The CEO's expected utility is

$$\begin{aligned} &w + b\Pr\{\text{not fired}\} - k(e) - c(p,r) \\ &\qquad = w + b\Big(p + (1-p)\Phi\big(-(Y + e^* - e)\sqrt{H}\big)\Big) - k(e) - c(p,r)\,. \end{aligned} \tag{12}$$

Observe that the cross-partial derivative of expression (12) with respect to e and p is negative; that is, effort at concealment, p, and effort at distortion, e, are substitute activities for the CEO.

Because $1-p<1$, Assumption 1 is still sufficient for the CEO to play a pure strategy with respect to his choice of e. Moreover, because the CEO's benefits are linear in p and his costs convex in p, he has a unique best response in terms of p as well. From Assumption 2(i) and (ii) that optimal p is in the interval $(0,1)$. Let $e^*(r)$ and $p^*(r)$ define the CEO's optimal choices; observe they satisfy the first-order conditions:

$$\big(1-p^*(r)\big)b\phi\left(-Y\sqrt{H}\right)\sqrt{H} - k'\big(e^*(r)\big) = 0\,;\text{ and} \tag{13}$$

$$b\left(1-\Phi\big(-Y\sqrt{H}\big)\right) - \frac{\partial c\big(p^*(r),r\big)}{\partial p} = 0\,. \tag{14}$$

From Assumption 2(iv) and (14), it follows that $p^{*\prime}(r)<0$. In turn, that result, expression (13), and the convexity of $k(\cdot)$ imply that $e^{*\prime}(r)>0$. To summarize:

Lemma 3 *An increase in the parameter r results in the* CEO *expending less effort on hiding the signal (i.e., $p^{*\prime}(r)<0$) and more effort on distorting the signal (i.e., $e^{*\prime}(r)>0$).*

Recall that the CEO's participation constraint is binding. Consequently, the firm's expected profit (and, thus, the board's expected utility) is

$$\begin{aligned} &\big(1-p^*(r)\big)\underbrace{\left(\frac{\sqrt{H}}{\tau}\phi(Z) - f\Phi(Z)\right)}_{V} \\ &\quad + \underbrace{b\big(p^*(r) + [1-p^*(r)]\Phi(-Z)\big) - k\big(e^*(r)\big) - c\big(p^*(r),r\big) - u_R}_{-w}\,. \end{aligned} \tag{15}$$

Similar to expression (11) earlier, there is no reason to expect *ex ante* that expression (15) is concave in r or admits an interior solution. In fact, depending on the functional forms and the parameter values it is possible that the optimal r is the smallest possible r, the largest possible r, or potentially some level in the middle. For example it can be shown that if

$$k(e) = e^2/2 \text{ and } c(p,r) = -r \times \big(\ln(1-p) + p\big)$$

(note $c(p,r) \geq 0$ and satisfies Assumption 2), then

- the optimal $r = 0$ if $q = 4/10$, $\tau = 1$, $f = 1/5$, and $b = 1$; but
- the optimal $r \to \infty$ if $q = 4/10$, $\tau = 1$, $f = 1/5$, and $b = 1/3$.

The fact that the optimal r could be infinite means, in theory, increasing the *limit* on penalties for concealing information could be welfare improving. In other words, if there is some $\overline{r}$ such that $r \leq \overline{r}$ and that constraint is binding because of limits on penalties, then strengthening penalties is welfare improving. On the other hand, the fact that the optimal r could be zero means, in theory, that mandating *increased* penalties could be welfare reducing. In other words, if there is some $\underline{r}$ such that $r \geq \underline{r}$ and that constraint is binding because of mandatory minimum penalties, then further increasing penalties is welfare reducing. To summarize

Proposition 5 *When the* CEO *can take efforts to conceal the signal, then increasing the limit on penalties can, but won't necessarily, increase welfare. Furthermore, raising the mandatory penalties can, but won't necessarily, reduce welfare.*

In other words, Proposition 5 indicates that there is no obvious social policy with respect to the penalties imposed externally on CEOs who seek to conceal information.

7 Conclusion

In response to the spate of recent corporate scandals, countries have passed a number of "reforms" aimed at improving corporate governance. Economics, despite a long history of studying regulation, has been slow, in the case of governance reforms, to provide a conceptual framework for their evaluation. Such a framework requires treating governance institutions as endogenous, so that we can evaluate behavioral changes in response to a new governance restriction. This paper provides models of endogenous governance and studies some commonly discussed reforms such as those in the Sarbanes-Oxley Act.

Our model is an extension of the Holmstrom (1999) career-concerns model. In our model, a CEO is evaluated by his board and receives a wage and private benefits from the job. The board receives a signal about the CEO's performance, and will replace the CEO if, by its best estimate, a replacement CEO is expected

to yield greater profits than the current one (once transition costs are accounted for). The CEO can exert effort to distort the signal the board receives and has incentives to do so because of the private benefits associated with the job. We assume that the board can specify *ex ante* how informative a signal the board will receive and the informativeness of the signal is assumed to be known at the time the CEO agrees to a contract.

In this model, we first evaluated a reform that increases the minimum precision of the signal (minimum quality of reporting). In equilibrium, this increase leads to higher turnover of CEOs, and greater compensation for CEOs. The increase in compensation can outweigh the benefit of better information about the CEO, so that a firm's profits fall in response to a reform that increases the minimum quality of reporting.

We next considered a model in which the government can increase the costs borne by the CEO when he tries to conceal information. This type of reform can increase value if (i) the increase represents imposing costs on the CEO that are greater than those that can be imposed privately (*e.g.,* criminalizing the concealment of information with jail time as a punishment); and (ii) the firm's objective function (*e.g.,* expression (15)) is everywhere increasing in the costs levied on the CEO. Observe that for this reform to be welfare improving, the increased cost must represent a punishment unavailable to the parties privately (*e.g.,* incarceration).

For many years, people have tried to make the case that something is "wrong" with corporate governance and we should "reform" it. This view ignores the reality that the observed system of governance has been around for a long time and appears to be the market solution. Many proposed governance reforms, such as increased disclosure, or requirements about the composition of the board or CEO salaries, could have been chosen by the market but in fact were not. Models of endogenous governance provide a start to understanding the reasons why the market might not have picked a contracting arrangement that, on its face, seems appealing. This paper provides a first step in this type of analysis; we expect that, in the future, more such work will greatly improve our understanding of governance reform.

Appendix: Proofs

Proof of Lemma 1: Observe

$$\begin{aligned}\frac{d}{dZ}\left(\frac{\sqrt{H}}{\tau}\phi(Z) - f\Phi(Z)\right) &= -Z\frac{\sqrt{H}}{\tau}\phi(Z) - f\phi(Z)\\ &= \left(\frac{f\tau\sqrt{H}}{\tau\sqrt{H}} - f\right)\phi(Z) = 0\,.\end{aligned}$$

Hence,

$$\begin{aligned}\frac{\partial V}{\partial q} &= \frac{1}{2\tau\sqrt{H}}\phi(Z)\frac{\partial H}{\partial q}\\ &= \frac{1}{2\tau\sqrt{H}}\phi(Z)\frac{\tau^2}{(q+\tau)^2} > 0\,,\end{aligned} \tag{16}$$

where the second fraction in the last line is $\partial H/\partial q > 0$. ■

Proof of Lemma 2: It was established in the text that if a pure-strategy equilibrium exists, then it is unique.

By construction $e = e^*$ solves the first-order condition for the CEO's problem of maximizing his expected utility when the board anticipates he will choose effort e^*; that is, $e = e^*$ is a solution to

$$b\phi\big((e - e^* - Y)\sqrt{H}\big)\sqrt{H} - k'(e) = 0\,. \tag{17}$$

If the CEO's objective function, expression (7), is globally concave in e when $\hat{e} = e^*$, then expression (17) is sufficient as well as necessary; moreover, it defines a global maximum. This means that $e = e^*$ is the CEO's unique best response to the board's anticipating his effort will be e^*; that is, that a pure-strategy equilibrium exists.

To establish the concavity of the objective function, we need to show the derivative of (17) is negative. Define

$$S(e) = (e - e^* - Y)\sqrt{H}\,.$$

The derivative of (17) is

$$\begin{aligned}-b\phi\big(S(e)\big)S(e)S'(e)\sqrt{H} - k''(e) &= -b\phi\big(S(e)\big)S(e)H - k''(e) &(18)\\ &\leq -b\phi\big(S(e)\big)S(e)H - \inf_{e\in\mathbb{R}_+} k''(e)\\ &\leq b\phi(1)H - \inf_{e\in\mathbb{R}_+} k''(e) &(19)\\ &\leq b\phi(1)\tau - \inf_{e\in\mathbb{R}_+} k''(e) &(20)\\ &< 0\,, &(21)\end{aligned}$$

where

(18) follows because $S'(e) = \sqrt{H}$;

(19) follows because the solution to the problem $\max_{s\in\mathbb{R}} -s\phi(s)$ is $s = -1$ (the first-order condition is $-\phi(s) + s^2\phi(s) = 0$, which has two solutions $s = 1$ and $s = -1$; but only the second satisfies the second-order condition);

(20) follows because $\partial H/\partial q = \tau^2/(p+\tau)^2 > 0$; hence, H is maximized by letting $q \to \infty$; but $\lim_{q\to\infty} H = \tau$; and

(21) follows from Assumption 1 because $\phi(1) = \exp(-1/2)/\sqrt{2\pi}$.

■

Proof of Proposition 1: Given that $k'(\cdot)$ is monotonic, it follows from expression (9) that de^*/dq will have the same sign as $d\big(\phi(-Y\sqrt{H})\sqrt{H}\big)/dq$. We have

$$\begin{aligned}\frac{d\phi(-Y\sqrt{H})\sqrt{H}}{dq} &= \frac{\phi(-Y\sqrt{H})}{2\sqrt{H}}\frac{\partial H}{\partial q} + YH\phi(-Y\sqrt{H})\overbrace{\frac{-f\tau}{2H^{3/2}}}^{d(Y\sqrt{H})/dH}\frac{\partial H}{\partial q}\\ &\propto 1 - Yf\tau\\ &= 1 + \frac{f^2\tau^2}{\sqrt{H}} > 0\end{aligned}$$

■

Proof of Proposition 3: Let Π equal the expression in (11). Straightforward calculations reveal that, when $k(e) = e^2/2$, the sign of $d\Pi/dq$ is the *opposite* of the sign of

$$b^2\tau\sqrt{H}\big(q + f^2q\tau + f^2\tau^2\big) + \frac{1}{\phi(Z)}\big(bf\tau^2 + q(bf\tau - 1)\big)\,.$$

That expression is positive for all q if $bf\tau \geq 1$. It follows, therefore, that Π is maximized by setting q equal to the minimum possible q, $\underline{q}$. ■

Proof of Proposition 4: As established in the text, the CEO's equilibrium wage is

$$-b\Phi(-Z) + k\big(e^*(q)\big) + u_R\,.$$

Differentiating with respect to q yields

$$b\phi(-Z)\frac{\partial Z}{\partial q} + k'\big(e^*(q)\big)e^{*\prime}(q)\,.$$

$e^{*\prime}(q) > 0$ by Proposition 1 and $\partial Z/\partial q > 0$ by (16) and connected discussion. Hence, the last expression is positive as was to be shown. ■

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