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## ABSTRACT

### CEO Compensation and Strategy Inertia\*

This paper considers the joint optimal design of CEOs' on-the-job compensation and severance pay in a general optimal contracting framework. We obtain a novel argument for high-powered, non-linear CEO compensation such as bonus schemes and option grants that is different from existing arguments based on moral hazard and risk taking. Based on this argument, the CEO's optimal on-the-job compensation scheme is designed to minimize the use of costly severance pay to reduce CEO entrenchment, thus minimizing the CEO's informational rents. Our model generates novel empirical predictions concerning the interrelation of CEOs' on-the-job compensation and severance pay as well as CEO turnover which, to the extent that they have been tested, are consistent with the empirical evidence.

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# 1 Introduction

A central tenet of managerial theories is that top executives act on the firm's behalf as "champions of change" (Geletkanycz and Black (2001))—ready and willing to adjust strategic policy and practice as demanded by the firm's changing environment. Yet evidence suggests that top executives often act as impediments to adaption, showing instead a strong "commitment to the strategic status quo" (Finkelstein and Hambrick (1990), Geletkanycz (1997)).

While organizational theorists have suggested vested interests and political resistance as the main reason for why firms are sluggish in adapting their strategies (e.g., Pfeffer and Salancik (1978)), the management literature has focused on top executives' psychological and cultural backgrounds (e.g., Hambrick, Geletkanycz, and Fredrickson (1993)). In this paper, we consider a different, almost mundane, explanation for why top executives might act as impediments to change. Moreover, using a general optimal contracting framework, we examine the implications of this argument for the optimal design of executive compensation.

The argument is based on the premise that CEOs are not perfect substitutes. Rather, each CEO has his own style and strategy, and this is the reason for why the CEO was hired (e.g., Bertrand and Schoar (2003)). By implication, if the firm wants to change its strategy, it will likely do so by hiring a new CEO. Consistent with this premise, empirical research suggests that major strategy changes tend to occur only after a new CEO has been appointed (Miller and Friesen (1980), Tushman, Virany, and Romanelli (1985)), while CEO succession is one of the primary means by which firms adapt to major changes in their environments (Tushman, Newman, and Romanelli (1986), Wiersema and Bantel (1992)).<sup>1</sup>

Anticipating that a strategy change may lead to his replacement, the incumbent CEO will, quite naturally, act as an impediment to change. In our model, the CEO observes a noisy signal indicating whether his style and strategy will likely be successful. If the signal is bad, the CEO may avert his imminent replacement by entrenching himself. If the firm's board can observe the same signal, albeit only at a later time, the CEO may undertake an irreversible investment that makes it ex-post suboptimal for the board to fire him, as in Shleifer and Vishny (1989) and

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<sup>1</sup>Hofer (1980) argues that a long-standing CEO must be replaced for a successful turnaround to occur. Generally, firms tend to choose successors with different experiences and characteristics than the previous CEO to achieve a better "fit" with the firm's new strategic orientation (White, Smith, and Barnett (1997)).

related models of managerial entrenchment.<sup>2</sup> If the firm’s board cannot observe the signal, the CEO can “entrench” himself by simply misreporting his signal, claiming that the firm’s future prospects under his style and strategy are good. In either case, the CEO’s ability to entrench himself implies that the firm forgoes a necessary strategy change.<sup>3</sup>

If a firm’s strategy inertia derives from its CEO being entrenched, the next question is why do CEOs cling to their present jobs? After all, if we believe that CEOs derive “private benefits” from running a company, it is not clear why these benefits should be specific to a particular company. In our model, the CEO entrenches himself to secure an (ex-post) rent associated with his future on-the-job compensation that he receives if he continues with the present firm. If the CEO is replaced, he receives severance pay. Linking the CEO’s incentives to entrench himself to his future on-the-job compensation, which is endogenous, allows us to focus on the issue we are interested in: how should the CEO’s benefit from entrenching himself—i.e., his on-the-job compensation—and his severance pay be optimally (and jointly) *designed*?

To the best of our knowledge, this is the first paper to consider the joint optimal design of CEOs’ on-the-job compensation and severance pay in a general optimal contracting framework, i.e., in a setting with more than two cash flows (here: a continuum) in which contracts are not restricted to a particular functional class such as, e.g., stocks or options.<sup>4</sup> Considering

<sup>2</sup>See, e.g., Bagwell and Zechner (1993), Edlin and Stiglitz (1995), Rajan, Servaes, and Zingales (2000), Scharfstein and Stein (2000), and Fulgieri and Hodrick (2005).

<sup>3</sup>Of course, if the CEO could change his style and strategy at will, there would be no need to replace him. While this may be possible in some cases, it seems not very plausible in general, however. For instance, it is hard to imagine that former Sunbeam CEO Al Dunlop—better known as “Chainsaw Al”—could easily shake off his ruthless cost-cutting image, even if he wanted to. Over time, CEOs acquire a reputation for having a particular style and strategy that cannot be easily changed. In a similar vein, Rotemberg and Saloner (2000), in a theoretical contribution, argue that hiring a CEO with a particular vision and style is a credible signal to the firm’s employees that the firm will pursue a particular strategy. By implication, if the CEO could change his style and strategy at will, the signal would not be credible. Finally, even if the CEO could change his style and strategy from one day to the next, it is not clear that he would want to. It might be better for him to cling to his trademark style and strategy than to lose his reputation, e.g., as a tough cost-cutter, in the managerial labor market.

<sup>4</sup>We are only aware of one other paper, Almazan and Suarez (2003), that considers the interaction between severance pay and on-the-job compensation. Their focus is on providing a novel economic argument for severance pay, however, while the CEO’s on-the-job compensation scheme is designed to minimize moral hazard. The firm’s cash flow in their model is either zero or  $R > 0$ , implying the optimal on-the-job incentive scheme pays either zero or  $w \leq R$ .

the joint optimal design of on-the-job compensation and severance pay allows us to develop a novel economic argument for why CEOs should receive high-powered, non-linear on-the-job compensation such as bonus schemes and option grants. What is more, using a general optimal contracting framework with more than two cash flows allows us to distinguish between linear and non-linear, as well as different types of non-linear, compensation schemes.

In our model, severance pay assumes the standard role of reducing the CEO's incentives to entrench himself.<sup>5</sup> Importantly, there is a one-to-one mapping between the CEO's severance pay and his (ex-ante) informational *rents* from being CEO. Hence, granting severance pay is costly. The CEO's optimal on-the-job compensation scheme is designed to minimize the use of costly severance pay, thus minimizing the CEO's informational rents.

In our basic model where only relatively little structure is imposed on the CEO's optimal compensation scheme, the optimal on-the-job compensation scheme is a high-powered bonus scheme that shifts all of the CEO's on-the-job compensation into the highest cash-flow states. Such a compensation scheme minimizes the CEO's *expected* on-the-job compensation—and thus his benefit from entrenching himself—at low signals, implying it also minimizes the amount of severance pay that is necessary to induce the CEO not to entrench himself.

In an extension of our basic model, the CEO can manipulate the firm's cash flows, which imposes an additional binding constraint on the optimal compensation scheme. The CEO's optimal on-the-job compensation scheme now becomes an option-like contract that pays zero up to a certain threshold and a fraction of the firm's incremental cash flow above that threshold. The basic economic principle that the CEO's optimal on-the-job compensation scheme shifts as much as possible of his on-the-job compensation into the highest cash-flow states—subject only to binding constraints—and that this minimizes the costs of reducing CEO entrenchment and, by implication, the costs of reducing strategy inertia, remains the same, however.

Our argument for why CEOs should receive high-powered, non-linear on-the-job compensation schemes such as option grants—driven by the objective to minimize the use of costly severance pay—is novel and different from existing arguments for high-powered (and possibly non-linear) compensation schemes based on moral hazard (e.g., Holmström (1979), Innes (1990))

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<sup>5</sup>Lambert and Larcker (1985) and Harris (1990) are two early models in which severance pay (or golden parachutes) plays the role of insuring executives against the loss of their jobs. For recent analyses, see, e.g., Almazan and Suarez (2003) and Eisfeldt and Rampini (2004). In the latter model, managers are paid a bonus to induce them to relinquish control of assets, which is conceptually similar to severance pay.

and risk taking (e.g., Smith and Stulz (1985)). In a recent paper, Dittmann and Maug (2006) estimate the standard principal-agent model used in the literature for a sample of 598 CEOs and conclude that neither moral hazard nor risk taking can satisfactorily explain the use of option grants.<sup>6</sup> The authors conclude “that we need a different contracting model to understand salient features of executive compensation contracts.”<sup>7</sup>

Our model predicts that CEOs’ on-the-job compensation and their severance pay should move in the same direction, i.e., they should either jointly increase or decrease. This prediction is consistent with the empirical evidence. In a recent study of contractual (i.e., not ex-post negotiated) CEO severance pay agreements, Rusticus (2006) finds a significant positive relationship between the amount of cash severance pay and CEOs’ on-the-job compensation. Likewise, Schwab and Thomas (2004) find that CEOs’ on-the-job compensation is positively related to their contractual severance pay, while Lefanowicz, Robinson, and Smith (2000) find that managers whose employment contracts stipulate generous golden parachutes are also more highly compensated on their jobs.<sup>8</sup> Incidentally, our prediction that CEOs’ on-the-job compensation and their severance pay should move in the same direction is orthogonal to the “outrage-constraint” perspective of Bebchuk and Fried (2004), who argue that severance pay is merely a form of “stealth compensation” acting as a substitute for more visible on-the-job incentive pay when the latter is subject to increased public scrutiny.

Another prediction of our model is that firms operating in volatile business environments where it is likely that a strategy change becomes optimal should award their CEOs both higher severance pay and higher on-the-job compensation, but CEO turnover should also be higher. Consistent with this prediction, Rusticus (2006) finds that “firms with more stability and less frequent strategic change have less need for severance agreements.”<sup>9</sup> Moreover, he also finds

<sup>6</sup>The “standard” moral hazard model also cannot explain why CEOs jointly receive on-the-job incentive pay and severance pay. Severance pay *reduces* CEOs’ incentive to exert effort, as it rewards them for failure and weakens the incentive effect provided by the threat of termination.

<sup>7</sup>Likewise, Jenter (2002), based on a numerical example, argues that moral hazard alone cannot satisfactorily explain the use of option grants in executive compensation contracts, while Carpenter (2000) and Ross (2004) cast doubt on the argument that options are granted to increase risk-taking incentives.

<sup>8</sup>Schwab and Thomas also document the pervasiveness of contractual severance pay. More than 93 percent of the CEO employment contracts in their sample formally stipulate severance pay.

<sup>9</sup>To proxy for the uncertainty of a firm’s operating environment and the likelihood of a strategic change, Rusticus uses return volatility and the length of the tenure of the previous CEO.

that, conditional on having a severance agreement, higher severance pay is associated with a higher likelihood of CEO turnover, which is again consistent with our prediction.

Our model may help to shed light on some developments which have taken place since the late 1970s. Technological innovations and massive deregulations in many industries have radically altered the industrial landscape in the United States, increasing strategic uncertainty and putting pressure on U.S. firms to adapt their business strategies at an increasingly faster pace.<sup>10</sup> When we reinterpret our above prediction as a time-series result, we obtain the prediction that, along with the increase in strategic uncertainty, both CEOs' on-the-job compensation and their severance pay should have increased, but also the likelihood of CEO turnover. The surge in CEO on-the-job compensation over the past decades, largely in the form of option grants, has been widely documented, e.g., by Hall and Liebman (1998) and Bebchuk and Grinstein (2005). As for severance pay, Walker (2005) points to a surge in contractual severance pay, while Lefanowicz, Robinson, and Smith (2000) and Bebchuk, Cohen, and Ferrell (2004) document an increase in both the usage and size of golden parachutes during the 1980s and 1990s. Finally, Huson, Parrino, and Starks (2001) provide evidence that CEO turnover has increased substantially since the 1970s.

There is a large literature on CEO compensation to which our paper is related.<sup>11</sup> To the best of our knowledge, only one other paper, Almazan and Suarez (2003), also considers the interplay between CEOs' severance pay and on-the-job compensation. There are two basic differences to our model. The first difference is with regard to the inefficiency addressed by the optimal contract design, and hence the economic rationale underlying the optimal contract. In our model, the inefficiency is that the CEO sometimes continues (in equilibrium) even though his replacement would have been first-best efficient. In Almazan and Suarez' model, CEO replacement is always first-best efficient. Rather, the inefficiency is that the CEO has insufficient incentives to create value. Second, Almazan and Suarez focus on providing novel economic arguments for severance pay, while the CEO's on-the-job compensation scheme is designed to minimize moral hazard (see footnote 4). The novel argument for severance pay in their paper is that severance pay may be a more effective, and hence cheaper, instrument to provide effort incentives than on-the-job incentive pay in that it provides a direct link between the CEO's payoff from renegotiations with

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<sup>10</sup>See section 4.1 for references. Consistent with this picture is also the widely documented rise in firm-level volatility in the United States over the past 30 years (e.g., Comin and Philippon (2005)).

<sup>11</sup>See Murphy (1999) for an overview of the literature.

the board and his ex-ante effort investment.

Dow and Raposo (2005a) also consider the link between CEO compensation and strategy change. In their model, however, the problem is not strategy inertia but the opposite problem that CEOs may choose overly “dramatic” strategy changes (e.g., mergers).<sup>12</sup> Dramatic changes involve the highest effort to success ratios, thus maximizing the CEO’s compensation. As none of the available strategy choices involves the CEO’s replacement, there is no need to offer the CEO any severance pay. Finally, Inderst and Mueller (2006) also examine the interrelation of decision making and incentive pay, although in their model the firm’s owner (who maximizes shareholder value) makes the decision, while ordinary employees, who make no decision and have no private information, receive high-powered incentive pay. The inefficiency derives from a classic holdup problem whereby the firm’s owner can ex-post adjust the firm’s business mix to erode the value of employees’ human capital. Like the two papers discussed above, and in contrast to the present paper, there are only two outcomes, implying there is no distinction between linear and non-linear, or between different types of non-linear, compensation schemes.

The rest of this paper is organized as follows. Section 2 presents the model and some preliminary results. The main analysis is in Section 3. Section 4 derives comparative static results and discusses empirical implications. Section 5 concludes. All proofs are in the Appendix.

## 2 CEO Entrenchment and Strategy Inertia

### 2.1 The Basic Model

#### Overview

We present a simple model of CEO entrenchment. Before going into details, let us give a brief overview of the model. In  $t = 0$ , a CEO with a particular style and strategy is hired to manage the firm. While he is the best available candidate at the time, there is uncertainty as to whether his style and strategy are a good fit. At some intermediate point in time,  $t = 1$ , the firm’s board or a controlling shareholder (“the shareholder”) observes a noisy signal indicating whether the CEO’s style and strategy will likely be successful. However, and this is an important assumption, the CEO privately observes the signal *before* the shareholder does (say, in  $t = 0.5$ ).

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<sup>12</sup>See also Dow and Raposo (2005b) for a related model in which successful organizational changes require that the CEO obtains the support of other senior managers.

This provides the CEO with a first-mover advantage: if the signal turns out to be bad, the CEO may avert his imminent replacement by making an irreversible investment that reduces the firm's future value under a potential successor. The firm's cash flow is realized in  $t = 2$ .

The CEO's ability to avert his replacement is crucial for our story, for it puts the focus on the issue we are interested in: how to design the CEO's incentives (not) to entrench himself. Our notion that the CEO can make an irreversible investment that makes it costly for shareholders to replace him is adopted from Shleifer and Vishny (1989), Scharfstein and Stein (2000), and related models of entrenchment (see footnote 2). Scharfstein and Stein mention the example of a manager who creates an excessively opaque accounting system that is difficult to understand for a potential successor. Alternatively, the CEO may destroy information that a successor needs to run the firm, or he may make an investment that is highly complementary to his own skills, like in Shleifer and Vishny's model. As Shleifer and Vishny make clear, however, the assumption that the investment is irreversible is crucial. For instance, hiring employees that are loyal to the CEO does not constitute an irreversible investment as a potential replacement can easily fire them. We will have more to say about the CEO's ability to entrench himself below.

## Technology and Beliefs

We model the uncertainty as to whether the CEO's style and strategy are a good fit by assuming that the firm's cash flow under the CEO is a random variable  $s \in S := [\underline{s}, \bar{s}]$ , where  $\underline{s} \geq 0$ , and where  $\bar{s}$  may be finite or infinite. The noisy signal that is first privately observed by the CEO, and then later also by the shareholder, is denoted by  $\theta \in \Theta := [\underline{\theta}, \bar{\theta}]$ . Each signal is associated with a conditional distribution function  $G_\theta(s)$  with continuous density  $g_\theta(s)$  in both  $\theta$  and  $s$ . The signal is informative about  $s$  in the sense of the Monotone Likelihood Ratio Property (MLRP), implying  $g_{\theta'}(s)/g_\theta(s)$  is strictly increasing in  $s$  for all  $\theta' > \theta$  in  $\Theta$ .<sup>13</sup> Observing a high signal is therefore good news in the sense that it puts more probability mass on high cash flows. We assume the signal is not verifiable vis-à-vis a court and hence not contractible. Finally, at the time when the CEO is hired, everyone has the same initial beliefs  $F(\theta)$ , where the density  $f(\theta)$  is assumed to be positive for all  $\theta \in \Theta$ . The common initial belief that the firm's future cash flow under the CEO is  $s = s'$  is therefore  $\Pr[s = s'] = \int_{\Theta} g_\theta(s') f(\theta) d\theta$ .

Realistically, whether the CEO's style and strategy will be successful may also depend on how

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<sup>13</sup>MLRP is satisfied by many standard probability distributions (Milgrom (1981)). Among other things, MLRP implies that the expected cash flow  $E[s | \theta]$  is increasing in  $\theta$ .

committed he is to implementing his strategy. We assume the following simple effort problem: if the CEO puts in high effort, everything is as described above. That is, the beliefs  $F(\theta)$  regarding the likelihood of observing a given signal  $\theta$  hold “on the equilibrium path” where the CEO puts in high effort. If the CEO puts in low effort, we assume that this gives rise to a sufficiently low signal under which the CEO’s style and strategy have little chance of being successful, so that it becomes optimal to replace him.<sup>14</sup> Finally, putting in high effort is costly: it implies the CEO must forgo private benefits of  $B > 0$ .

Replacing the CEO means that the shareholder will hire a successor with a different style and strategy. Let  $V > 0$  denote the firm’s expected cash flow under the potential successor (net of any compensation). Observe that there is no need to make distributional assumptions about  $V$ —what is important is only the *expected* firm value under a potential successor. Also, note that  $V$  does not depend on  $\theta$ : the signal is “match-specific” in the sense that it only indicates whether this particular CEO is a good fit; it contains no information about how good a fit any particular successor might be.<sup>15</sup> Finally, to make the shareholder’s problem nontrivial, we assume it is optimal to replace the CEO for some but not all signals  $\theta \in \Theta$ .<sup>16</sup>

## CEO Compensation

The CEO’s compensation package consists of his on-the-job compensation  $w(s)$ , which may depend on the firm’s cash flow, and his severance pay  $W$  in case he is replaced. As the signal  $\theta$  is nonverifiable, the CEO’s compensation cannot directly condition on it. However, the CEO’s compensation will indirectly depend on  $\theta$  as his decision to entrench himself will depend on the signal.<sup>17</sup> Realistically, the CEO’s on-the-job pay cannot exceed the firm’s total cash flow, implying that  $w(s) \leq s$ . Moreover, we assume that  $w(s)$  is nondecreasing in  $s$ , although it

<sup>14</sup>For concreteness, we could assume that low effort gives rise to the lowest possible signal  $\theta = \underline{\theta}$ , although as we will see shortly, the precise specification is not important. What is important is only that the signal is sufficiently low so that replacing the CEO becomes optimal.

<sup>15</sup>Our notion that the signal is match-specific is similar to Hermalin and Weisbach (1998) and Hermalin (2005).

<sup>16</sup>For instance, this is optimal if  $E[s | \theta]$  is sufficiently greater than  $V$  at high  $\theta$  and sufficiently smaller than  $V$  at low  $\theta$ , while  $F(\theta)$  puts sufficient probability mass on both high and low  $\theta$ .

<sup>17</sup>As the CEO makes his decision to entrench himself under private information, a natural approach to this problem would be to let the CEO choose from a menu of compensation schemes. In Section 3.4, we will show that offering a menu is strictly suboptimal in our model, implying the assumption that  $w = w(s)$  and that  $W$  is a constant is without loss of generality.

will become clear shortly that this assumption is only for expositional convenience. While it considerably simplifies the analysis, the constraint that  $w(s)$  be nondecreasing does not bind at the optimal solution.

## 2.2 Preliminary Analysis and Discussion

### Terminology

The CEO's decision to entrench himself, as well as the shareholder's decision to retain or replace the CEO, will depend on the signal  $\theta$ , the firm's expected cash flow under a potential successor  $V$ , and the CEO's compensation package  $\{w(s), W\}$ . Moreover, if the CEO is replaced, a successor with a different style and strategy will be hired, while if the CEO is retained, his style and strategy remain in place. Since the focus of our analysis is on the optimal design of the CEO's compensation package, we say that the compensation package  $\{w(s), W\}$  "*implements a strategy change at the signal  $\theta$* " if a successor with a different style and strategy is hired (in equilibrium). Likewise, we say that  $\{w(s), W\}$  "*preserves the strategic status quo at the signal  $\theta$* " if the CEO is retained, implying his style and strategy remain in place. Finally, if at a given signal the strategic status quo is preserved while a strategy change would have been (first-best) optimal, we refer to this inefficiency as *strategy inertia*.

### First-Best Benchmark

As a reference point, let us briefly derive the first-best benchmark. The first-best optimal decision rule is to preserve the strategic status quo if  $E[s \mid \theta] := \int_S s g_\theta(s) ds \geq V$  and to implement a strategy change if  $E[s \mid \theta] < V$ . Given that  $E[s \mid \theta]$  is strictly increasing in  $\theta$ , and given our assumption that it is optimal to implement a strategy change for some but not all signals  $\theta \in \Theta$ , there exists a unique interior cutoff signal  $\theta_{FB} \in (\underline{\theta}, \bar{\theta})$  defined by  $E[s \mid \theta_{FB}] = V$  such that it is first-best optimal to preserve the strategic status quo if  $\theta \geq \theta_{FB}$  and to implement a strategy change if  $\theta < \theta_{FB}$ .<sup>18</sup>

### The CEO's Entrenchment Decision

When deciding whether to entrench himself at a given signal  $\theta$ , the CEO compares his expected on-the-job compensation  $E[w(s) \mid \theta] := \int_S w(s) g_\theta(s) ds$  with his severance pay  $W$ . We

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<sup>18</sup>As  $G_\theta(s)$  satisfies MLRP, it also satisfies First-Order Stochastic Dominance (F OSD), implying  $E[s \mid \theta]$  is strictly increasing in  $\theta$ . In conjunction with continuity of  $g_\theta(s)$ , this implies that there exists a unique cutoff signal  $\theta_{FB} \in (\underline{\theta}, \bar{\theta})$  satisfying  $E[s \mid \theta_{FB}] = V$ .

first derive a preliminary result, namely, under any feasible compensation scheme the CEO's expected on-the-job compensation  $E[w(s) | \theta]$  must be strictly increasing in  $\theta$ . Clearly, it cannot be optimal to give the CEO a fixed wage  $w(s) = w$  for all  $s \in S$ . Otherwise, he would either always (i.e., for all  $\theta \in \Theta$ ) or never prefer his on-the-job compensation to his severance pay. Arguably, if  $w(s) = w = W$  the CEO is just indifferent. But if his on-the-job compensation is exactly equal to his severance pay, the CEO has no incentives to put in high effort. Given our assumption that  $w(s)$  is nondecreasing, ruling out a fixed wage  $w(s) = w$  implies that  $w(s)$  is strictly increasing in  $s$  for some  $s \in S$  on a set of positive measure. In conjunction with the fact that  $G_\theta(s)$  satisfies MLRP, this in turn implies that the CEO's expected on-the-job compensation  $E[w(s) | \theta]$  is strictly increasing in  $\theta$  for all  $\theta \in \Theta$ .

The fact that  $E[w(s) | \theta]$  is strictly increasing in  $\theta$  implies that if the CEO prefers his on-the-job compensation to his severance pay at the signal  $\theta = \theta'$ , then he also prefers his on-the-job compensation at all higher signals  $\theta > \theta'$ . Precisely, there exists a unique interior cutoff signal  $\theta^* = \theta^*(w(s), W) \in (\underline{\theta}, \bar{\theta})$  defined by

$$E[w(s) | \theta^*] = W \quad (1)$$

such that the CEO prefers his on-the-job compensation for all signals  $\theta \geq \theta^*$  and his severance pay for all signals  $\theta < \theta^*$ .

Consider next the shareholder's decision to retain or replace the CEO. The shareholder optimally retains the CEO if  $E[s - w(s) | \theta] \geq V - W$  and replaces him if  $E[s - w(s) | \theta] < V - W$ . There are four cases. The first case is where  $\theta \geq \theta^*$  and  $E[s - w(s) | \theta] \geq V - W$ . In this case, the CEO needs to do nothing: the signal is so good that the shareholder wants to retain the CEO, while the CEO prefers his expected on-the-job compensation to his severance pay. The second case is where  $\theta < \theta^*$  and  $E[s - w(s) | \theta] < V - W$ . Again, preferences are well aligned. The signal is so bad that the shareholder wants to replace the CEO, while the CEO has no incentives to entrench himself as he prefers his severance pay over his expected on-the-job compensation. The third case is where  $\theta < \theta^*$  but  $E[s - w(s) | \theta] \geq V - W$ . In this case, the CEO prefers his severance pay over his expected on-the-job compensation, while the shareholder wants to retain the CEO. In equilibrium, however, this (arguably peculiar) case will not arise.

The fourth case is where  $\theta \geq \theta^*$  but  $E[s - w(s) | \theta] < V - W$ . In this case, the CEO prefers his expected on-the-job compensation to his severance pay, while the shareholder wants to replace the CEO. This is the interesting case where the CEO will entrench himself to avert

his otherwise imminent replacement. By our assumption that the CEO can make an irreversible investment that reduces the firm's value under a potential successor, he will decrease  $V$  so that  $E[s - w(s) | \theta] \geq V - W$ , implying the shareholder will find it ex-post optimal to retain the CEO. As the investment is irreversible, there is no scope for renegotiations.

Let us summarize. In equilibrium, the CEO is retained for all signals  $\theta \geq \theta^*$  and replaced for all signals  $\theta < \theta^*$ . Moreover, a given compensation package  $\{w(s), W\}$  is associated with a unique cutoff signal  $\theta^* = \theta^*(w(s), W)$  defined in (1). Hence, a given compensation package  $\{w(s), W\}$  preserves the strategic status quo for all signals  $\theta \geq \theta^*(w(s), W)$ , while it implements a strategy change for all signals  $\theta < \theta^*(w(s), W)$ .

## A Simpler Model of CEO Entrenchment

In the above model, the CEO must make an irreversible investment in order to entrench himself. Such an investment is not necessary if we drop the assumption that the shareholder can observe the signal at a later point in time. Contrary to what we have assumed above, suppose now only the CEO (privately) observes the signal  $\theta$ , while the shareholder must rely on whatever information the CEO gives her (e.g., at the board meeting). Denote the shareholder's information—i.e., the signal reported by the CEO—by  $\hat{\theta}$ . While the assumption that only the CEO observes the signal may appear extreme, it is trying to capture the notion that CEOs have an informational advantage vis-à-vis shareholders, not just in a timing sense, but in the literal sense that they have important information which board members, even through diligent monitoring, cannot acquire.<sup>19</sup>

In this simpler setting where only the CEO observes the signal  $\theta$ , the issue of whether a menu of contracts is optimal becomes particularly important. As we will show in Section 3.4, letting the CEO choose from a menu after he observes his signal is strictly suboptimal in our model. Consider next the shareholder's decision to retain or replace the CEO. The shareholder will retain the CEO if  $E[s - w(s) | \hat{\theta}] \geq V - W$  and replace him if  $E[s - w(s) | \hat{\theta}] < V - W$ . Consequently, the CEO can (trivially) achieve any desired outcome by choosing his reported signal  $\hat{\theta}$  appropriately. Like above, the equilibrium outcome thus depends exclusively on the CEO's incentives, and therefore on the cutoff signal  $\theta^*(w(s), W)$  associated with his compensation package. Once again,

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<sup>19</sup>Jensen (1993) argues: "The CEO most always determines the agenda and the information given to the board. This limitation severely hinders the ability of even highly talented board members to contribute effectively to the monitoring of the CEO and the company's strategy."

we thus have that the compensation package  $\{w(s), W\}$  preserves the strategic status quo for all signals  $\theta \geq \theta^*$ , while it implements a strategy change for all signals  $\theta < \theta^*$ , where the cutoff signal  $\theta^* = \theta^*(w(s), W)$  is defined in (1). The solution to this simpler entrenchment problem where the CEO can entrench himself by simply misreporting his private signal is thus formally equivalent to the solution of the above problem where the CEO must make an irreversible investment to entrench himself.

### Endogenous Benefits of Entrenchment

There are no exogenous (e.g., private) benefits of entrenchment in our model. The CEO's benefit from entrenching himself is that he receives his future on-the-job compensation  $w(s)$ , while his (opportunity) cost of entrenching himself is that he forgoes his severance pay  $W$ . Assuming that all benefits of entrenchment are endogenous allows us to focus on the question we are interested in: how should the CEO's benefit from entrenching himself—i.e., his future on-the-job compensation  $w(s)$ —be optimally *designed*?

What makes the optimal design of the CEO's on-the-job compensation scheme a nontrivial problem is that the CEO is inherently biased in favor of continuing. Precisely, the CEO's bias derives from the effort problem we have introduced above. Consider the incentive constraint of inducing the CEO to exert high effort. If the CEO puts in low effort, we have assumed that this gives rise to a sufficiently low signal under which the CEO's strategy has little chance of being successful, so that it becomes optimal to implement a strategy change. But even “on the equilibrium path” where the CEO puts in high effort, there is a nontrivial probability  $F(\theta^*) > 0$  that a strategy change will be implemented. The CEO's incentive constraint is therefore

$$\int_{\theta^*}^{\bar{\theta}} E[w(s) | \theta] f(\theta) d\theta + F(\theta^*) W \geq W + B, \quad (2)$$

which can be rewritten more conveniently as

$$\int_{\theta^*}^{\bar{\theta}} (E[w(s) | \theta] - W) f(\theta) d\theta \geq B. \quad (3)$$

Hence, in order for the CEO to have sufficient incentives to put in high effort, there must be a wedge between his expected future on-the-job compensation  $E[w(s) | \theta]$  and his severance pay  $W$ . Intuitively, since low effort results in the implementation of a strategy change, severance pay constitutes a “reward” for the CEO putting in low effort. To induce the CEO to put in high effort, his expected on-the-job compensation must therefore be sufficiently greater than his

severance pay. In a sense, this is quite similar to a strand of efficiency-wage models in which workers are motivated by the fact that their on-the-job pay exceeds their expected income if they are fired (e.g., Shapiro and Stiglitz (1984), Yellen (1994)).

It is worth emphasizing that the wedge between  $E[w(s) | \theta]$  and  $W$  required by (3) imposes no constraint on the functional form of the CEO’s on-the-job compensation scheme  $w(s)$ . What it requires is only that “on average”—i.e., across all signals  $[\theta^*, \bar{\theta}]$ —the CEO’s *expected* on-the-job compensation must exceed his severance pay by a certain amount, which in turn biases the CEO in favor of continuing. For instance, if  $W = 0$  the CEO wants to stay in power for *all* signals  $\theta \in \Theta$  since his expected on-the-job compensation is strictly positive while his severance pay is zero. In summary, there is no direct relation between the CEO’s effort problem and the optimal design of  $w(s)$ , implying our subsequent results regarding the optimal functional form of  $w(s)$  are driven solely by the problem of motivating the CEO not to entrench himself, not by the problem of motivating him to put in high effort. What the effort problem does is only to create a bias on the part of the CEO to remain in power, which makes his entrenchment problem nontrivial.<sup>20</sup>

### 3 The CEO’s Optimal Compensation Package

#### 3.1 The Shareholder’s Problem

To motivate the tradeoff which the shareholder faces when designing the CEO’s compensation package, consider again the CEO’s incentive constraint (2). By standard arguments, (2) must bind at the optimal solution, implying the CEO’s expected compensation if he puts in high effort must equal  $W + B$ . As the CEO’s opportunity cost of putting in high effort is  $B$ , this implies the CEO earns a (informational) rent equal to the amount of his severance pay  $W$ .

**Proposition 1.** *The CEO earns a rent equal to the amount of his severance pay  $W$ .*

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<sup>20</sup>Another way of seeing this is as follows. One can easily show that if  $\theta$  is observable and contractible—in which case there is no entrenchment problem—there exists an infinite number of compensation packages  $\{w(s), W\}$  that satisfy the incentive constraint (3) and implement the first best. One example is the compensation package where  $W = 0$  and where the CEO receives a fixed wage of  $w = B/[1 - F(\theta_{FB})]$ .

To see why the shareholder must leave the CEO a rent, we can rewrite (2) as

$$\int_{\theta^*}^{\bar{\theta}} E[w(s) | \theta] \frac{f(\theta)}{1 - F(\theta^*)} d\theta = W + \frac{B}{1 - F(\theta^*)}. \quad (4)$$

Accordingly, if the shareholder wants to increase the CEO's severance pay by one dollar, she must also increase his expected on-the-job compensation by one dollar.<sup>21</sup> Regardless of whether the strategic status quo is preserved or whether a strategy change is implemented, the CEO is better off by one dollar. Intuitively, the CEO earns a rent because his compensation scheme cannot discriminate between the different possible causes of a low signal. On the one hand, the signal may be low because—despite putting in high effort—the CEO's style and strategy are a bad fit. On the other hand, the signal may be low because the CEO put in low effort. In the first case, severance pay constitutes a reward for the CEO not to entrench himself. In the second case, severance pay constitutes a “reward” for the CEO putting in low effort.

An important implication of (4) is that an increase in the CEO's severance pay must be accompanied by a simultaneous increase in his expected on-the-job compensation. If this were not the case, the CEO would have insufficient incentives to put in high effort. Hence, there exists a delicate balance between the CEO's severance pay and his expected on-the-job compensation. In particular, the two must move in the same direction.

As we have shown, awarding the CEO severance pay is costly as it leaves him valuable rents. However, without any severance pay there would never be any strategy change. As we have remarked earlier, if  $W = 0$  the CEO would always want to stay in power. To analyze the shareholder's tradeoff between inducing an efficient strategy change and leaving the CEO valuable rents, we now consider the shareholder's maximization problem. The shareholder chooses  $w(s)$  and  $W$  to maximize

$$F(\theta^*)(V - W) + \int_{\theta^*}^{\bar{\theta}} E[s - w(s) | \theta] f(\theta) d\theta, \quad (5)$$

subject to the CEO's incentive constraint (2) and equation (1) defining the unique cutoff signal  $\theta^* = \theta^*(w(s), W)$  associated with a given compensation package  $\{w(s), W\}$ . Inserting the binding incentive constraint into (5), we can write the shareholder's objective function as

$$\int_{\theta^*}^{\bar{\theta}} E[s | \theta] f(\theta) d\theta + F(\theta^*)V - B - W. \quad (6)$$

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<sup>21</sup>Precisely, the left-hand side in (4) denotes the CEO's expected on-the-job compensation *conditional* on the strategic status quo being preserved.

By inspection, the shareholder has two main objectives. The first three terms in (6) represent the overall surplus created, implying the shareholder seeks to maximize overall efficiency. Precisely, since  $E[s | \theta] - V$  is negative and decreasing in  $\theta$  for  $\theta < \theta_{FB}$  and positive and increasing in  $\theta$  for  $\theta > \theta_{FB}$ , the shareholder seeks to push the cutoff signal  $\theta^*$  as close as possible towards the first-best benchmark  $\theta_{FB}$ . Recall that the interval  $[\theta^*, \theta_{FB})$  defines the range of all signals at which the strategic status quo is preserved while a strategy change would have been first-best optimal. Accordingly, the shareholder's first main objective is to minimize the range of signals associated with strategy inertia. The shareholder's second main objective follows from the last term in (6): minimize the CEO's severance pay  $W$  and thus his informational rents.

Based on this tradeoff between minimizing strategy inertia and leaving the CEO valuable rents, we can state the shareholder's problem of designing the CEO's compensation package in two equivalent ways. Holding the CEO's severance pay  $W$  fixed, the optimal on-the-job compensation scheme pushes the cutoff signal  $\theta^*$  as close as possible towards  $\theta_{FB}$ , thus minimizing the range of signals  $[\theta^*, \theta_{FB})$  associated with strategy inertia. Conversely, holding the cutoff signal  $\theta^*$  fixed, the optimal on-the-job compensation scheme minimizes the CEO's severance pay  $W$  and thus his rents. One problem is just the dual of the other. We obtain the following result.

**Proposition 2.** *The uniquely optimal CEO compensation package consists of severance pay  $W > 0$  and a bonus scheme paying  $w(s) = 0$  if  $s < \hat{s}$  and  $w(s) = s$  if  $s \geq \hat{s}$  for some  $\hat{s} \in (\underline{s}, \bar{s})$ .*

**Proof.** See Appendix.

The uniquely optimal CEO on-the-job compensation scheme is a high-powered, discontinuous bonus scheme that shifts all of the CEO's on-the-job compensation into the highest cash-flow states. The intuition is as follows. As low cash flows are relatively more likely after low signals (due to the fact that  $G_\theta(s)$  satisfies MLRP), a bonus scheme of the sort described in Proposition 2 minimizes the CEO's expected on-the-job compensation at low signals. Given that the prospect of receiving his on-the-job compensation is the reason why the CEO wants to entrench himself, a bonus scheme thus minimizes the CEO's incentives to entrench himself at low signals. This in turn implies that a relatively smaller amount of severance pay is needed to induce the CEO *not* to entrench himself at low signals. Given the one-to-one mapping between the CEO's severance pay and his informational rents, a bonus scheme of the sort described in Proposition 2 thus minimizes the amount of rents that must be left to the CEO to accomplish a given cutoff signal

$\theta^*$ , and thus a given level of strategy inertia  $[\theta^*, \theta_{FB}]$ .

The flip side of shifting all of the CEO’s on-the-job compensation into the highest cash-flow states is that the CEO has strong incentives to stay in power at high signals. This is inconsequential, however, because at high signals the CEO’s and the shareholder’s preferences are well aligned: both prefer the strategic status quo over a strategy change.

### 3.2 Continuous versus Discontinuous On-The-Job Compensation Schemes

The robust insight from our previous analysis was that—in order to minimize the costs of inducing the CEO not to entrench himself—all of his on-the-job compensation must be shifted into the highest cash-flow states. In a relatively unconstrained setting like the one above, this implies that the CEO’s optimal on-the-job compensation scheme is a discontinuous bonus scheme under which the CEO receives  $w(s) = 0$  if  $s < \hat{s}$  and  $w(s) = s$  if  $s \geq \hat{s}$  for some threshold  $\hat{s} \in (\underline{s}, \bar{s})$ .<sup>22</sup> Such a discontinuous bonus scheme may entail problems of its own, however. For instance, if the firm’s cash flow increases only slightly from  $\hat{s} - \varepsilon$  to  $\hat{s}$ , the CEO’s on-the-job compensation jumps from zero to  $w(s) = \hat{s}$ . To the extent that the CEO can manipulate the firm’s cash flows, he may thus have an incentive to do so.

In what follows, we ask how the CEO’s optimal on-the-job compensation scheme must be modified so that it becomes immune to manipulation problems of the sort just described. For concreteness, suppose the CEO is able to manipulate the firm’s cash flow at private cost  $h(\Delta)$ , where  $\Delta = |s' - s|$ , and where  $s'$  and  $s$  denote the manipulated and the original cash flow, respectively. The cost function  $h(\Delta)$  is assumed to be nondecreasing and convex with  $h(0) = 0$  and  $h'(0) = \gamma$ , where  $\gamma$  is positive but (possibly very) small.<sup>23</sup>

Given that  $h(\Delta)$  is nondecreasing and convex, any on-the-job compensation scheme that is immune to “small” manipulations around  $\Delta = 0$  is also immune to “large” manipulations  $\Delta > 0$ ,

<sup>22</sup>The only binding constraint in Proposition 2 is that  $w(s) \leq s$ . As we have noted previously, the other constraint that  $w(s)$  be nondecreasing was only introduced for convenience to simplify the analysis. Given that it is optimal to shift as much as possible of the CEO’s on-the-job compensation into the highest cash-flow states, this constraint does not bind at the optimum.

<sup>23</sup>The CEO’s private cost of manipulating the firm’s cash flows by  $\Delta$  is likely to be much lower than  $\Delta$ —at least for small values of  $\Delta$ —implying that  $\gamma \leq 1$ . The special case where  $\gamma = 1$  coincides with an assumption frequently found in financial contracting models that  $s - w(s)$  be nondecreasing (e.g., Innes (1990), Nachman and Noe (1994), DeMarzo and Duffie (1999)).

which implies the relevant constraint associated with the CEO's manipulation problem is that his marginal manipulation cost around  $\Delta = 0$  must equal or exceed his marginal benefit for all  $s \in S$ .<sup>24</sup> As the optimal solution requires to shift as much as possible of the CEO's on-the-job compensation into the highest cash-flow states, this constraint binds at the optimal solution. We obtain the following result.

**Proposition 3.** *Suppose the CEO can manipulate the firm's cash flows at marginal cost greater than or equal to  $\gamma > 0$ . His uniquely optimal compensation package then consists of severance pay  $W > 0$  and an “option-like” on-the-job compensation scheme paying  $w(s) = 0$  if  $s < \hat{s}$  and  $w(s) = \gamma(s - \hat{s})$  if  $s \geq \hat{s}$  for some  $\hat{s} \in (\underline{s}, \bar{s})$ .*

**Proof.** See Appendix.

Since the additional constraint imposed by the manipulation problem binds, the optimal on-the-job compensation scheme from Proposition 2 is not feasible any more. Instead of a discontinuous bonus scheme, the new optimal on-the-job compensation scheme is an “option-like” contract under which the CEO receives  $w(s) = 0$  up to some threshold  $\hat{s}$  while for all  $s \geq \hat{s}$  he receives a (possibly very small) fraction  $\gamma$  of the firm's incremental cash flow above that threshold.<sup>25</sup> Besides the fact that the optimal on-the-job compensation scheme from Proposition 3 is immune to manipulation, it has the appealing property that it is continuous in  $s$ . For this reason, our following comparative static results are based on the optimal compensation scheme from Proposition 3. The first result is immediate given the preceding discussion.

**Corollary 1.** *As the CEO's marginal manipulation cost  $\gamma$  increases, his optimal on-the-job compensation scheme becomes “steeper”—i.e., the pay-for-performance sensitivity increases—and it becomes less costly for the shareholder to accomplish a given cutoff signal  $\theta^*$  and therefore a given level of strategy inertia  $[\theta^*, \theta_{FB}]$ .*

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<sup>24</sup>If the optimal on-the-job compensation scheme is immune to “small” manipulations from  $s$  to  $s' = s + \varepsilon$ , then it is also immune to “large” manipulations from  $s'' < s$  to  $s'$  as the CEO's private manipulation cost for the last increment from  $s$  to  $s'$  is weakly higher under the “large” manipulation due to our assumption that  $h(\Delta)$  is convex. An analogous argument holds for  $s' = s - \varepsilon$ .

<sup>25</sup>The “strike price”  $\hat{s}$  is uniquely pinned down by the requirement that the incentive constraint (2) binds. If  $\gamma$  is close to zero, (2) cannot be satisfied for any  $\hat{s} > \underline{s}$ . Precisely, as  $\gamma$  goes to zero the “strike price”  $\hat{s}$  approaches  $\underline{s}$ , implying the optimal on-the-job compensation scheme becomes  $w(s) = F + \gamma s$ , which can be implemented by giving the CEO a fixed wage of  $F$  plus stock.

**Proof.** See Appendix.

The robust insight from our model thus far has been that the optimal on-the-job compensation scheme must shift as much as possible of the CEO’s on-the-job compensation into the highest cash-flow states. The precise functional form of the optimal on-the-job compensation scheme depends on the constraints we impose on the model. In a relatively unconstrained setting like in Section 3.1, the optimal on-the-job compensation scheme is a high-powered, discontinuous bonus scheme. If we introduce a simple manipulation problem like in this subsection, the optimal on-the-job compensation scheme becomes an option-like contract. There are many other constraints that one might possibly want to consider, albeit some are more difficult to incorporate into our model than others. For instance, to obtain a closed-form solution, we had to assume that the CEO is risk neutral. While arguably restrictive, this assumption might be less problematic in the case of CEOs, who are potentially less risk averse than ordinary employees given their high wealth and the selection process they have undergone to become the CEO. A simple, yet arguably crude way of capturing some basic aspects of risk aversion would be to introduce a minimum consumption constraint  $w(s) \geq C$ . Given this constraint, the optimal on-the-job compensation scheme from Proposition 3 would change only insofar as the CEO would then receive a base wage equal to  $C$  in addition to his option contract.

### 3.3 The Relation Between Severance Pay and Strategy Inertia

Hitherto we have been concerned with the derivation of the CEO’s optimal compensation package. For a given amount of severance pay  $W$ , the CEO’s optimal on-the-job compensation scheme pushes up the cutoff signal  $\theta^*$  as close as possible towards  $\theta_{FB}$ , thus minimizing the range of signals  $[\theta^*, \theta_{FB}]$  associated with strategy inertia. Conversely, for a given cutoff signal  $\theta^*$ —and therefore a given level of strategy inertia  $[\theta^*, \theta_{FB}]$ —the optimal on-the-job compensation scheme minimizes the amount of severance pay that must be offered to the CEO, thus minimizing his informational rents. In this section, we examine how an increase in severance pay affects the cutoff signal  $\theta^*$ —and thus the level of strategy inertia  $[\theta^*, \theta_{FB}]$ —given that the CEO’s on-the-job compensation scheme is chosen optimally.

Intuitively, an increase in severance pay reduces the CEO’s incentives to entrench himself at a given signal. At the same time, however, the increase in severance pay must be accompanied by a simultaneous increase in the CEO’s expected on-the-job compensation to preserve the wedge

required by his incentive constraint (2), which in turn makes it *more* attractive for the CEO to continue. As we will now show, under the optimal on-the-job compensation scheme the first effect outweighs the second, implying an increase in the CEO’s severance pay pushes the cutoff signal  $\theta^*$  upwards, thus reducing strategy inertia.

The intuition is as follows. Under the optimal CEO on-the-job compensation scheme from Proposition 3 (or, alternatively, Proposition 2), the increase in  $w(s)$  that is necessary to match the increase in  $W$  occurs at relatively high cash flows, implying  $E[w(s) | \theta]$  increases primarily at high signals. Conversely,  $E[w(s) | \theta]$  increases only little at low signals. Hence, while “on average” the CEO’s expected on-the-job compensation must increase one-for-one with his severance pay to preserve the wedge required by (2), it increases by more than  $W$  at high signals and by less than  $W$  at low signals. At low signals, the difference  $E[w(s) | \theta] - W$  consequently *decreases*, implying an increase in  $W$  pushes the cutoff signal  $\theta^*$  upwards and hence towards the first-best benchmark  $\theta_{FB}$ .<sup>26</sup>

**Proposition 4.** *Under the CEO’s optimal on-the-job compensation scheme, the shareholder can push up the cutoff signal  $\theta^*$ —thus reducing strategy inertia—by increasing the CEO’s severance pay (and thus his informational rents). Fully eliminating strategy inertia is too costly, however: at the optimal solution it must hold that  $\theta^* < \theta_{FB}$ .*

**Proof.** See Appendix.

The last statement in Proposition 4 suggests that it is too costly for the shareholder to implement the first best. Intuitively, when evaluated at the first-best benchmark  $\theta^* = \theta_{FB}$ , a marginal decrease in the cutoff signal  $\theta^*$  has only a negligible effect on the shareholder’s expected payoff. A marginal reduction in the CEO’s rents, however, represents a first-order cost saving. Given that pushing up  $\theta^*$  is costly, it is of course also never optimal to set  $\theta^* > \theta_{FB}$ , implying at the optimal solution it must hold that  $\theta^* < \theta_{FB}$ .

In recent years, the magnitude of executives’ severance packages has been the subject of much discussion. A common argument is that high severance pay constitutes a “reward” for failure, which is not only unnecessary but also counterproductive in the sense that it mutes

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<sup>26</sup>While the optimal value of  $W$  trades off the benefits of reducing strategy inertia against the costs of leaving the CEO rents, the specific solution depends on distributional assumptions. Once the optimal value of  $W$  is pinned down, the remaining choice variable  $\hat{s}$  (and therefore  $\theta^*$ ) is uniquely pinned down by (2).

CEOs' incentives to put in effort.<sup>27</sup> Indeed, this is precisely what would also happen in our model if the CEO's severance pay were set too high relative to his on-the-job compensation. However, our model cautions that imposing a binding cap on severance pay may come at a high cost that can easily offset any potential benefits: while it reduces the CEO's rents, it also pushes down the cutoff signal  $\theta^*$ , thus creating more strategy inertia and reducing overall shareholder value.

### 3.4 Menu of Compensation Schemes

At the time when the CEO makes his entrenchment decision, only he observes the signal  $\theta$ . Based on the observed signal, the CEO then (effectively) chooses between his expected on-the-job compensation  $E[w(s) | \theta]$  and his severance pay  $W$ . In principle, one could envision a richer model in which the CEO reports a signal  $\hat{\theta}$  and—based on the reported signal—receives a compensation package from a prespecified menu  $\{w(s, \hat{\theta}), W(\hat{\theta})\}$ . As we will now show, introducing such a menu is strictly suboptimal in our model.

Let  $\Theta_+$  denote the set of all signals at which the strategic status quo is preserved, and let  $\Theta_-$  denote the set of all signals at which a strategy change is implemented. It is easy to see that it cannot be optimal to make the CEO's severance pay contingent on his reported signal. *Conditional* on reporting some signal in the set  $\Theta_-$ , the CEO would always report the signal that yields him the highest amount of severance pay, i.e., he would always report the signal  $\hat{\theta} \in \arg \max_{\theta' \in \Theta_-} W(\theta')$ . Hence,  $W$  must be a constant  $W(\hat{\theta}) = W$ .

There is a similarly straightforward argument why it is not helpful to make the CEO's on-the-job compensation contingent on his reported signal. As the choice between preserving the strategic status quo and implementing a strategy change is binary, all that matters is whether the signal is an element of  $\Theta_-$  or  $\Theta_+$ . Conditional on knowing that the signal lies in the set  $\Theta_+$ , there is thus no benefit to obtaining more precise information about the CEO's signal by letting him choose from a menu of on-the-job compensation schemes.

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<sup>27</sup>A prominent example is the lawsuit by Walt Disney shareholders against the company for awarding Michael Ovitz severance pay worth \$130 million after being only 14 months with Disney. Public pressure against high severance packages is not limited to the United States. The United Kingdom, for instance, recently had a public inquiry about “rewards for failure” (DTI (2003)), and it has witnessed substantial shareholder activity against high severance packages. As a result, listing rules were amended in 2002 to require firms to publish their directors' remuneration reports, which must be approved by shareholders.

But we can prove an even stronger claim, namely, that making the CEO’s on-the-job compensation contingent on his reported signal is *strictly* suboptimal. The intuition is as follows. As the preceding analysis has shown, the CEO’s optimal on-the-job compensation scheme shifts as much as possible of his expected on-the-job compensation into high-signal states. By construction, any richer menu of on-the-job compensation schemes  $w(s, \hat{\theta})$ —regardless of whether or not it includes the “single” optimal on-the-job compensation scheme derived previously—must therefore shift some of the CEO’s expected on-the-job compensation “back” into low-signal states.<sup>28</sup> Formally, a richer menu  $w(s, \hat{\theta})$  does not minimize  $E[w | \theta]$  at low values of  $\theta$ . But this feature of minimizing  $E[w | \theta]$  at low signals is precisely what drives optimality in our model, as it minimizes the amount of severance pay that is necessary to accomplish a given cutoff signal  $\theta^*$ . Accordingly, if the shareholder were to offer a richer menu  $w(s, \hat{\theta})$ , she would either have to leave the CEO a higher rent to accomplish a given cutoff signal  $\theta^*$ , or—holding the CEO’s rent constant—tolerate a lower cutoff signal and hence more strategy inertia.

**Proposition 5.** *It is uniquely optimal to offer the CEO a simple compensation package consisting of a single on-the-job compensation scheme  $w(s)$  and fixed amount of severance pay  $W$ .*

**Proof.** See Appendix.

## 4 Comparative Static Analysis

### 4.1 CEO Pay and Business Environment

As the preceding analysis has shown, reducing strategy inertia is costly: it implies that the shareholder must leave the CEO valuable rents. The question is therefore how much strategy inertia should the shareholder optimally tolerate? In this section, we argue that the answer depends on the firm’s external business environment. In a stable business environment where it is unlikely that a strategy change becomes optimal, the *expected* costs of having an entrenched CEO are relatively small. Conversely, in an unstable business environment where it is likely that a strategy change becomes optimal, the expected costs of having an entrenched CEO are potentially severe.

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<sup>28</sup>The argument is identical regardless of whether we consider the optimal on-the-job compensation scheme from Proposition 2 or 3.

In our model, the likelihood that a strategy change becomes optimal is  $F(\theta_{FB})$ . As the first-best cutoff signal  $\theta_{FB}$  increases, there is a larger number of signals at which preserving the strategic status quo is inefficient. Consequently, the shareholder must also raise the second-best cutoff signal  $\theta^*$  to make sure that the strategic status quo is indeed preserved less frequently. Raising  $\theta^*$  is costly, however: it implies the shareholder must increase both the CEO's severance pay and his expected on-the-job compensation. Accordingly, CEOs operating in unstable business environments should receive more generous compensation packages, both in terms of higher severance pay and higher on-the-job compensation. At the same time, however, the fact that a strategy change is more likely implies that CEO turnover should also be higher.

To ensure the existence of a uniquely optimal value of  $W$ , we assume that the shareholder's objective function is strictly quasiconcave in  $W$ . Once the optimal value of  $W$  is pinned down, the remaining choice variables  $\theta^*$  and  $w(s)$  are uniquely determined (see footnote 26). We have the following result.

**Proposition 6.** *As the firm's business environment becomes more unstable—implying the likelihood of a strategy change becoming optimal increases—both the CEO's severance pay and his on-the-job compensation, but also the likelihood of CEO turnover, increases.*

**Proof.** See Appendix.

Proposition 6 suggests that it may be warranted to pay CEOs potentially generous compensation packages—both in terms of high severance pay and high on-the-job compensation—when a firm's business environment is relatively unstable.<sup>29</sup> This reduces strategy inertia in precisely those situations when the ability to adapt to changes in the firm's environment is key. Proposition 6 is consistent with Rusticus' (2006) findings that CEOs' (contractual) severance pay is positively correlated with i) measures proxying for the uncertainty of the firm's operating environment and the likelihood of a strategy change, ii) the CEO's on-the-job compensation (see also Schwab and Thomas (2004) and Lefanowicz, Robinson, and Smith (2000)), and iii) the likelihood of CEO turnover.

Proposition 6 may also help to shed light on a number of developments which have taken place over the past decades. As Holmström and Kaplan (2001) argue, since the late 1970s the

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<sup>29</sup>An increase in uncertainty alone—e.g., in the form of a mean-preserving spread—does not necessarily imply that the likelihood that a strategy change becomes optimal increases. What is important is that  $\theta_{FB}$  increases.

“pace of economic change has accelerated.” Between 1978 and 1996, some of the most important industries in the United States, including airlines, broadcasting, entertainment, natural gas, trucking, banks and thrifts, utilities, and telecommunications, have experienced massive deregulations. The 1980s and 1990s also witnessed fundamental technological innovations, notably in the information technology and telecommunications industries, that have radically altered the industrial landscape in the United States. These developments—key drivers behind what Jensen (1993) refers to as “Modern Industrial Revolution”—have put increasing pressure on U.S. firms to adapt their business strategies at an increasingly faster pace. The takeover and merger waves of the 1980s and 1990s are often viewed as consequences of these developments.

When we reinterpret Proposition 6 as a time-series result, we obtain the prediction that, along with the “increasing pace of economic change”, both CEOs’ severance pay and on-the-job compensation, but also the likelihood of CEO turnover, should have increased. This prediction is consistent with evidence by Hall and Liebman (1998) that the mean value of CEO stock option grants has increased almost sevenfold between 1980 and 1994, from about \$155,000 to over \$1,210,000. Similarly, Bebchuk and Grinstein (2005) show that between 1993 and 2003 the average CEO compensation among S&P 500 firms has increased almost threefold from \$3.7 million to \$9.1 million. As for severance packages, Walker (2005) points to a surge in (contractual) severance pay, while Lefanowicz, Robinson, and Smith (2000) and Bebchuk, Cohen, and Ferrell (2004) both document that the usage and size of golden parachutes has increased during the 1980s and 1990s. Finally, Huson, Parrino, and Starks (2001) provide evidence that CEO turnover has increased substantially since the 1970s.

The rise in CEO compensation over the past decades is also the subject of several other papers. Like this paper, Dow and Raposo (2005a) link this development to the fact that firms’ business environments have become more unstable. In their model, however, CEOs receive higher pay because the range of possible business strategies—in particular strategies involving radical changes—has increased, while shareholders want to incentivize CEOs *not* to pursue radical changes. Bebchuk and Fried (2004) argue that the rising stock market of the 1990s gave boards more latitude to boost executive pay. In their view, boards do not maximize shareholder value. Murphy and Zábojník (2004) argue that the rise in CEO compensation reflects a shift in the relative importance of general versus firm-specific human capital. Relatedly, Gabaix and Landier (2006) attribute the rise in CEO pay to greater competition for managerial talent caused by an

increase in firms' market capitalizations. Finally, Almazan and Suarez (2003) and Hermalin (2005) both link the rise in CEO compensation to changes in corporate governance: to a shift from weak to strong boards and to more diligent monitoring by boards, respectively.

Proposition 6 also lends itself for cross-industry predictions. Accordingly, industries undergoing fundamental changes should exhibit higher CEO turnover but also higher CEO pay than relatively stable industries. We are not aware of empirical studies analyzing how CEO pay and turnover vary jointly across industries.<sup>30</sup>

A special, and arguably extreme, case of our model is that where a "strategy change" involves shutting down the firm. For fear of losing his job, the CEO might try to prevent an efficient shutdown of his firm. According to Jensen (1993), inertia is one of the main obstacles to what he calls "Modern Industrial Revolution": the reluctance of managers to shut down their firms impedes the efficient transfer of assets from old, declining industries to new, thriving industries. Our model implies that the least costly way to induce managers to accept the necessary shutdown of their firms is a combination of severance pay and high-powered on-the-job compensation such as option grants. This is consistent with Mehran, Norgler, and Schwartz's (1997) finding that option grants appear to have a positive effect on the likelihood of voluntary liquidation. It is also consistent with Dial and Murphy's (1995) clinical study of General Dynamic's partial liquidation, where stock option programs helped to overcome managers' resistance against liquidating plants and selling off assets, even if this meant that they had to sacrifice their own jobs.

## 4.2 CEO Pay and Firm Characteristics

### CEO Pay and Firm Size

Our model also makes a natural prediction regarding the relation between CEO pay and firm size. At larger firms, there is more at stake. Precisely, for a given signal  $\theta < \theta_{FB}$  the costs of preserving the strategic status quo while a strategy change would be efficient are higher for larger firms. To mitigate these higher costs, larger firms should therefore have a higher cutoff signal  $\theta^*$  and, by implication, both higher CEO pay and higher CEO turnover. To explore the relationship between firm size, CEO pay, and CEO turnover, we scale both  $V$  and  $s$  by a factor  $\alpha > 0$ . We obtain the following result.

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<sup>30</sup>There is some evidence that CEO pay is lower in regulated industries which, one might argue, are more stable (Murphy (1999)). Along similar lines, Crawford, Ezzell, and Miles (1995) and Hubbard and Palia (1995) both find that deregulation appears to have contributed to the rise of CEO pay in the banking industry.

**Proposition 7.** *Larger firms have both higher CEO pay and higher CEO turnover.*

**Proof.** See Appendix.

Consistent with Proposition 7, Conyon (1997), Schwab and Thomas (2004), Bebchuk and Grinstein (2005), and Rusticus (2006) all find that CEO pay increases with firm size. For evidence that larger firms have higher executive turnover, see Warner, Watts, and Wruck (1988) and Murphy (1999). There are, of course, many other possible reasons for why CEOs of larger firms might be paid more. For instance, larger firms might need more talented and thus more expensive CEOs. It is not entirely clear, however, why this argument would also imply that larger firms should have higher CEO turnover.

### **CEO Pay and Corporate Governance**

There are two “drivers” that affect the magnitude of the CEO’s compensation in our model. Firstly, the CEO must be compensated for forgoing private benefits  $B$ . Secondly, he must be compensated for not entrenching himself, which secures him an additional rent of  $W$  on top of  $B$ . In what follows, we examine how these two factors interact.

Suppose  $B$  increases. The direct effect, implied by the incentive constraint (2), is that the CEO’s on-the-job compensation must increase to ensure that he puts in high effort. But this only strengthens the CEO’s incentives to entrench himself after observing a low signal, i.e., the cutoff signal  $\theta^*$  goes down. To counteract the decrease in  $\theta^*$ , the shareholder must increase the CEO’s severance pay, which in turn implies she must (further) increase the CEO’s on-the-job compensation. As Proposition 8 below shows, it is not optimal to push back the cutoff signal  $\theta^*$  all the way to its original level, however. Ultimately, an increase in  $B$  thus results in a lower cutoff signal and therefore more strategy inertia, but also lower CEO turnover.

The extent to which the CEO is able to appropriate private benefits might depend on exogenous firm characteristics. But it may realistically also depend on the firm’s corporate governance, which imposes a natural constraint on the CEO’s ability to enjoy private benefits. In this regard,  $B$  should be inversely related to the quality of the firm’s corporate governance: it should be low in firms with strong corporate governance and high in firms with weak corporate governance. We have the following result.

**Proposition 8.** *Firms with weak corporate governance have higher CEO pay, more strategy inertia, and lower CEO turnover.*

**Proof.** See Appendix.

Proposition 8 is consistent with empirical evidence suggesting that CEO turnover is higher in firms with strong corporate governance, as well as evidence suggesting that weak corporate governance is conducive to higher CEO pay (e.g., Cyert, Kang, and Kumar (2002)).

## 5 Conclusion

Using an optimal contracting framework with a continuum of cash flows, we consider the joint optimal design of CEOs' on-the-job compensation and severance pay. Considering the joint design of on-the-job compensation and severance pay allows us to develop a novel economic argument for why CEOs should receive high-powered, non-linear on-the-job compensation such as bonus schemes and option grants. Based on this argument, the CEO's optimal on-the-job compensation scheme is designed to minimize the use of costly severance pay.

In our basic model where only little structure is imposed on the optimal compensation scheme, the CEO's optimal on-the-job compensation scheme is a high-powered bonus scheme that shifts all of his on-the-job compensation into the highest cash-flow states. Such a compensation scheme minimizes the CEO's *expected* on-the-job compensation—and thus his benefit from entrenching himself—in precisely those situations when replacing the CEO is efficient. This, in turn, implies that a relatively smaller amount of severance pay is needed to induce the CEO not to entrench himself. In an extension of our basic model in which the CEO can manipulate the firm's cash flows, his optimal on-the-job compensation scheme becomes an option-like contract. The basic economic principle that the optimal compensation scheme shifts as much as possible of the CEO's on-the-job compensation into the highest cash-flow states—subject only to binding constraints—remains the same, however.

Our argument for why CEOs should receive high-powered, non-linear on-the-job compensation schemes—driven by the objective to minimize the use of costly severance pay—is novel and different from existing arguments based on moral hazard or risk taking. Our model also lends itself to empirical implications which, to the extent that they have been tested, are consistent with the empirical evidence. For instance, our model predicts that CEOs' on-the-job compensation should be positively correlated with their severance pay, and that CEOs operating in volatile business environments should receive both higher on-the-job pay and higher severance

pay. At the same time, however, CEOs operating in volatile business environments should face a likelihood of being replaced.

## 6 Appendix

**Proof of Proposition 2.** The fact that  $W > 0$  follows from the argument in the main text. It remains to prove that it is uniquely optimal to grant the CEO an on-the-job compensation scheme of the form  $w(s) = 0$  if  $s < \hat{s}$  and  $w(s) = s$  if  $s \geq \hat{s}$  for some  $\hat{s} \in (\underline{s}, \bar{s})$ .

We argue to a contradiction. Suppose it was optimal to implement a given cutoff signal  $\theta^*$  with a different on-the-job compensation scheme  $\tilde{w}(s)$ , and denote the corresponding severance pay by  $\widetilde{W}$ . We show that there then exists some on-the-job compensation scheme  $w(s)$  such that (i) the incentive constraint (2) remains binding and (ii) we can still implement  $\theta^*$ —though now with a lower severance pay  $W$ . That is, in a slight abuse of notation, we show that the new on-the-job compensation compensation scheme satisfies  $\theta^*(w, W) = \theta^*(\tilde{w}, \widetilde{W}) = \theta^*$  and  $W < \widetilde{W}$ , which by inspection of (5), contradicts the optimality of  $\tilde{w}(s)$ .

We proceed in two steps. We first choose  $\overline{W} = \widetilde{W}$  and  $\overline{w}(s)$  with  $\overline{w}(s) = 0$  for  $s < \tilde{s}'$  and  $\overline{w}(s) = s$  for  $s \geq \tilde{s}'$  such that  $\theta^*(\overline{w}, \overline{W}) = \theta^*$ . That is, defining  $d(s) := \tilde{w}(s) - \overline{w}(s)$ , we have that

$$\int_S d(s)g_{\theta^*}(s)ds = 0. \quad (7)$$

Given the construction of  $\overline{w}(s)$ , there exists a value  $\tilde{s} \in (\underline{s}, \bar{s})$  such that  $d(s) \geq 0$  for all  $s < \tilde{s}$  and  $d(s) \leq 0$  for all  $s > \tilde{s}$ , where both inequalities are strict over sets of positive measure. Take now any signal  $\widehat{\theta} > \theta^*$ . By MLRP of  $G_\theta(s)$  and (7), it then holds that

$$\begin{aligned} \int_S d(s)g_{\widehat{\theta}}(s)ds &= \int_{\underline{s}}^{\tilde{s}} d(s)g_{\theta^*}(s)\frac{g_{\widehat{\theta}}(s)}{g_{\theta^*}(s)}ds + \int_{\tilde{s}}^{\bar{s}} d(s)g_{\theta^*}(s)\frac{g_{\widehat{\theta}}(s)}{g_{\theta^*}(s)}ds \\ &< \frac{g_{\widehat{\theta}}(\tilde{s})}{g_{\theta^*}(\tilde{s})} \int_S d(s)g_{\theta^*}(s)ds = 0, \end{aligned} \quad (8)$$

which implies the incentive constraint (2) is slack under  $\overline{w}(x)$  and  $\overline{W}$ .

In a second step, we can now construct the asserted compensation scheme with  $w(s) = 0$  for  $s < \hat{s}$  and  $w(s) = s$  for  $s \geq \hat{s}$  and  $W < \overline{W} = \widetilde{W}$ . In order to do this, we continuously increase the threshold  $\tilde{s}'$  in  $\overline{w}(s)$  and decrease  $\overline{W}$ , while still satisfying  $\theta^*(\overline{w}, \overline{W}) = \theta^*$ , until (2) again binds. The fact that this is possible follows from continuity of all payoffs in  $\tilde{s}'$  and the fact that (2) is violated as  $\tilde{s}' \rightarrow \bar{s}$ . Q.E.D.

**Proof of Proposition 3.** By the argument in the main text, the manipulation problem adds one additional constraint to the shareholder's maximization problem: the slope of  $w(s)$  must not exceed  $\gamma$ . Following footnote 23, we focus on the case where  $\gamma \leq 1$ . We argue to a contradiction and assume we want to implement a given cutoff signal  $\theta^*$  with different on-the-job compensation scheme  $\tilde{w}(s)$ . Like in the Proof of Proposition 2, we can then again construct  $\bar{w}(s)$  with  $\bar{w}(s) = 0$  for  $s < \hat{s}'$  and  $\bar{w}(s) = \gamma(s - s)$  for  $s \geq \hat{s}'$  such that (7) is satisfied. As the slope of  $\tilde{w}(s)$  cannot exceed  $\gamma$ , there then exists a value  $\tilde{s} \in (\underline{s}, \bar{s})$  such that  $d(s) \geq 0$  for all  $s < \tilde{s}$  and  $d(s) \leq 0$  for all  $s > \tilde{s}$ , where both inequalities are strict over sets of positive measure. The rest of the argument is identical to that in the Proof of Proposition 2. Q.E.D.

**Proof of Corollary 1.** By Proposition 3, an increase in  $\gamma$  increases the slope of the optimal on-the-job compensation scheme to the right of the threshold  $\hat{s}$ .<sup>31</sup> It remains to prove that as  $\gamma$  increases, implementing a given cutoff signal  $\theta^*$  requires a lower amount of severance pay.

To prove this, we totally differentiate (1), which pins down  $\theta^*$ , and also the constraint (4) to obtain (holding  $\theta^*$  fixed)

$$\frac{dW}{d\gamma} = \frac{\int_{\theta^*}^{\bar{\theta}} \left[ \int_{\hat{s}}^{\bar{s}} [1 - G_\theta(\hat{s})] [1 - G_{\theta^*}(s)] - [1 - G_{\theta^*}(\hat{s})] [1 - G_\theta(s)] ds \right] f(\theta) d\theta}{\int_{\theta^*}^{\bar{\theta}} [G_{\theta^*}(\hat{s}) - G_\theta(\hat{s})] f(\theta) d\theta}. \quad (9)$$

The denominator of (9) is positive as  $G_\theta(s)$  satisfies FOSD, which is implied by MLRP. To see that the numerator is negative, note that  $[1 - G_\theta(s)] / [1 - G_{\theta^*}(s)]$  is strictly increasing in  $s$  for all  $\theta > \theta^*$ , which is again implied by MLRP.<sup>32</sup> Q.E.D.

**Proof of Proposition 4.** Totally differentiating (1), which pins down  $\theta^*$ , and the constraint (4) while substituting the optimal on-the-job compensation scheme from Proposition 3 yields

$$\frac{d\theta^*}{dW} = -\frac{1}{\gamma} \frac{\int_{\theta^*}^{\bar{\theta}} [G_{\theta^*}(\hat{s}) - G_\theta(\hat{s})] f(\theta) d\theta}{\left[ \int_{\hat{s}}^{\bar{s}} \frac{dG_{\theta^*}(\hat{s})}{d\theta^*} ds \right] \left[ \int_{\theta^*}^{\bar{\theta}} [1 - G_\theta(\hat{s})] f(\theta) d\theta \right]}. \quad (10)$$

To evaluate the sign of (10), note that MLRP implies that  $G_\theta(s)$  is decreasing in  $\theta$  for all  $s \in (\underline{s}, \bar{s})$ , implying that  $d\theta^*/dW > 0$ .

<sup>31</sup>Moreover, holding either  $\theta^*$  or  $W$  fixed, to keep the incentive constraint (2) binding, the threshold  $\hat{s}$  must shift to the right as  $\gamma$  increases.

<sup>32</sup>As  $G_\theta(s)$  is differentiable, this is equivalent to requiring that  $g_\theta(s)/[1 - G_\theta(s)]$  is strictly decreasing in  $\theta$  for any given  $s \in (\underline{s}, \bar{s})$ . This is commonly referred to as the Monotone Hazard Rate Property (MHRP), which is implied by MLRP. To obtain this expression, we use the fact that  $E[w(s) | \theta] = \gamma \int_{\hat{s}}^{\bar{s}} [1 - G_\theta(s)] ds$ , which follows from partial integration.

Consider next the claim that  $\theta^* < \theta_{FB}$ . Totally differentiating (1) and (4) while substituting the optimal on-the-job compensation scheme from Proposition 3 yields

$$\frac{d\hat{s}}{dW} = -\frac{1}{\gamma} \frac{1 - F(\theta^*)}{\int_{\theta^*}^{\bar{\theta}} [1 - G_\theta(\hat{s})] f(\theta) d\theta}. \quad (11)$$

Next, differentiating (5) with respect to  $W$  and substituting  $d\hat{s}/dW$  from (11), we obtain

$$-\frac{d\theta^*}{dW} f(\theta^*) [E[s | \theta^*] - V] - 1, \quad (12)$$

which yields the first-order condition

$$E[s | \theta^*] - V = \frac{-F(\theta^*)}{f(\theta^*)(d\theta^*/dW)}. \quad (13)$$

Given that  $d\theta^*/dW > 0$  from (10), we have at an interior solution that  $E[s | \theta^*] - V < 0$  and therefore that  $\theta^* < \theta_{FB}$ . Q.E.D.

**Proof of Proposition 5.** By the argument in Section 2.2, we can restrict consideration to on-the-job compensation schemes  $w(s, \theta)$  that are strictly increasing in  $s$  for some  $s$  on a set of positive measure. In conjunction with the fact that  $G_\theta(s)$  satisfies MLRP, truthtelling then implies that  $\Theta_- = [\underline{\theta}, \theta^*)$  and  $\Theta_+ = [\theta^*, \bar{\theta}]$  with  $E[w(s, \theta^*) | \theta^*] = W$ . The following auxiliary result follows now immediately from the Proof of Proposition 2.

**Claim 1.** *Take two different feasible on-the-job compensation schemes  $\tilde{w}(s)$  and  $\hat{w}(s)$  such that  $\hat{w}(s) = 0$  for  $s < \hat{s}$  and  $\hat{w}(s) = s$  for  $s \geq \hat{s}$ . If  $E[\hat{w}(s) | \theta'] \geq E[\tilde{w}(s) | \theta']$  for some  $\theta' < \bar{\theta}$ , then  $E[\hat{w}(s) | \theta'] > E[\tilde{w}(s) | \theta']$  for all  $\theta > \theta'$ .*

To complete the proof, we must distinguish between two cases. If  $w(s, \theta^*)$  satisfies  $w(s, \theta^*) = 0$  for  $s < \hat{s}$  and  $w(s, \theta^*) = s$  for  $s \geq \hat{s}$ , Claim 1 and truthtelling imply that the same on-the-job compensation scheme is also chosen for all  $\theta \geq \theta^*$ . That is, the optimal menu is degenerate with  $w(s, \theta) = w(s, \theta^*)$ . Suppose next that  $w(s, \theta^*)$  takes a different form as above. As in the Proof of Proposition 2, we can then construct a single on-the-job compensation scheme  $\hat{w}(s)$  satisfying  $\hat{w}(s) = 0$  for  $s < \hat{s}$  and  $\hat{w}(s) = s$  for  $s \geq \hat{s}$  such that the same cutoff signal  $\theta^*$  is implemented while the incentive constraint is relaxed. This follows from the fact that  $E[\hat{w}(s) | \theta] > E[w(s, \theta) | \theta]$  for all  $\theta > \theta^*$ , which in turn follows from Claim 1 and the truthtelling requirement for the original menu. As in Proposition 2, we can finally adjust the new (single) on-the-job compensation scheme  $\hat{w}(s)$  so as to implement  $\theta^*$  with a lower severance pay. Q.E.D.

**Proof of Proposition 6.** We show that the optimal choice of  $W$  is strictly increasing in  $V$ , which by (10) implies that the corresponding optimal choice of  $\theta^*$  is also strictly increasing. Implicit differentiation of the first-order condition for  $W$  in (13) gives

$$\frac{dW}{dV} = -\frac{f(\theta^*)(d\theta^*/dW)}{SOC} > 0,$$

where  $SOC < 0$  must hold at an interior optimum. Q.E.D.

**Proof of Proposition 7.** We show that the optimal choice of  $W$  is strictly increasing in  $\alpha$ , which by (10) implies that the corresponding optimal choice of  $\theta^*$  is also strictly increasing. Note first that the first-order condition (13) now transforms to

$$\alpha [E[s \mid \theta^*] - V] = \frac{-F(\theta^*)}{f(\theta^*)(d\theta^*/dW)}, \quad (14)$$

where we can again substitute  $d\theta^*/dW$  from (10). Implicit differentiation of (14) gives

$$\frac{dW}{d\alpha} = \frac{E[s \mid \theta^*] - V}{SOC} > 0,$$

where we used the result from Proposition 5 that at the optimum it holds that  $\theta^* < \theta_{FB}$ , while  $SOC < 0$  must hold at an interior optimum. Q.E.D.

**Proof of Proposition 8.** We show first that in order to implement a given cutoff signal  $\theta^*$ , the higher is  $B$  the higher must also be the severance pay  $W$ . We totally differentiate (1), which determines  $\theta^*$ , and the constraint (4) to obtain

$$\frac{dW}{dB} = \frac{1 - G_{\theta^*}(\hat{s})}{\int_{\theta^*}^{\hat{\theta}} [G_{\theta^*}(\hat{s}) - G_\theta(\hat{s})] f(\theta) d\theta} > 0, \quad (15)$$

where the sign follows again from MLRP of  $G_\theta(s)$ , which implies FOSD.

Take now some value  $B = \hat{B}$ . The optimal compensation package specifies an amount of severance pay  $W = \hat{W}$  and some on-the-job compensation scheme  $w(s) = \hat{w}(s)$ , which is in turn characterized by a unique threshold (or “strike price”)  $\hat{s} = \hat{s}'$ . Denote the corresponding cutoff signal by  $\theta^* = \hat{\theta}^*$ . If  $B = \tilde{B} > \hat{B}$ , we know from (15) that in order to implement the same cutoff signal  $\theta^* = \hat{\theta}^*$ , the severance pay must increase:  $W = \tilde{W} > \hat{W}$ . To still satisfy the incentive constraint (4), the CEO’s expected on-the-job compensation must also increase, i.e., the new threshold  $\hat{s} = \hat{s}''$  must satisfy  $\hat{s}'' < \hat{s}'$ .

Consider next the derivative (12) of the shareholder’s objective function. By construction, we have for  $B = \hat{B}$ ,  $\hat{s} = \hat{s}'$ ,  $W = \hat{W}$ , and  $\theta^* = \hat{\theta}^*$  that the derivative is just zero. (This is just the

first-order condition.) We now want to evaluate the sign of the derivative when we substitute  $B = \tilde{B}$ ,  $\hat{s} = \hat{s}''$ ,  $W = \tilde{W}$ , and  $\theta^* = \hat{\theta}^*$ , i.e., we want to evaluate the sign of the derivative at the point where with higher private benefits the same cutoff signal is implemented, albeit with higher severance pay and a higher expected on-the-job compensation. More precisely, we want to show that the derivative (12) is then negative. By inspection of (12), this is the case if at  $\theta^* = \hat{\theta}^*$  the derivative  $d\theta^*/dW$  is strictly lower when  $B = \tilde{B}$  and thus  $W = \tilde{W}$  and  $\hat{s} = \hat{s}''$ . Given that  $\hat{s}'' < \hat{s}'$ , this in turn holds if the derivative (10) is strictly increasing in  $\hat{s}$ . To show that this is the case, we rearrange (10) to obtain

$$\frac{d\theta^*}{dW} = \frac{1}{\gamma} \left( \frac{-1}{\int_{\hat{s}}^{\bar{s}} \frac{dG_{\theta^*}(s)}{d\theta^*} ds} \right) \left( \frac{\int_{\theta^*}^{\bar{\theta}} [G_{\theta^*}(\hat{s}) - G_\theta(\hat{s})] f(\theta) d\theta}{\left[ \int_{\theta^*}^{\bar{\theta}} [1 - G_\theta(\hat{s})] f(\theta) d\theta \right]} \right). \quad (16)$$

The first expression in parentheses is positive by  $dG_{\theta^*}(\hat{s})/d\theta^* < 0$ , which is implied by FOSD and thus by MLRP, strictly increasing in  $\hat{s}$ . Next, after some transformations, we have that the sign of the derivative of the last term in (16) with respect to  $\hat{s}$  is given by the expression

$$\int_{\theta^*}^{\bar{\theta}} [g_{\theta^*}(\hat{s}) [1 - G_\theta(\hat{s})] - g_\theta(\hat{s}) [1 - G_{\theta^*}(\hat{s})]] f(\theta) d\theta > 0. \quad (17)$$

The fact that (17) is also strictly positive follows again from MLRP, by which  $g_\theta(s)/[1 - G_\theta(s)]$  must be strictly decreasing in  $\theta$  for all  $s \in (\underline{s}, \bar{s})$ . (Recall that MLRP implies MHRP.) Hence, we have shown that given  $B = \tilde{B}$ , if we evaluate (12) at the value  $W = \tilde{W}$  where  $\theta^* = \hat{\theta}^*$ , then the derivative is strictly negative. Given strict quasiconcavity of the objective function and the fact that  $\theta^*$  (and thus, in particular,  $\hat{\theta}^*$ ) is interior, we thus have that for  $B = \tilde{B}$  the optimal severance pay is strictly lower than  $W = \tilde{W}$ . But this finally implies that under the optimal compensation package there is more entrenchment if  $B = \tilde{B}$  than if  $B = \hat{B} < \tilde{B}$ . Q.E.D.

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