CEO Compensation and Strategy Inertia*

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Abstract

Research suggests that top executives—rather than embracing strategy change as an opportunity to adapt to changes in the firm's environment—act as impediments to adaptation, showing instead a strong commitment to the firm's strategic status quo. This paper provides a simple explanation based on agency theory for why strategy inertia might persist and derives implications for the optimal design and magnitude of CEO compensation packages. Using an optimal contracting framework, we show that CEOs should receive severance pay *in combination* with high-powered and highly convex on-the-job compensation schemes such as bonus schemes and option grants. Our argument for why CEOs should receive option grants is novel and different from arguments based on moral hazard and risk-taking: the optimal CEO on-the-job compensation scheme minimizes the amount of severance pay that is necessary to induce the CEO not to block value-increasing strategy changes, thus minimizing the CEO's informational rents. Our model suggests how deregulation and changes in firms' external business environments might have contributed to the widely documented increase in CEO pay and turnover over the past decades.

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1 Introduction

The ability to keep pace with major changes in industry and broader environmental contexts is a key concern within today's organizations. As the CEO will typically have better or, at least, more timely information than the board, a firm's long-term survival in the market place will depend crucially on the CEO's ability and incentives to initiate even fundamental strategy changes when this is necessary. However, instead of willingly taking over the role of "champions of change" (Geletkanycz and Black (2001)), the management literature has identified incumbent CEOs as a major obstacle towards change.[1]

Though it has been argued that this may be partially due to the psychological or cultural background of incumbent CEOs (e.g., Hambrick, Geletkanycz, and Fredrickson (1993)), one rationale for CEOs to resist fundamental changes may be much more mundane. Initiating change may be a risky endeavour. Even if it succeeds, the incumbent CEO may not prove to be suitable under the changed circumstances, given that his skills and experience were honed under the firm's old strategy.[2] The prospect of losing his job may thus stop a CEO from becoming pro-active. Instead, he may even try to withhold information from the board that would indicate the necessity to undertake the change.[3] Or, he may turn "pro-active" by entrenching himself, e.g., by making "protective" investments that make it impossible or extremely costly for shareholders to replace him, as in Shleifer and Vishny (1989) and related models of managerial entrenchment.

[1] There is widespread documentation that rather than facilitate change, top executives often act as impediments to adaption. (Some of the classical references are Harrigan (1985), Pettigrew (1985), and Miller (1991)). Management's bias towards the "strategic status quo" is also discussed more broadly in Finkelstein and Hambrick (1990) and Geletkanycz (1997).

[2] In fact, some scholars hold the view that a fundamental strategy change can only be successful if the firm is changed at the top (e.g., Hofer (1980)). The relation between strategy change and top management turnover has also been widely documented in the management literature (e.g., Miller and Friesen (1980), Tushman, Virany, and Romanelli (1985)). Firms often choose successors with different career experiences, educational backgrounds, and personal characteristics than the previous CEO to achieve a better "fit" with the firm's new strategic orientation (Gupta and Govindargan (1983), White, Smith, and Barnett (1997)).

[3] While boards monitor the firm's performance, they typically do not question the CEO's strategy unless there is evidence that things go wrong (Mace (1971), Finkelstein and Hambrick (1996)). Besides, evaluating the CEO's strategy is not easy: "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" (Jensen (1993)).

If CEOs' inertia supposedly derives from the fear to lose their job, why is it that CEOs should cling that much to their present job. After all, even if we believe that they derive "private benefits" from running a company, it is not clear why these should be specific to some company. Of course, the CEO will be very reluctant to leave if his current position pays him a "rent" in the form of a higher wage than what he would be worth on the market. But if we believe that the CEO's compensation contract is chosen so as to maximize shareholder value, it is in turn not obvious why such a "rent" should be paid in the first place.[4]

Our model ties these loose ends together, offering an integrated framework to study how CEOs may become overtly resistant to change and how this can be mitigated by a careful design of their compensation package. In our model, a CEO will indeed have to accept a pay cut when he loses his job. Paying the CEO a "rent" in case he continues to run the firm will in turn be optimal to make him work hard. This, however, will endogenously bias the CEO against initiating a change that may ultimately cost his job. As the CEO's bias against change derives from his fear to forego compensation that is in excess of his market value, it is the structure of his compensation that must be carefully chosen so as to minimize this bias at least costs to shareholders.

The key results of our model pertain to the interaction of the CEO's compensation "on the job" and the choice of severance pay. The insight that severance pay can enhance firm value by reducing managerial entrenchment is not novel to this paper.[5] Granting the CEO severance pay is, however, only one side of the coin. What is more, it is also costly as in order to preserve the CEO's incentives to work hard an increase in severance pay must be matched by an increase in his on-the-job pay, which in turn can make him more biased against change. We show that severance pay can, however, still help to induce more change and that less severance pay is needed to do so if the CEO's on-the-job compensation is optimally structured. We find that a high-powered and highly convex compensation scheme is optimal.

[4] If we believe, instead, that the CEO can substantially influence his own pay package, then he may be equally protected against losing his job. But then it is not clear why the CEO would not want to undertake whatever action maximizes the value of his "empire".

[5] The role of severance pay and golden parachutes as means to overcome executives' resistance to change is well understood (e.g., Lambert and Larcker (1985), Harris (1990), Almazan and Suarez (2003)). What is less well understood is how and why severance pay and CEOs' on-the-job compensation are interrelated. To our knowledge, the only paper that addresses this issue is Almazan and Suarez's paper, which shows that severance pay is an effective substitute for costly on-the-job incentive pay in providing CEOs incentives to exert effort.

The argument why high-powered incentives are optimal is, to our knowledge, novel and, what is more, will also give rise to novel predictions. High-powered incentives are optimal as they allow to pay the CEO a given above-market wage in a way that minimizes his bias or, alternatively, in a way that requires to use less severance pay. The CEO will then receive a high payoff exactly in states where it is also optimal that he continues with the existing strategy. In contrast, expected pay will be low in states where change is optimal and the CEO is thus likely to lose his job, that is unless he would start to entrench himself and resist change. Importantly, it is precisely the latter states where the CEO's bias matters as change should be induced.

In our base model in which only little structure is imposed on the optimal compensation scheme, this implies the CEO receives a high-powered discontinuous bonus scheme. In an extension of our base model we consider a simple problem in which the CEO can manipulate the firm's share value. In this case, the CEO's optimal on-the-job compensation scheme becomes an option grant. The underlying economic principle is the same, however.

Our model may help to explain the observed increase in both severance pay and CEO on-the-job compensation over the past decades (Hall and Liebman (1998), Bebchuk and Grinstein (2005)). When a firm's external business environment becomes more uncertain—like in the 1980s and 1990s when massive technological changes and deregulation fundamentally changed the industrial landscape in the U.S.—our model implies that the level of both severance pay and CEO option grants should increase. It also implies that CEO turnover should increase along with the increase in pay, which is consistent with evidence by Huson, Parrino, and Starks (2001) that CEO turnover has increased over the past decades. Further implications of our model are derived in the main body of the paper.

We feel that our model offers a plausible argument based on agency theory for why strategy inertia might persist and derives implications for the optimal design of CEOs' compensation packages. Our model suggests that the optimal compensation package should consist of a combination of severance pay and high-powered and highly convex on-the-job compensation, such as bonus schemes and option grants, which is consistent with what we see in practice. The argument for why on-the-job compensation should be highly convex is different from existing arguments based on moral hazard (Holmström (1979), Innes (1990)) and risk-taking (Smith and Stulz (1985)). This may be important as it seems that these models have so far not been completely successful in explaining the salient features of executive compensation.[6] In addition, our model offers different and novel predictions such as that severance pay and high-powered on-the-job compensation should go hand in hand, which would seem orthogonal to the predictions of a standard moral-hazard model.[7] Interestingly, this prediction is also different from the "outrage constraint" perspective on executive compensation that is taken in Bebchuk and Fried (2004), according to which severance pay as one form of "stealth compensation" provides a substitute for more visible on-the-job pay in case of increased public scrutiny. In fact, the complementary nature of severance pay and on-the-job pay becomes most visible by the fact that the size of the CEO's severance pay is exactly equal to the overall rent, i.e., the difference between the ex-ante value of his compensation package and what would be necessary to make him take his job. If it is important to forestall strategic inertia, then we show that this rent can become substantial, in particular for large firms where shareholders' stakes are larger.

There is a large literature on CEO compensation to which our paper is related. As we have already remarked, our argument for awarding CEOs high-powered and highly convex on-the-job compensation is different from existing arguments based on effort provision and risk-taking. For an overview of the executive compensation literature, see Murphy (1999). A closely related paper is Almazan and Suarez (2003). To the best of our knowledge, it is the only paper besides ours that considers the interrelation between severance pay and on-the-job compensation. Unlike our model, however, the role of compensation design in their model is not to improve the efficiency of continuation decisions. Absent any private information, the continuation decision is always efficient, regardless of the CEO's initial compensation scheme. Rather, the authors focus on

[6] For instance, Dittmann and Maug (2005) estimate the standard principal-agent model used in the literature for a sample of 598 CEOs and conclude that neither effort provision nor risk-taking can satisfactorily explain why observed CEO compensation schemes are so highly convex. The authors conclude "that we need a different contracting model to understand salient features of executive compensation contracts." In a similar vein, Jenter (2002)—based on a numerical example—doubts whether effort provision can satisfactorily explain the use of option grants, while Carpenter (2000) and Ross (2004) cast doubt on the argument that options are granted to increase risk-taking incentives.

[7] In a comprehensive legal study of CEO employment contracts in the U.S., Schwab and Thomas (2004) find that more than 93 percent of all contracts formally stipulate severance pay. In virtually all cases, the size of the CEO's severance pay is positively correlated with his on-the-job pay. Similarly, Lefanowicz, Robinson, and Smith (2000) find that managers whose employment contracts stipulate generous golden parachutes also tend to be more highly compensated on their jobs.

the effect this continuation decision has on the CEO's ex-ante incentives to create value, thus providing a novel argument for severance pay: by creating a direct link between the CEO's payoff from renegotiating with the board and his ex-ante investment, severance pay is more effective at providing effort incentives than costly on-the-job incentive pay.

Dow and Raposo (2005a) also consider the interrelation between CEO compensation and strategy change, albeit in their model the problem is not strategy inertia but the opposite problem that CEOs may choose overly "dramatic" strategy changes (e.g., mergers).[8] Dramatic changes involve the highest effort to success ratios, thus maximizing the CEO's compensation. While in their model CEOs also receive high-powered compensation, the reason is to provide effort incentives. Moreover, none of the available strategy choices endangers the CEO's tenure, implying there is no need for severance pay. Finally, in Eisfeldt and Rampini (2004) a manager has private information about the productivity of the assets under his control. To induce a low-productivity manager to relinquish control of his assets, shareholders must pay him a bonus, whose role is similar to the role of severance pay in our model.

Our paper also differs from the above papers in terms of its focus on the non-linearity (precisely: convexity) of the optimal compensation scheme. To address non-linearity, a minimum of three outcome states is required. Our model has a continuum of possible outcomes.[9]

The rest of this paper is organized as follows. Section 2 lays out the model. Section 3 contains our main analysis. Section 4 presents comparative static results. Section 5 concludes. All proofs are in the Appendix.

2 The Model

The model is conceivably simple. In $t = 0$ the firm's shareholders—represented by, e.g., the board of directors or a large shareholder—hire a new CEO. While the CEO is the best candidate from

[8] See also Dow and Raposo (2005b) for a related model in which successful organizational changes require that CEOs obtain the support of other senior managers.

[9] This is also one difference to the model in Inderst and Mueller (2006), which examines the optimality of broad-based incentive compensation with two payoff states. There, employees make no decisions and have no private information. Decisions are made by the firm's owner (who maximizes shareholder value), who may behave opportunistically and take actions that erode the value of firm-specific human capital. What is shared with the current paper is, however, the focus on the interaction of compensation (there, of the firm's aggregate wage bill) with decision-making.

the pool of available CEOs, there is uncertainty as to whether his strategy is a good fit for the firm. We model this initial uncertainty by assuming that the firm's future value in $t = 2$ under the CEO's strategy is a random variable $s \in S := [\underline{s}, \overline{s}]$, where $\underline{s} \geq 0$, and where $\overline{s}$ may be either finite or infinite.

A key assumption of our model is that the CEO has better, or more timely, information as to whether his strategy is likely to be successful. Precisely, we assume that in $t = 1$ the CEO privately observes the state of nature $\theta \in \Theta := [\underline{\theta}, \overline{\theta}]$, which is a noisy signal of s in the sense of the Monotone Likelihood Ratio Property (MLRP). Hence, observing a high state of nature is good news as it puts relatively more probability mass on high values of s.[10] We assume the relation between θ and s is characterized by the conditional distribution function $G_\theta(s)$ with continuous density $g_\theta(s)$ in both θ and s. MLRP then implies that $g_{\theta'}(s)/g_\theta(s)$ is strictly increasing in s for all $\theta' > \theta$ in Θ.

In $t = 0$ when the CEO is hired, everybody has common expectations regarding the likely success of his strategy. These expectations are represented by the distribution function $F(\theta)$, which has positive density $f(\theta) > 0$ for all $\theta \in \Theta$. The ex-ante likelihood that the firm's future value under the CEO's strategy is $s = s'$ is consequently $\int_\Theta g_\theta(s')f(\theta)d\theta$.

As discussed in the Introduction, the fundamental choice in our model is between "continuation", in which case the CEO continues his strategy, and allowing "change". We denote the firm's expected future value in this case by $V > 0$.[11] As a reference point, let us briefly analyze the first-best optimal continuation decision. The first-best decision is to choose continuation if $E[s \mid \theta] := \int_S sg_\theta(s)ds \geq V$ and change if $E[s \mid \theta] < V$. Ruling out trivial cases where one or the other is optimal in all states of nature, this implies there exists a unique interior cutoff state $\theta_{FB} \in (\underline{\theta}, \overline{\theta})$ given by $E[s \mid \theta_{FB}] = V$ such that continuation is optimal if and only if $\theta \geq \theta_{FB}$.[12]

The crux with implementing the first best is that the CEO privately observes the state of nature. Depending on his incentives (see below), he might prefer continuation when change is efficient, thus causing precisely the sort of strategy inertia discussed in the Introduction.

As our focus is on the design of the optimal compensation scheme, which is why we consider a

[10] MLRP is satisfied by many standard probability distributions (Milgrom (1981)).

[11] What is important from our perspective is only the firm's *expected* future value under the successor's strategy, implying there is no need to make distributional assumptions about V.

[12] As $G_\theta(s)$ satisfies MLRP it also satisfies FOSD, implying $E[s \mid \theta]$ is strictly increasing in θ. In conjunction with continuity of $g_\theta(s)$, this implies there exists a unique interior value θ_{FB} satisfying $E[s \mid \theta_{FB}] = V$.

continuum of payoffs, we try to keep the following modelling details as parsimonious as possible. The success of the CEO's strategy depends also on how much effort he puts in to implement his strategy. We stipulate that if the CEO puts in high effort, the success likelihood is given by the above distribution function $F(\theta)$. Putting in high effort is costly, however: it implies the CEO must forgo private benefits $B > 0$. In contrast, if the CEO puts in low effort, his strategy has little chance of success. For concreteness, we may assume that the state of nature is then $\theta = \underline{\theta}$, albeit the precise details are not important. Intuitively, the effort problem will make it optimal to defer some of the CEO's compensation. This will in turn bias the CEO against change as in case change is initiated he will ultimately lose his job with some probability. For simplicity, we assume that this is the case with probability one.[13]

That the CEO has ultimately discretion as to whether change is implemented or not is derived from first principles in our model, namely from the assumption that the CEO only privately observes θ. One straightforward interpretation of the model is that if the decision is made in favor of "continuation", then this window of opportunity closes again, depriving other parties such as the board to revert the CEO's decision at some future point in time, say when θ becomes common knowledge. A different interpretation is that the CEO may be able to conceal for as long as possible, in particular, low values of θ or to prevent future strategy changes by undertaking an irreversible "protective" investment that makes it impossible or extremely costly to fire him.[14] Again for simplicity, when taking the latter interpretation we abstract from any additional costs that may be associated with such entrenchment strategies, both costs to the CEO and to the firm. That is, the only costs that are of interest to us are those related to the resulting strategy inertia.

Whatever perspective we take, this boils down to a situation where the CEO essentially chooses between change and continuation. His choice will then depend on the observed state θ and on the respective compensation. We denote the CEO's on-the-job compensation by $w(s)$, which can condition on the firm's value, and his severances pay by W. At this point, it could

[13] All of our results hold if this probability is sufficiently large.

[14] See, for instance, Shleifer and Vishny (1989), Bagwell and Zechner (1993), Edlin and Stiglitz (1995), Scharfstein and Stein (2000), or Fulghieri and Hodrick (2005) for related models of managerial entrenchment. Scharfstein and Stein (2000) give the example of a manager who creates an opaque accounting system that is difficult to understand for a potential successor. Relatedly, the CEO may withhold or obscure information that a successor needs to successfully manage the firm.

be asked whether there would not be a better way to elicit the CEO's private information. The answer is now. In particular, as we show below it would never be optimal to design a mechanism that would condition the contract on the CEO's "message" $\widehat{\theta} \in \Theta$, or that would likewise allow the CEO to pick from a menu of contracts $\{w(\theta, s), W(\theta)\}$.

Some further assumptions are required to complete our model. First, we assume it is optimal to continue the CEO's strategy in some but not all states of nature.[15] If it was optimal to either continue or change the CEO's strategy in all states of nature, then the fact that the CEO has private information would be irrelevant. Second, we assume that $w(s) \leq s$, implying the CEO's on-the-job compensation cannot exceed the firm's total value. Third, we assume that $w(s)$ is nondecreasing in s. As will become clear shortly, this assumption is only for expositional convenience. While it allows us to shorten the derivation of our results, the constraint that $w(s)$ be nondecreasing does not bind at the optimum.

3 CEO Compensation and Strategy Inertia

3.1 The Shareholders' Problem

Before writing down the shareholders' problem, let us derive some preliminary results that simplify the exposition. For instance, 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., in all states of nature $\theta \in \Theta$—prefer continuation (if $w > W$) or change (if $w < W$). Arguably, if $w(s) = w = W$ the CEO is indifferent. But if the CEO's on-the-job compensation is equal to his severance pay, he 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 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 $E[w(s) \mid \theta] := \int_S w(s) g_\theta(s) ds$ is strictly increasing in θ for all $\theta \in \Theta$.

The fact that $E[w(s) \mid \theta]$ is strictly increasing in θ implies that the CEO's preferences are monotonic in θ : if he prefers continuation in some state of nature $\theta' \in \Theta$, he also prefers continuation in all higher states $\theta > \theta'$. Precisely, there exists a unique interior cutoff $\theta^* =$

[15] For instance, this is optimal if $E[s \mid \theta]$ is sufficiently greater than V for high and sufficiently smaller than V for low values of θ, and if $F(\theta)$ puts sufficient probability mass on both high and low values of θ.

$\theta^*(w(s), W) \in (\underline{\theta}, \overline{\theta})$ given by

$$E[w(s) \mid \theta^*] = W \tag{1}$$

such that the CEO prefers continuation if and only if $\theta \geq \theta^*$. Hence, truthtelling imposes a straightforward and analytically tractable constraint in our model.

The second constraint in the shareholders' problem derives from motivating the CEO to put in high effort. The corresponding incentive constraint is

$$\int_{\theta^*}^{\overline{\theta}} E[w(s) \mid \theta] f(\theta) d\theta + F(\theta^*) W \geq W + B. \tag{2}$$

Low effort results in a state of nature $\underline{\theta} < \theta^*$ in which change is implemented, implying the CEO's payoff from exerting low effort is $W + B$. By contrast, if the CEO puts in high effort the state of nature is distributed according to $F(\theta)$, implying continuation is implemented if $\theta \geq \theta^*$ and change is implemented if $\theta < \theta^*$.

To see more clearly what the implications of this incentive constraint are for our model, we may rewrite (2) more conveniently as

$$\int_{\theta^*}^{\overline{\theta}} \left(E[w(s) \mid \theta] - W \right) f(\theta) d\theta \geq B. \tag{3}$$

Hence, for the CEO to put in high effort there must be a wedge between his expected on-the-job compensation and his severance pay.[16]

It is worth pointing out that the wedge required by (3) has no implications for the functional form of $w(s)$. As can be easily seen, all it requires is that "on average"—i.e., across all continuation states $[\theta^*, \overline{\theta}]$—the CEO's *expected* on-the-job compensation $E[w(s) \mid \theta]$ must exceed his severance pay by a certain margin. It is important to bear this in mind, for it implies our results derived below regarding the optimal functional form of $w(s)$ are solely driven by concerns of how to mitigate distortions arising from the CEO having private information, not by concerns of how to motivate him to put in effort.[17]

[16] In a sense, this is quite similar to efficiency-wage models where workers are motivated by the fact that their on-the-job pay exceeds their expected income when being dismissed (e.g., Shapiro and Stiglitz (1984), Yellen (1994)). From our perspective, what is important is that this wedge (endogenously) biases the CEO in favor of continuation, thus making it a nontrivial problem that he has private information.

[17] Another way of seeing this is as follows. One can easily show that if the CEO has no private information with respect to θ, then there exists an infinite number of contracts satisfying (3) that implement the first best, including a fixed wage equal to $w = B/[1 - F(\theta_{FB})]$.

With these preliminary results at hand, we can state our first main observation. By standard arguments, the incentive constraint (2) must bind at the optimum. Hence, in equilibrium the CEO's expected compensation must equal $W + B$, which implies he earns a rent of W on top of being compensated for forgoing his private benefits of B.

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

To understand why the shareholders must leave the CEO a rent, we may rearrange (2) as

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

Accordingly, if the shareholders want to raise the CEO's severance pay by one dollar, they must also raise his expected on-the-job compensation by one dollar.[18] Whether or not continuation is ultimately implemented, the CEO is thus better off by one dollar. The notion that severance pay constitutes a measure of the CEO's (informational) rents strikes us as a realistic implication of our model. It derives from the fact that shareholders cannot directly penalize the CEO for putting in low effort. On the one hand, the state of nature may be low because, despite putting in high effort, the CEO's strategy turns out to be unsuccessful. On the other hand, the state of nature may be low because the CEO put in low effort. In the first case, severance pay constitutes a reward for the CEO not to block a value-increasing strategy change. In the second case, severance pay constitutes a "reward" for the CEO's shirking.

Also plausible, we believe, is the implication that an increase in severance pay must be matched by a simultaneous increase in the CEO's expected on-the-job compensation. If this were not the case, the CEO would have little or no incentive to continue his strategy. Moreover, anticipating this, he would have no incentive to put in high effort. Accordingly, there exists a delicate balance between the CEO's severance pay and his expected on-the-job compensation. In particular, the two should move in the same direction.

To summarize, granting the CEO severance pay is costly as it leaves him valuable rents. However, without any severance pay the CEO would always prefer continuation over change, simply because his expected on-the-job compensation must always be strictly positive as he must be motivated to put in high effort.[19] To analyze this trade-off in more detail, we shall now look

[18] Precisely, the left-hand side in (4) denotes the CEO's expected on-the-job compensation conditional on continuation being implemented.

[19] This can be easily seen by setting $W = 0$ in (4).

at the shareholders' maximization problem. The shareholders choose $w(s)$ and W to maximize

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

subject to (1) and (3). Inserting the binding incentive constraint (2) into (5), we can rewrite the shareholders' objective function more conveniently as

$$\int_{\theta^*}^{\overline{\theta}} E[s\mid\theta]f(\theta)d\theta+F(\theta^*)V-B-W, \tag{6}$$

which illustrates that the shareholders have two main objectives. The first three terms in (6) represent the total surplus, implying the first main objective is to maximize efficiency. Precisely, as $E[s \mid \theta]-V$ is negative and decreasing in θ for $\theta<\theta_{FB}$ and positive and increasing in θ for $\theta>\theta_{FB}$, the shareholders' first main objective is to push up θ^* as close as possible to θ_{FB} (but not beyond). We will sometimes refer to the interval $[\theta^*,\theta_{FB}]$ as the "inertia region." As we will show below, the inertia region is always positive in equilibrium. The shareholders' second main objective is to minimize the CEO's severance pay W and thus his informational rents.

We already know that W must be positive in equilibrium; otherwise the CEO would prefer continuation in all states of nature $\theta\in\Theta$. What is not obvious is what the optimal CEO on-the-job compensation scheme $w(s)$ looks like. By (6) we can express the shareholders' problem of choosing $w(s)$ in two equivalent ways. Holding the CEO's severance pay (and thus his rents) W fixed, the optimal on-the-job compensation scheme minimizes the inertia region $[\theta^*,\theta_{FB}]$. Conversely, holding the inertia region fixed, the optimal on-the-job compensation scheme minimizes the CEO's severance pay. One problem is 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* $\hat{s}\in(\underline{s},\overline{s})$.

Proof. See Appendix.

The optimal CEO on-the-job compensation scheme is a high-powered and discontinuous bonus scheme that shifts all of the CEO's payoffs into states where the firm's value s is highest. The intuition is straightforward. As low firm values are relatively more likely after a low state of nature (due to the fact that $G_\theta(s)$ satisfies MLRP), a bonus scheme minimizes the CEO's *expected* on-the-job compensation in low states of nature. This makes continuation as unattractive as possible for the CEO in such states, which in turn implies less severance pay is necessary to induce the CEO not to block value-increasing strategy changes. Formally, the compensation scheme in Proposition 2 minimizes $E[w(s) \mid \theta]$ at low values of θ, thus implementing a given cutoff θ^* with the minimum necessary amount of severance pay.

The flip side of shifting all of the CEO's compensation into states where the firm's value is highest is that a bonus scheme provides the CEO with a relatively high expected compensation in high states of nature. This is inconsequential, however, as in high states of nature the CEO's and the shareholders' preferences are perfectly aligned: both prefer continuation.

3.2 Extension of the Basic Model

Absent any additional constraints, the basic insight that the CEO's compensation should be shifted as much as possible into states where the firm's value is highest implies that the optimal on-the-job compensation scheme takes a somewhat extreme form: it makes the CEO the full claimant to the firm's value above a certain threshold, denoted by $\hat{s}$ in Proposition 2.[20] Such a discontinuous compensation scheme may entail problems of its own, however. For instance, if the firm's value in $t = 2$ increases only slightly from $\hat{s} - \varepsilon$ to $\hat{s}$, the CEO's compensation jumps from zero to $w(s) = \hat{s}$, which may tempt the CEO to manipulate the firm's value—provided this is possible, of course. To examine the implications of this problem for the optimal compensation scheme, we now depart from our previous setup and assume the CEO can manipulate the firm's value. Manipulation comes at a private cost $h(\Delta)$, where $\Delta = |s' - s|$, and where s' and s denote the manipulated and true firm value, respectively. The cost function $h(\Delta)$ is nondecreasing and convex with $h(0) = 0$ and $h'(0) = \gamma$, where γ is assumed to be positive but small.[21]

We restrict consideration to optimal on-the-job compensation schemes ensuring that no manipulation takes place in equilibrium. Given that $h(\Delta)$ is nondecreasing and convex, any on-the-job compensation scheme ruling out "small" manipulations around $\Delta = 0$ also rules out

[20] The only binding constraint we have thus far imposed on $w(s)$ is that $w(s) \leq s$. As noted previously, the other constraint that $w(s)$ is nondecreasing was only introduced to shorten the analysis. Given that the optimal solution requires to shift as much as possible of the CEO's compensation into states where s is highest, it is obvious that this constraint does not bind at the optimum.

[21] The CEO's private cost of manipulating the firm's value by Δ might realistically be less than Δ—at least for small Δ—implying that $\gamma \leq 1$. The special case where $\gamma = 1$ coincides with an assumption frequently made in financial contracting models that $s - w(s)$ must be nondecreasing (e.g., Innes (1990), Nachman and Noe (1994), DeMarzo and Duffie (1999)). The argument commonly used to justify this assumption is that otherwise the firm's shareholders might have an incentive to destroy firm value.

"larger" manipulations $\Delta > 0$, which implies the binding constraint on the optimal on-the-job compensation scheme derives from the derivative of $h(\Delta)$ at $\Delta = 0$.[22]

The assumption that the CEO can manipulate the firm's value in $t = 2$ introduces an additional constraint on the optimal on-the-job compensation scheme: the marginal manipulation cost around $\Delta = 0$ must equal or exceed the marginal benefit to the CEO for all $s \in S$. As the optimal on-the-job compensation scheme requires to shift as much as possible of the CEO's compensation into states where the firm's value is highest, this additional constraint binds. We obtain the following result.

Proposition 3. *Suppose the CEO can manipulate the firm's value in $t = 2$ at marginal cost greater than or equal to $\gamma > 0$. Then the uniquely optimal compensation package consists of severance pay $W > 0$ and some 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 $\hat{s} \in (\underline{s}, \overline{s})$.*

Proof. See Appendix.

Due to the additional constraint introduced by the manipulation problem, the previously optimal on-the-job compensation scheme in Proposition 2 is no longer feasible. Instead of making the CEO the full claimant to the firm's value above some threshold, the new optimal on-the-job compensation scheme promises the CEO a fraction γ of the firm's *incremental* value above some threshold. This on-the-job compensation scheme can be implemented by giving the CEO options.[23] Apart from its practical appeal, the optimal compensation scheme in Proposition 3 also has the appealing technical property that it is continuous in s. We will therefore use this compensation scheme for our comparative static results. The following comparative static result is immediate given the above discussion.

Corollary 1. *As the marginal manipulation cost γ increases, the slope of the optimal on-the-job*

[22] If "small" manipulations from s to $s' = s + \varepsilon$ are ruled out, then "large" manipulations from $s'' < s$ to s' are also ruled out as the manipulation cost for the last increment from s to s' is weakly higher under the "large" manipulation due to the fact that $h'(\Delta)$ is nondecreasing. An analogous argument holds for $s' = s - \varepsilon$.

[23] The option's "strike price" $\hat{s}$ is uniquely pinned down by the requirement that (3) binds. Proposition 3 does not include the special case where γ is close to zero so that (3) cannot be satisfied for any $\hat{s} > \underline{s}$. As γ goes to zero, the option's "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.

compensation scheme becomes "steeper"—i.e., the pay-for-performance sensitivity increases—and it becomes less costly to reduce strategy inertia.

Proof. See Appendix.

The robust insight from our analysis is that the optimal on-the-job compensation scheme shifts as much as possible of the CEO's compensation into states where the firm's value is highest. The precise functional form depends on the constraints we impose on our model. In a relatively unconstrained setting like Section 3.1 the optimal compensation scheme is a high-powered and discontinuous bonus scheme. If we introduce a simple manipulation problem like here, the optimal compensation scheme becomes a stock option. There are many other constraints that one might want to consider, albeit some are more difficult to deal with than others. For instance, to obtain a closed-form solution we must 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 employees given their wealth and the selection process they have gone through to become CEO. A simple yet crude way of capturing some basic aspects of risk aversion is to introduce a minimum consumption requirement $w(s) \geq C$. Given this constraint, the optimal on-the-job compensation scheme in Proposition 3 changes only insofar as the CEO then receives a base wage of C in addition to options.

3.3 The Effect of CEO Compensation on Strategy Inertia

The focus of our analysis thus far has been the derivation of the optimal on-the-job compensation scheme $w(s)$. Holding the CEO's severance pay W fixed, the optimal on-the-job compensation scheme minimizes the inertia region, while holding the inertia region fixed, it minimizes the CEO's severance pay. This section examines how an increase in W affects the inertia region given that the CEO's on-the-job compensation scheme is chosen optimally. Intuitively, an increase in W makes it less attractive for the CEO to continue. At the same time, however, the increase in W must be matched by an increase in the CEO's expected on-the-job compensation to preserve the wedge required by (3), which makes it more attractive for the CEO to continue. As we will show below, under the optimal on-the-job compensation scheme the first effect outweighs the second, implying the total effect of an increase in W is that θ^* increases, thereby reducing the inertia region.

The intuition is straightforward. Under the optimal on-the-job compensation scheme in Proposition 3 (or Proposition 2), the increase in the CEO's expected on-the-job compensation that is necessary to match an increase in W occurs at relatively high values of s, implying $E[w(s) \mid \theta]$ increases primarily in high states of nature. Conversely, in low states of nature $E[w(s) \mid \theta]$ increases only by little. Hence, while the CEO's expected on-the-job compensation increases "on average" one-for-one with his severance pay (cf., (4)), it increases by more than W in high states of nature and by less than W in low states of nature. In low states of nature the difference $E[w(s) \mid \theta] - W$ consequently *decreases*, implying an increase in W pushes the cutoff θ^* up towards θ_{FB}, thus reducing the inertia region.[24]

Proposition 4. *Under the optimal CEO on-the-job compensation scheme shareholders can reduce strategy inertia by increasing the CEO's severance pay and thus his informational rents. Fully eliminating strategy inertia is too costly, however*: *at the optimum it holds that* $\theta^* < \theta_{FB}$.

Proof. See Appendix.

The intuition for the last statement in Proposition 4 is straightforward. While a marginal decrease in θ^* at $\theta^* = \theta_{FB}$ has a negligible effect on the shareholders' expected payoff, a marginal reduction in the CEO's rents represents a first-order cost saving. Given that pushing up θ^* is costly, it is of course also never optimal to set $\theta^* > \theta_{FB}$, implying at the optimum it must hold that $\theta^* < \theta_{FB}$.

The magnitude of executives' severance packages has been the subject of much recent discussion. A common argument is that high severance pay constitutes a "reward" for failure, which is not only unnecessary but also counterproductive as it mutes CEOs' incentives to put in effort.[25] Indeed, this is precisely what would also happen in our model if the CEO's severance

[24] While the optimal value of W trades off the benefit of reducing the inertia region against the cost of leaving the CEO more rents, the specific solution depends on distributional assumptions. Once W is pinned down, however, the only remaining choice variable $\hat{s}$ (and therefore θ^*) is uniquely pinned down by (4).

[25] A prominent example is the lawsuit by Walt Disney shareholders against the company for awarding Michael Ovitz severance pay worth \$140 million after being only 14 months with Disney. Public pressure against high severance pay is not limited to the U.S., however. The U.K., for instance, recently had a public inquiry about "rewards for failure" (DTI (2003)), and it has witnessed substantial shareholder activity against high severance pay. As a result, listing rules were amended in 2002 to require firms to publish their directors' remuneration reports, which must be approved by shareholders. While this approval is only advisory, the vote helped shareholder

pay were set too high relative to his on-the-job compensation. However, our model cautions that imposing an artificial cap on severance pay might come at a high cost: while it reduces the CEOs' rents, it exacerbates strategy inertia and reduces overall shareholder value.

Corollary 2. *Introducing a binding cap on the CEO's severance pay is inefficient. While it reduces his rents, it exacerbates strategy inertia and reduces overall shareholder value.*

3.4 Menus of Compensation Schemes

Thus far we have *assumed* that the CEO's compensation package takes the simple form where W is a fixed amount and $w(s)$ depends only on s. We will now show that this assumption is without loss of generality. In fact, we will show that introducing a menu of compensation schemes $\{w(s,\theta), W\}$ is strictly suboptimal in our model.

Let Θ_- denote the set of states of nature in which change is implemented and Θ_+ the set of states of nature in which continuation is implemented. It is easy to see why it cannot be optimal to make W dependent on $\theta \in \Theta_-$: conditional on announcing a state of nature in the set Θ_-, the CEO would always announce the state that yields him the highest severance pay, i.e., he would always announce the state $\theta \in \arg\max_{\theta' \in \Theta_-} W(\theta')$. Consequently, the CEO's severance pay must be a fixed amount $W(\theta) = W$.

There is a similarly intuitive argument for why a menu of on-the-job compensation schemes $w(s,\theta)$ is not helpful. As the continuation decision is binary, shareholders only need to know whether θ is an element of Θ_- or Θ_+. Hence, there is no benefit to letting the CEO choose from a menu of on-the-job compensation schemes $w(s,\theta)$ that reveals more about the state of nature. However, we will prove an even stronger result that introducing such a menu is *strictly* suboptimal. The intuition is as follows. The optimal on-the-job compensation scheme shifts more of the CEO's expected on-the-job compensation $E[w \mid \theta]$ into high states of nature than any other feasible compensation scheme. By construction, any richer menu of compensation schemes—regardless of whether or not it includes the "single" optimal on-the-job compensation scheme derived earlier—must therefore shift some of the CEO's expected on-the-job compensation "back" into low states of nature.[26] In other words, a menu of on-the-job compensation

activists to gain publicity in their fight against high severance packages, e.g., in the rejection of a £20 million contractually stipulated severance package for the head of GlaxoSmithKline, Britain's biggest drug manufacturer.

[26] The argument is independent of whether we consider the optimal CEO on-the-job compensation scheme from

schemes $w(s, \theta)$ does not minimize $E[w \mid \theta]$ when θ is low. But this property of minimizing the CEO's expected on-the-job compensation in low states of nature is precisely what drives optimality in our model, as it implies strategy inertia can be reduced at the lowest possible costs to shareholders. With a richer menu $w(\theta, s)$ shareholders would either have to leave the CEO more rents to implement the same cutoff θ^*, or—holding the CEO's rents fixed—implement a lower cutoff and hence tolerate 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 Firms' Business Environments

The preceding discussion has shown that reducing strategy inertia is costly: it implies the firm's shareholders must leave the CEO valuable rents. The question is therefore how much strategy inertia should the shareholders optimally tolerate? In this section, we argue that the answer depends on the firm's external business environment. In a stable environment where it is unlikely that a strategy change becomes optimal anytime soon, the *expected* cost of having the CEO blocking value-increasing strategy changes is relatively small. Conversely, in a less stable environment where it is quite likely that a strategy change becomes optimal, the expected cost of having the CEO blocking strategy changes is potentially severe.

In our model, the likelihood that a strategy change becomes optimal is $F(\theta_{FB})$. As θ_{FB} increases, there are more states of nature in which maintaining the strategic status quo is inefficient. Consequently, the shareholders must raise the second-best cutoff θ^* correspondingly to ensure that the status quo is indeed maintained less frequently. From our previous analysis we know that raising θ^* is costly, however. It implies the shareholders must increase both the CEO's severance pay and his expected on-the-job compensation. Hence, CEOs of firms in unstable business environments should receive more generous compensation packages. At the same time, however, the fact that strategy changes are implemented more frequently in these

Proposition 2 or 3.

firms implies CEO turnover should also be higher.

We assume the shareholders' objective function is strictly quasiconcave in W. This ensures the existence of a uniquely optimal choice of W. Once W is pinned down, the remaining choice variables θ^* and $w(s)$ are uniquely determined by (4). We have the following result.

Proposition 6. *As the firm's external business environment becomes more unstable—implying the likelihood that a strategy change becomes optimal increases—both the size of the CEO's compensation package and the likelihood of CEO turnover should increase.*

Proof. See Appendix.

Proposition 6 suggests it may be optimal to pay CEOs potentially generous compensation packages when a firm's business environment is relatively unstable.[27] This reduces strategy inertia in precisely those times when flexibility and the ability to adapt to changes in the environment are key. This intuition can help to explain why certain trends and developments taking place since the late 1970s might be interrelated. Like Jensen (1993) and many others, Holmström and Kaplan (2001) argue that the "pace of economic change has accelerated" since the late 1970s. Between 1978 and 1996, some of the most important industries in the U.S., including airlines, broadcasting, entertainment, natural gas, trucking, banks and thrifts, utilities, and telecommunications, have experienced massive deregulation. The 1980s and 1990s also witnessed fundamental technological innovations, notably in the information technology and telecommunications sectors, that have radically altered the industrial landscape in the U.S. These developments—key forces behind what Jensen (1993) calls "Modern Industrial Revolution"—have put increasing pressure on U.S. firms to change their business strategies, industry focus, and managements. The takeover and merger waves of the 1980s and 1990s are frequently viewed as consequences of these developments.

Our model suggests that the need for more flexibility might come at a high cost: CEOs must be awarded more severance pay but also higher bonuses and more option grants. This is consistent with the rise in CEO stock option grants over the past decades documented by Hall and Liebman (1998). Accordingly, 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,

[27] An increase in uncertainty—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 θ_{FB} increases.

Bebchuk and Grinstein (2005) show that between 1993 and 2003 the average CEO compensation among S&P 500 firms (in 2002 dollars) has increased almost threefold from $3.7 million to $9.1 million.[28] Our model also suggests that CEO turnover should increase along with the rise in CEO pay. This is consistent with evidence by Huson, Parrino, and Starks (2001) that CEO turnover has increased substantially over the past decades.

The widely documented rise in CEO compensation is also the subject of several other papers. Like this paper, Dow and Raposo (2005) link this trend to the fact that firms' business environments have become more unstable. In their model, CEOs receive higher pay because the range of possible business strategies—in particular strategies involving radical change—has increased, and shareholders want to incentivize CEOs *not* to pursue such (radical) strategies. Bebchuk and Fried's (2004) "managerial power perspective" has a different flavor. They argue that the rising stock market of the 1990s gave executives and 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 fundamental shift in the relative importance of general versus firm-specific human capital. Beneficiaries are CEOs with above-average general human capital, whose compensation is bid up by the market. Finally, Almazan and Suarez (2003) and Hermalin (2005) both link the rise in CEO compensation to changes in corporate governance. In Almazan and Suarez's paper a shift from weak to strong boards goes hand in hand with higher incentive pay and CEO turnover. Similarly, Hermalin argues that the rise in CEO compensation reflects greater board diligence. To compensate CEOs for the higher likelihood of being fired, their pay must increase.

Proposition 6 also lends itself for some cross-sectional implications. Accordingly, industries undergoing fundamental changes should exhibit higher CEO turnover but also higher CEO pay than stable industries. We are not aware of any empirical studies analyzing how CEO pay and turnover vary across industries.[29]

A special case of our model is that in which "change" involves shutting down the firm.

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[28] As for severance pay, Walker (2005) argues that there has been a surge in (contractually stipulated) severance pay, while Lefanowicz, Robinson, and Smith (2000) and Bebchuk, Cohen, and Ferrell (2004) find that the use of golden parachutes has increased substantially in the 1980s and 1990s.

[29] There is evidence that CEO pay is lower in regulated industries which, one could argue, are relatively more stable (Murphy (1999)). Along similar lines, Crawford, Ezzell, and Miles (1995) and Hubbard and Palia (1995) both find that deregulation seems to have contributed to the rise of CEO pay in the banking industry.

For fear of losing his job, the CEO might want to continue even if shutting down the firm is efficient. According to Jensen (1993), inertia is a key impediment to what he calls "Modern Industrial Revolution": managers' reluctance to shut down firms impedes the efficient transfer of assets from old declining industries to new thriving industries. Our model implies that the least costly way to get managers to accept the necessary shutdown of their firms is to offer them severance pay in combination with high-powered on-the-job compensation such as bonus schemes and 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 makes a natural prediction regarding the relation between CEO pay and firm size. At larger firms there is more at stake: for a given state of nature $\theta < \theta_{FB}$ the costs of blocking a value-increasing strategy change are higher for larger firms. To mitigate these higher costs, larger firms should have a higher cutoff value θ^* and hence both higher CEO pay and higher CEO turnover. To explore the implications of firm size for CEO pay and turnover we shall scale up both V and s by a factor $\alpha > 0$. We obtain the following result.

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

Proof. See Appendix.

There are, of course, many other plausible reasons for why CEOs of larger firms should be paid more. For instance, larger firms may need more talented and thus more expensive CEOs. It is not clear, however, why this argument should also imply that larger firms should have higher CEO turnover.[30]

CEO Pay and Corporate Governance

[30] Conyon (1997) and Bebchuk and Grinstein (2005) both 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).

In our model there are two "drivers" that affect the magnitude of the CEO's pay. Firstly, the CEO must be compensated for forgoing his private benefits B. Secondly, he must be compensated for allowing change, which secures him an additional (informational) rent of W on top of B. In what follows, we examine how these two factors interact.

Suppose B increases. The direct effect is that the CEO's on-the-job compensation must increase to ensure that he puts in high effort. But this only strenghtens the CEO's incentives to continue after observing a low state of nature, i.e., the cutoff value θ^* decreases. To counteract this decrease in θ^*, the shareholders must raise the CEO's severance pay, which in turn must be accompanied by an (additional) increase in his on-the-job compensation. As Proposition 8 below shows, it is not optimal to push up θ^* all the way to its original level, however. Consequently, an increase in B results in a lower cutoff value θ^* and thus in more strategy inertia, but also in lower CEO turnover.

The extent to which the CEO can consume private benefits may depend on his particular job. Some CEO positions may arguably allow for more perk consumption than others. But it may realistically also depend on the firm's corporate governance, which imposes a natural limit on the CEO's perk consumption. 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 should have both 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

Research suggests that top executives—rather than embracing strategy change as an opportunity for firms to evolve in sync with their environments—act as impediments to change, showing instead a strong commitment to the firm's strategic status quo. This paper provides a simple explanation based on agency theory for why strategy inertia might persist and derives implications for the design and magnitude of CEOs' compensation packages.

Our paper makes a number of contributions. Perhaps most importantly, it provides insights into how severance pay and CEOs' on-the-job pay might be interrelated. For instance, the optimal design of the CEO's on-the-job compensation scheme in our model is driven by the objective to minimize his severance pay, which in turn provides a measure of his (informational) rents. The uniquely optimal—i.e., severance-pay-minimizing—on-the-job compensation scheme is a high-powered and highly convex compensation scheme that shifts as much as possible of the CEO's pay into states where the firm's value is highest. In our base model where we impose only little structure on the optimal compensation scheme, this implies the CEO receives severance pay in combination with a bonus scheme. In an extension of our base model in which the CEO can manipulate the firm's value, he receives severance pay in combination with an option grant. Interestingly, the CEO's on-the-job compensation and his severance pay must move in the same direction, implying shareholders cannot increase one without increasing the other.

Our argument for why CEOs should receive high-powered and highly convex on-the-job compensation schemes is novel and different from arguments based on effort provision or risk-taking, which some researches have argued cannot satisfactorily explain the widespread use of CEO option grants (see Introduction). Our model also makes empirical predictions linking the magnitude of CEO pay to changes in firms' external business environments. Perhaps most importantly, it predicts that firms operating in unstable business environments in which strategy changes are likely to become optimal in the future must pay their CEOs more. At the same time, CEO turnover in these firms should also be higher compared to firms operating in stable environments.

On a more general level, our model suggests that formal or informal restrictions on either the magnitude or composition of CEO pay may stifle economic change. Promoting flexibility may require that shareholders leave CEOs substantial rents in the form of seemingly generous severance packages. High-powered on-the-job compensation schemes, in turn, are necessary to economize on the use of costly severance pay and thus ultimately on the rents that CEOs can appropriate. Countries in which formal or informal restrictions on CEO pay practices exist may thus experience more, not less, strategy inertia and therefore less industrial change.

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 give 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 $\hat{s} \in (\underline{s}, \overline{s})$.

We argue to a contradiction. Suppose thus that the board wants to implement some θ^* with a different on-the-job pay scheme $\widetilde{w}(s)$. We denote the corresponding severance pay by $\widetilde{W}$. We show that there exists some $w(s)$ such that (i) the constraint (3) remains binding and that (ii) θ^* is still implemented—though now with a lower severance pay W. That is, with a slight abuse of notation the new compensation scheme satisfies $\theta^*(w, W) = \theta^*(\widetilde{w}, \widetilde{W}) = \theta^*$ and $W < \widetilde{W}$, which by inspection of (5) would contradict optimality of the original contract $\widetilde{w}(s)$.

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

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

Given the construction of $\overline{w}(s)$, which pays nothing for low and all for high s, there must be a value $\widetilde{s} \in (\underline{s}, \overline{s})$ such that $d(s) \geq 0$ for all $s < \widetilde{s}$ and $d(s) \leq 0$ for all $s > \widetilde{s}$, where both inequalities are strict over sets of positive measure. Take now any $\widehat{\theta} > \theta^*$. By MLRP of $G_\theta(s)$ and (7), it then holds that

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

which implies that the constraint (3) is slack if we choose $\overline{w}(x)$ and $\overline{W}$.

In a second step, we can now construct the asserted compensation scheme with $w(s) = 0$ for $s < \widehat{s}$ and $w(s) = s$ for $s \geq \widehat{s}$ and with $W < \overline{W} = \widetilde{W}$. For this we continuously increase the threshold $\widehat{s}'$ in $\overline{w}(s)$ and decrease $\overline{W}$, while still satisfying $\theta^*(\overline{w}, \overline{W}) = \theta^*$, until (3) becomes again binding. That this is possible follows from continuity of payoffs in $\widehat{s}'$, while (3) surely does not hold as we approach the upper limit with $\widehat{s}' \to \overline{s}$ (and thus from $\theta^*(\overline{w}, \overline{W}) = \theta^*$ also $\overline{W} \to 0$). This completes the proof of Proposition 2. Q.E.D.

Proof of Proposition 3. By the argument in the main text the possibility of manipulation adds one additional constraint to the firm's program: that the slope of $w(s)$ must not exceed γ.

(Note that $w(s)$ is then necessarily continuous such that by monotonicity it is almost everywhere differentiable.) Following the argument in footnote 21, we restrict consideration to $\gamma \leq 1$. We argue again to a contradiction and suppose that the firm wants to implement a given θ^* with another contract $\widetilde{w}(s)$. As in the proof of Proposition 2, we can then again construct a contract $\overline{w}(s)$ with $\overline{w}(s) = 0$ for $s < \widehat{s}'$ and $\overline{w}(s) = \gamma(s - s)$ for $s \geq \widehat{s}'$ such that (7) is satisfied. As also the slope of $\widetilde{w}(s)$ must not exceed γ, there exists again a value $\widetilde{s} \in (\underline{s}, \overline{s})$ such that $d(s) \geq 0$ for all $s < \widetilde{s}$ and $d(s) \leq 0$ for all $s > \widetilde{s}$, where both inequalities are strict over sets of positive measure. The rest of the argument is now identical to that in Proposition 2. Q.E.D.

Proof of Corollary 1. By Proposition 3 an increase in γ allows to make the CEO's compensation strictly steeper to the right of the threshold $\widehat{s}$, which is also strictly optimal.[31] It remains to prove that implementing a given θ^* requires a lower severance pay as γ increases.

For this we totally differentiate (1), which determines θ^*, and also the constraint (4) to obtain (holding θ^* fixed) the derivative

$$\frac{dW}{d\gamma} = \frac{\int_{\theta^*}^{\overline{\theta}} \left[\int_{\widehat{s}}^{\overline{s}} \left[[1 - G_\theta(\widehat{s})] \, [1 - G_{\theta^*}(s)] - [1 - G_{\theta^*}(\widehat{s})] \, [1 - G_\theta(s)] \right] ds \right] f(\theta) d\theta}{\int_{\theta^*}^{\overline{\theta}} \left[G_{\theta^*}(\widehat{s}) - G_\theta(\widehat{s}) \right] f(\theta) d\theta}. \tag{9}$$

The denominator of (9) is positive as $G_\theta(s)$ satisfies First-Order Stochastic Dominance, which is implied by MLRP. Next, 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.[32] Q.E.D.

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

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

To determine the sign of (10), note that MLRP implies First-Order Stochastic Dominance such that $G_\theta(s)$ is decreasing in θ for all $s \in (\underline{s}, \overline{s})$. This yields that $d\theta^*/dW > 0$.

[31] Holding either θ^* or W fixed, to keep (3) binding the threshold $\widehat{s}$ must shift to the right as γ increases.

[32] As $G_\theta(s)$ is differentiable, this is equivalent to requiring that $g_\theta(s)/[1 - G_\theta(s)]$ is strictly decreasing in θ for any given $s \in (\underline{s}, \overline{s})$. This is commonly referred to as the Monotone Hazard Rate Property (MHRP), which is implied by MLRP. To obtain this expression, we used the fact that $E[w(s) \mid \theta] = \gamma \int_{\widehat{s}}^{\overline{s}} [1 - G_\theta(s)] ds$, 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 from Proposition 3 yields

$$\frac{d\widehat{s}}{dW} = -\frac{1}{\gamma}\frac{1 - F(\theta^*)}{\int_{\theta^*}^{\overline{\theta}} [1 - G_\theta(\widehat{s})] f(\theta) d\theta}, \tag{11}$$

We next differentiate (5) with respect to W and substitute for $d\widehat{s}/dW$ from (11). This yields the derivative

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

which yields the first-order condition

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

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

Proof of Proposition 5. We can again restrict consideration to on-the-job pay schemes $w(s, \theta)$ that are strictly increasing at some s. Given that all $w(s, \theta)$ are thus strictly increasing somewhere and that $G_\theta(s)$ satisfies MLRP, the truthtelling constraint implies again that $\Theta_- = [\underline{\theta}, \theta^*)$ and $\Theta_+ = [\theta^*, \overline{\theta}]$ with $E[w(s, \theta^*) \mid \theta^*] = W$. The following auxiliary result follows now immediately from the proof of Proposition 2.

Claim 1. *Take two different feasible pay schemes $\widetilde{w}(s)$ and $\widehat{w}(s)$ such that $\widehat{w}(s) = 0$ for $s < \widehat{s}$ and $\widehat{w}(s) = s$ for $s \geq \widehat{s}$. Then if $E[\widehat{w}(s) \mid \theta'] \geq E[\widetilde{w}(s) \mid \theta']$ holds for some $\theta' < \overline{\theta}$, it holds strictly for all $\theta > \theta'$.*

To complete the proof, we distinguish between two cases. If $w(s, \theta^*)$ satisfies $w(s, \theta^*) = 0$ for $s < \widehat{s}$ and $w(s, \theta^*) = s$ for $s \geq \widehat{s}$, Claim 1 and truthtelling imply that the same contract is chosen for all $\theta \geq \theta^*$. That is, the menu is then degenerate with $w(s, \theta) = w(s, \theta^*)$. Suppose next that $w(s, \theta^*)$ has a different form. As in the proof of Proposition 2, we can then construct a single offer $\widehat{w}(s)$ satisfying $\widehat{w}(s) = 0$ for $s < \widehat{s}$ and $\widehat{w}(s) = s$ for $s \geq \widehat{s}$ such that the same cutoff θ^* is implemented while the constraint (3) is relaxed. This follows as for all $\theta > \theta^*$ we have that $E[\widehat{w}(s) \mid \theta] > E[w(s, \theta) \mid \theta]$, which in turn follows immediately from Claim 1 and the truthtelling requirement for the original menu. As in Proposition 2, we can then adjust the new (single) on-the-job pay scheme $\widehat{w}(s)$ so as to implement θ^* 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 θ^* 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 $SOC < 0$ represents the second-order condition, which must be satisfied at an interior optimum. Q.E.D.

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

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

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 from Proposition 5 that $\theta^* < \theta_{FB}$ at the optimum and that the second-order condition at the optimum requires that $SOC < 0$. Q.E.D.

Proof of Proposition 8. We show first that to implement a given cutoff θ^*, the higher B the higher must be the respective severance pay W. We totally differentiate (1), which determines θ^*, and the constraint (4) to obtain

$$\frac{dW}{dB} = \frac{1 - G_{\theta^*}(\widehat{s})}{\int_{\theta^*}^{\overline{\theta}} \left[G_{\theta^*}(\widehat{s}) - G_\theta(\widehat{s})\right] f(\theta) d\theta} > 0, \tag{15}$$

where the sign follows again from MLRP of $G_\theta(s)$, which implies First-Order Stochastic Dominance.

Take now some value $B = \widehat{B}$. The optimal contract specifies a severance pay $W = \widehat{W}$ and an on-the-job pay $w(s) = \widehat{w}(s)$, which is in turn characterized by some cutoff (or "strike price") $\widehat{s} = \widehat{s}'$. Denote also the resulting cutoff by $\theta^* = \widehat{\theta}^*$. If private benefits are higher and equal to $B = \widetilde{B} > \widehat{B}$, we know from (15) that in order to obtain the same cutoff $\theta^* = \widehat{\theta}^*$ the severance pay must be strictly higher: $W = \widetilde{W} > \widehat{W}$. To still satisfy the incentive constraint (4), this requires that also the on-the-job pay $\widetilde{w}(s)$ must become more attractive to the CEO, i.e., the respective cutoff $\widehat{s} = \widehat{s}''$ must satisfy $\widehat{s}'' < \widehat{s}'$.

Consider next the derivative (12) of the objective function. By construction, we have for $B = \widehat{B}$, $\widehat{s} = \widehat{s}'$, $W = \widehat{W}$, and $\theta^* = \widehat{\theta}^*$ that the derivative is just zero. (This is just the first-order condition.) We now want to sign the derivative if we substitute, instead, $B = \widetilde{B}$, $\widehat{s} = \widehat{s}''$, $W = \widetilde{W}$, and $\theta^* = \widehat{\theta}^*$, i.e., at the point where with higher benefits the same cutoff is achieved, albeit with a higher severance pay and a higher on-the-job pay. More precisely, we want to show that the derivative (12) is then negative. From inspection of (12) this is the case if at the cutoff $\theta^* = \widehat{\theta}^*$ the derivative $d\theta^*/dW$ is strictly lower for the case where we have $B = \widetilde{B}$ and thus $W = \widetilde{W}$ and $\widehat{s} = \widehat{s}''$. Given that $\widehat{s}'' < \widehat{s}'$ this in turn holds if the derivative (10) is strictly increasing in $\widehat{s}$. To show that this is the case, we rearrange (10) to obtain

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

The first expression in parentheses is positive by $dG_{\theta^*}(\widehat{s})/d\theta^* < 0$, which is implied by First-Order Stochastic Dominance and thus by MLRP, strictly increasing in $\widehat{s}$. Next, after some transformations we have that the sign of the derivative of the last term in (16) w.r.t. $\widehat{s}$ is determined by the expression

$$\int_{\theta^*}^{\overline{\theta}} \left[g_{\theta^*}(\widehat{s}) \left[1 - G_{\theta}(\widehat{s})\right] - g_{\theta}(\widehat{s}) \left[1 - G_{\theta^*}(\widehat{s})\right]\right] f(\theta) d\theta. \tag{17}$$

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

7 References

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