

CEO Fit, Contract Horizon, and Turnover

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Abstract

This paper develops a model in which a board hires managers whose fit with the firm changes over time. To infer whether a manager's fit deteriorates, the board could offer severance pay or rely on noisy firm performance. The paper rationalizes the use of renewable fixed-term contracts as a mechanism periodically switching away from severance (at renewal dates) to relying on performance. This has novel implications for the determinants of CEO contract horizon, turnover, and age. One implication is that there will be a tighter link between turnover and (under)performance in downturns, which could falsely appear as lack of relative performance evaluation.

Keywords: voluntary and forced turnover, renewable contracts, contract length, CEO age, adverse selection.

JEL Classification: G30, G34, D82

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1 Introduction

Boards hiring CEOs are often concerned that even high-quality managers might not be the best fit for their firm. For example, Ronald Boire’s was considered an “ideal chief executive for Barnes & Noble,” when he was hired in 2015, but he stepped down a year later because he “was not a good fit for the organization.”¹ What nurtures such concerns is that “fit” reflects the complex match between a manager’s collection of skills and the firm’s assets and growth options (Lazear, 2009), and the quality of this match could deteriorate in a dynamically changing environment. A manager’s fit might change also because of inadequate firm-specific human capital investments, family or health issues, or conflicts with subordinates. No matter the cause, such changes might impact firm performance. This gives rise to the question how to evaluate, compensate, and replace managers who have better information how their fit with the firm changes over time.

There are at least two reasons why this question is interesting both from a theoretical and empirical perspective. First, recent evidence shows that “involuntary” turnover is concentrated in industry downturns (Jenter and Kanaan, 2015). This is puzzling, as it runs counter to received theory that managers should not be punished for bad luck outside their control. However, another way to look at this evidence is as being part of a different problem that makes it difficult to distinguish between voluntary and involuntary turnover. The true reason behind a seemingly “voluntary” departure could be that a CEO’s fit has changed, but the promise of severance pay (\$10.5m in Mr. Boire’s case) mitigates her desire to hide it to avoid termination. Thus, the question is when such severance promises are offered and when they are effective. If they work less well in downturns, the board’s alternative would be to base turnover decisions on (under)performance, in line with Jenter and Kanaan’s (2015) evidence. The second stylized fact that motivates the paper is the wide-spread use of renewable fixed-term contracts in CEO compensation. More than 45% of CEO contracts in practice take this form (Gillan et al., 2009), but there is barely any theory explaining their use. Mr. Boire had a three year contract that could then renew for another two years. But which CEO, firm, and industry characteristics determine the length of such contracts? And why does turnover, which often happens before renewal, become performance sensitive mainly close to renewal (Cziraki and Groen-Xu, 2016)? By analyzing a setting in which managers’ fit changes over time, this paper relates the above stylized facts and derives a number of novel implications concerning both firing and hiring decisions. Key is how boards decide whether to rely on performance measures or incentives

¹ “Barnes & Noble Says CEO Boire ‘Not a Good Fit’ and Will Step Down,” WSJ, 16 August 2016. See also “Is Leo Apotheker a Good Fit as H-P’s New CEO?” WSJ, 30 September 2010.

for “voluntary” turnover to seed out managers who are no longer a good fit.

The model considers a board that repeatedly appoints managers. Once hired, a manager can increase the likelihood of being a good fit by investing in firm-specific human capital. However, only the manager observes the extent of such investments and how they impact her fit. The paper’s main results arise from asking whether the board should offer incentives that the manager truthfully reports changes in her fit over time.² These incentives amount to promising severance pay to managers replaced for being a bad fit.

The first key insight, illustrated in Figure 2, is that it is optimal to abstain from offering such incentives in regular intervals. In practice, this can be implemented with renewable fixed-term contracts, which are costless to terminate at renewal dates. The result is due to the following trade-off. On the one hand, making managers honest has the advantage that their fit does not have to be evaluated based on the firm’s noisy cash flow performance. This is beneficial, as a good fit today increases the likelihood of a good fit tomorrow. On the other hand, a policy of always offering incentives for truthful reporting creates strong incentives to lie, as managers who are a good fit are kept even if the firm produces low cash flows. As a result, the longer potential tenure a manager can look forward to, the more reluctant would she be to reveal that her fit has deteriorated, as she is paid an “efficiency” wage for her firm-specific human capital investments in every period she is on the job. Hence, the manager’s severance package must increase in her potential remaining tenure, and it compensates her as if she would stay until the contract’s end.³ The cost of such compensation stands in a stark mismatch with the benefits of offering incentives for truthful reporting in some future period t , which are only realized if the manager is still with the firm at this point.

In light of this cost-benefit mismatch, the advantage of *not* incentivizing truthful reporting is that it cuts through the manager’s ability to stick with the firm by lying about her fit. Specifically, it allows dispensing with severance when replacing a manager and, even more important, it reduces the necessary severance pay in all preceding periods. The disadvantage is that the manager’s fit needs to be evaluated based on the firm’s noisy cash flow performance. This results in a trade-off between minimizing the risk of making the wrong replacement or retention decision and minimizing the cost of employing the manager. As illustrated in Figure 2, this trade-off is best resolved by tying turnover to

²Prior work has argued that it might be suboptimal to screen out an agent’s private information if the principal cannot commit not to act on that information (Hart and Tirole, 1988). Note that none of the following arguments require that the manager agrees that someone else might be a better fit for the job.

³Indeed, half of S&P 1500 firms have ex ante severance agreements, with such agreements being associated with more truthful managers (Rau and Xu, 2013; Brown, 2015). Furthermore, CEOs with longer remaining tenure have higher severance agreements (Rau and Xu, 2013).

firm (under)performance (rather than to truthful reporting and severance pay) in regular intervals. This significantly reduces the need for severance pay, while exposing the board to the relatively low risk of making inefficient replacement decisions in year six or 11, which the manager reaches only with eight and one percent probability, respectively.

What determines whether the board should offer severance pay or tie replacement to firm underperformance? A key factor is the manager's outside option.⁴ A manager with low-paying alternative employment opportunities would be more reluctant to voluntarily disclose information leading to her dismissal. This necessitates offering a higher severance package to such a manager. Hence, the board might, instead, rely more often on the firm's performance to judge the manager's fit. The result would be a stronger relation between underperformance and involuntary turnover in downturns, when managers' outside options are low. Jenter and Kanaan's (2015) corresponding finding could, thus, be the result of an optimal replacement policy rather than lack of relative performance evaluation.

An off-the shelf implementation of the contract illustrated in Figure 2 readily exists. Renewable fixed-term contracts allow for turnover at any time, but their termination is costless at renewal dates. What makes them suitable is that the board can choose renewal to coincide with the periods in which it is optimal not to seek truthful reporting from the manager. Since the manager is not offered severance upon termination, she has no incentives for truthful reporting in such periods, and the board decides on renewal based on the firm's cash flow performance. Indeed, renewable fixed-term contracts are very common in practice (Gillan et al., 2009), and their turnover-performance sensitivity spikes close to renewal dates (Cziraki and Groen-Xu, 2015). Despite the prevalence of such contracts, however, this paper seems to be the first trying to understand their use.⁵

The paper's second contribution is to study the determinants of the length of renewable fixed-term contracts. The preceding discussion implies that contracts offered to managers with lower outside options (as in downturns) will be of shorter length. This is because it is optimal to judge such managers more often based on the firm's performance (rather than rely on offering severance pay). A second determinant is the manager's fit persistence. The importance of incentivizing truthful reporting to learn the manager's fit is lower if that fit is very likely to change, such as in rapidly developing firms or firms undergoing change. Then, contracts will be shorter and turnover more closely tied to performance. Third, for large firms and firms with better growth options, there will be more at stake from having

⁴Incumbents' outside option is typically not another CEO position, and departing CEOs take a big pay cut in their new employment following dismissal (Fee and Hadlock, 2004).

⁵Renewable fixed-term contracts are long-term contracts with a costless termination option at renewal dates. Instead, the focus in the prior literature is on whether a given time horizon is best covered with a long-term or a series of short-term contracts (e.g., Hart and Tirole, 1988).

the right manager in charge. Thus, contract horizon will be longer and severance pay will be larger in such firms.

CEO age also plays a key role. It is particularly important if the board cannot commit not to renegotiate the manager's contract at renewal periods and seek truthful reporting after all. Hiring older managers then automatically commits the board to a shorter contract horizon. Thus, an immediate implication is that firms offer lower severance packages to older CEOs, which is in line with the findings of Rau and Xu (2013). A second implication is that the board hires older managers in downturns, as then managers' outside options are low and incentivizing truthful reporting is costlier.

Extending the baseline model, another prediction is that boards might sometimes prefer a CEO from a selected "club" with better outside options to one more likely to be a good fit. This occurs when managers are paid above their outside option, as then a higher outside option has the positive effect of reducing the need for severance pay. This could explain why boards tolerate investments in general human capital, increasing managers' outside options, even if they come at the expense of firm-specific human capital. Taking into account that CEOs' outside options reflect their reputation could further explain why boards avoid damaging departing CEOs' reputation and why replacing CEOs with a reputation for underperformance is more expensive (Goldman and Huang, 2015).

The main contribution of the paper is to analyze a dynamic setting in which turnover is tied both to truthful reporting and to performance measures, which has novel implications for contract horizon, turnover, and compensation practices. A novel element is that the board's lack of information is not due to reduced monitoring, but to not offering severance pay that would compensate the agent for not trying to avoid termination. This helps to cut through the agent's ability to extract rent, which is magnified in a dynamic setting. These features differentiate the paper from prior work advocating that there might be benefits of laxer control (Crémer, 1995; Aghion and Tirole, 1997; Boot et al., 2008); from papers in which managers are better informed about their fit, but in which that fit does not change over time (Hermalin and Weisbach, 1998; Taylor, 2010; Dow, 2013); as well as from prior static models rationalizing the use of severance pay (Levitt and Snyder, 1997; Inderst and Mueller, 2010; Almazan and Suarez, 2003; Van Wesep, 2010; Van Wesep and Wang, 2014). In particular, the paper has novel implications concerning term limits and the dynamic use and structure of severance agreements.

All of the above issues distinguish the paper also from Jenter and Lewellen (2014) and Garrett and Pavan (2012). Both papers consider dynamically changing types, but take the polar opposite approaches. In Jenter and Lewellen (2014), the board does not screen out managers and must, thus, rely on the firm's most recent performance to infer their

productivity. By contrast, Garrett and Pavan (2012) analyze contracts that always incentivize managers to report their private information. Their main insight is that the board needs to share less surplus with the manager over time, making the board progressively tolerant towards lower managerial quality. The decision how to evaluate the manager in the present paper can be seen as optimally relying on both approaches.

The dynamics of managerial turnover are also analyzed in Eisfeldt and Rampini (2008) who predict that CEO turnover is procyclical. In business cycle upturns, boards are forced to pay managers more, since their outside option is higher. Thus, severance packages can be more generous, making bad managers more likely to leave the firm. However, managers in their model only live for one period, which does not allow analyzing the dynamics of the employment relationship between the firm and its manager. Related contributions are Anderson et al. (2016) and Eisfeldt and Kuhnen (2013), in which a publicly observable shock prompts the firm to look for a manager who is better suited to the new environment. Assuming that the shock also decreases industry returns offers one explanation to Jenter and Kanaan’s (2015) findings that forced turnover is higher in industry-wide bad times (Eisfeldt and Kuhnen, 2013). Instead, in the present paper, such apparent lack of relative performance evaluation emerges, as boards rely more often on firm performance to judge the manager’s fit when managers’ outside opportunities are low. The insight that in market booms there would be, instead, more voluntary turnover could further explain why Fee et al. (2015) find no evidence for a lack of relative performance evaluation once taking into account that supposedly “voluntary” turnover could also be due to a bad fit.

Turnover features in the literature also as a threat to discipline managers (Stiglitz and Weiss, 1983), as well as when managers are risk averse and become too expensive to motivate or when they take a better outside option (Sannikov, 2008; Wang, 2011, 2015). Instead, the reason for turnover in the present paper is to appoint a better manager, which raises the question of whether severance pay should be offered to stimulate truthful reporting. The paper also contributes to prior work on human capital investments (Jovanovic, 1979 a,b; and Felli and Harris, 1996) by analyzing a setting in which the worker’s fit is her private information and that it changes over time.⁶

The paper continues as follows. Section 2 describes the model. Section 3 derives the optimal contract and discusses its implementation. Section 4 concludes. All derivations and proofs are in the Appendix. Implications 1–7 contain the main empirical implications.

⁶One of the paper’s novel aspects is to analyze the factors affecting contract horizon and tenure limits. This builds on prior work arguing that such limits reduce agents’ ability to extract rent, such as Lazear (1979), Prescott and Townsend (2006), and Hertzberg et al. (2010). The main difference to the political economy literature on term limits (Aghion and Jackson, 2016) is that turnover can occur during the manager’s contract term, and monetary incentives play a key role.

2 Model

Consider an infinitely lived firm in which the board maximizes shareholder wealth and is in charge of hiring and replacing the firm's manager (she). The firm operates in an economy, in which every period t consists of three dates. At the first date of every period, $\tau_t = 0$, an incumbent manager can invest in firm-specific human capital. Such investment increases the likelihood that her fit, $\theta_t \in \{\theta_A, \theta_C\}$ with the firm in the current period is good, $\theta_A > \theta_C$, but carries a non-monetary cost c . At the second date $\tau_t = 1$, the manager learns and can report her fit, and the board can decide whether or not to keep her on the job. Replacing the incumbent implies that a replacement manager will steer the firm as preferred by the board for the remainder of the period. All cash flows from the period are realized at the final date $\tau_t = 2$. If the board has not already replaced the manager at the interim date, it can choose again whether or not to keep her for the next period. Cash flows are verifiable and can take values $x_t = \{x, x + \Delta x\}$. The manager's fit $0 \leq \theta_t \leq 1$ is interpreted as the likelihood of achieving the higher cash flow $x + \Delta x$, where $x, \Delta x \geq 0$. At all times, the manager is protected by limited liability. All parties are risk neutral and the common discount factor between two neighboring periods is $\delta \in (0, 1)$. We now add more structure to this framework.

Neither the board nor potential managers have private information when a new manager is hired. Furthermore, the managers from which the board can choose have zero wealth and are identical in all respects except their age (i.e., managers are not infinitely lived and leave the labor market once they reach their retirement age). However, the key assumption is that, upon being hired, the manager privately learns the realization of θ_t at the interim date $\tau_t = 1$ of every period. This realization depends on whether the manager invests in firm-specific human capital, which is also non-verifiable to outsiders. Without such investment at the beginning of a period, the manager's fit is θ_C . If, instead, the manager invests in firm-specific human capital, there is a probability e_t that her fit is θ_A , and only probability $1 - e_t$ that it is θ_C .

The probability $e_t(\theta_{t-1})$ that a manager's investment in firm-specific human capital results in a good fit θ_A in period t depends on her fit θ_{t-1} from the previous period. Specifically, there is a positive correlation with $e_t(\theta_A) > e_1 > e_t(\theta_C)$, where e_1 is the likelihood of θ_A in the manager's first (complete) period after being hired. In this Markov environment, the t -subscripts in $e_t(\theta_A)$ and $e_t(\theta_C)$ are not necessary, but they are helpful to keep track of the intertemporal forces affecting contracting. Initially, $\{e_1, e_t(\theta_A), e_t(\theta_C)\}$ and the manager's outside option, which pays \bar{U} per period, are fixed, but Section 3.3 relaxes these assumptions.

Contracting At the beginning of the employment relation, the board offers the manager a contract $\mathbf{w} = (w_t, \Delta w_t, w_{s,t}, \psi_t^1, \psi_t^2)_{t=1}^T$. The contract components characterizing any given period t can depend on the current and past cash flow realizations $(x_i)_{i=1}^t$ as well as reports $(\hat{\theta}_i)_{i=0}^t$ by the manager about her fit (if there are such reports). Unless otherwise noted, the history dependence is not made explicit, but captured only by the subscript t . In this contract, w_t stands for the manager’s wage in the low cash flow state and Δw_t stands for how much she receives in addition (i.e., her “bonus”) in the case of a high cash flow realization; $w_{s,t}$ is the manager’s severance pay if she is replaced at the interim date $\tau_t = 1$ *prior* to the realization of cash flows $x_t = \{x, x + \Delta x\}$ in that period, with ψ_t^1 being the probability of such interim replacement; ψ_t^2 stands for the probability of replacing the manager at the end of the period, i.e., in $\tau_t = 2$ *after* the cash flow realization x_t .⁷ Both for realism and to simplify the analysis, attention is restricted to deterministic contracts and replacement strategies. Thus, $\psi_t^\tau = \{0, 1\}$, which is labeled for transparency as $\{keep, replace\}$. While the contract does not explicitly consider a payment to the manager for leaving the firm at the beginning of a period before she obtains private information, we show that such payments will not arise.

The manager is penniless and protected by limited liability, which requires that $w_t, w_{s,t} \geq 0$.⁸ The manager should further have no incentives to destroy cash flows, $\Delta w_t \geq 0$ (Innes, 1990). Contracts that satisfy these requirements are labeled as “feasible.” Furthermore, it is assumed that the manager cannot be prevented from leaving the firm at any time during the employment relationship. Thus, the contract should at least compensate her for her outside employment opportunity, which would pay her \bar{U} at the end of every period until retirement. We assume that if the manager leaves the firm at the interim date $\tau_t = 1$ of a period, she still obtains \bar{U} from her outside employment opportunity for that period.⁹ Figure 1 summarizes the timeline of a period.

Replacement and Performance Evaluation If the board replaces the incumbent at the interim date, the new manager is paid \bar{U} to complete the period with the board’s preferred strategy, which has a success likelihood of $\bar{\theta}$, requires no firm-specific human capital investment and does not give rise to private information. Then, the board makes the manager an offer covering the whole potential relationship in the beginning of the following

⁷The payment to the manager at the end of the period could also be reinterpreted as the manager’s severance pay if she is fired in the end of that period.

⁸Since both the board and managers are risk neutral and use the same discount factor, savings do not play a role, unless the manager tries to save to buy the firm or pay the board never to replace her. However, this would not arise if the board believes that a replacement manager can increase firm profits by more than what the incumbent believes can achieve.

⁹Assuming that the manager receives only a fraction of \bar{U} leads to the same qualitative results.

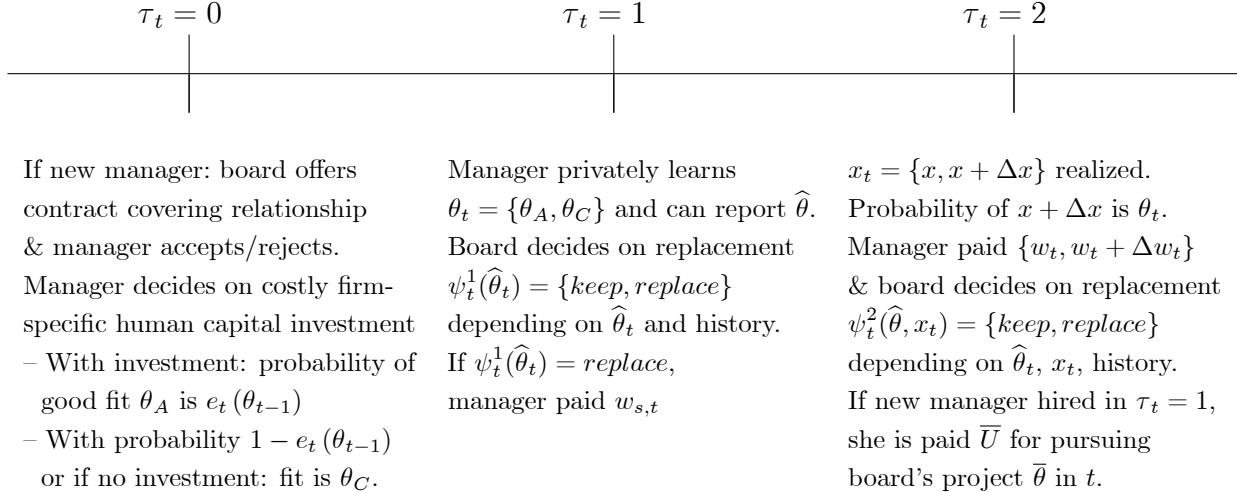


Figure 1: Timeline of a period.

period. Since managers are ex ante identical, their information evolves independently, and time is infinite, the board's contracting problem when making an offer to a replacement manager is identical to that faced with her predecessor. If a manager is replaced, she is not rehired. The following assumption further helps to streamline the analysis.

Assumption 1. *The board's replacement and retention decisions should not be suboptimal given the information it has at that point in time.*

Assumption 1 rules out commitment not to renegotiate retention and replacement strategies that are suboptimal given the board's ex post information. In particular, it rules out replacing a manager whose fit is θ_A or retaining a manager whose fit is θ_C , as it is assumed that $\theta_C < \bar{\theta} < \theta_A$.

Without screening out the manager's private information at the interim date $\tau_t = 1$, the board remains uninformed about the manager's fit.¹⁰ We follow Burkart et al. (1997) and assume that, when uninformed, the board abstains from "effective" control and retains the manager. This is preferable if

$$e_t(\theta_C)\theta_A + (1 - e_t(\theta_C))\theta_C > \bar{\theta} \iff e_t(\theta_C) > \frac{\bar{\theta} - \theta_C}{\theta_A - \theta_C}. \quad (1)$$

In this case, if the firm produces high cash flows at the end of this period, the board expects that the incumbent's likelihood of being a good fit in the following period will be higher than that of a replacement manager; the board assumes the opposite if the firm has

¹⁰Remaining uninformed is often optimal in dynamic settings with limited commitment (Hart and Tirole, 1988; Bester and Strausz, 2001). Closely related, Malcomson (2016) shows that full separation does not arise in relational incentive contracts with persistent private information.

produced low cash flows

$$E[e_{t+1}(\theta_t) | x] < e_1 < E[e_{t+1}(\theta_t) | x + \Delta x], \quad (2)$$

where the expectation is about the realization of θ_t , conditional on the cash flow realization in t and the prior history. A sufficient condition for (2) to hold in terms of primitives is given in Appendix B (cf. expression (37)).

Together with Assumption 1, condition (2) implies that the board will not show patience for managers that are (or could be) a bad fit. This helps to abstract from issues related to learning the manager’s fit over an extended period of time, which have been studied extensively by the previous literature.¹¹ Here it should be noted that Assumption 1 is not as strong as requiring full renegotiation-proofness. Section 3.2.4 discusses the implications of imposing this condition.

Alternative Interpretations of Fit The model can be extended to assume that the manager overestimates her fit. In a similar same vein, one could interpret θ as the manager’s vision—her way of doing things and steering the firm at a level that is difficult for the board to control or verify.¹² Such extensions lead to the same qualitative results.

Finally, though there is no truly voluntary turnover in this model, premature replacements (at the interim date $\tau_t = 1$) are labeled in what follows as “voluntary.” The reason is that a smooth transition, eased by a severance package, might appear voluntary to outsiders, even if the board and the manager disagree behind the scenes whether a replacement could do a better job.

3 A Multi-Period Employment Relation

Let $\mathbf{w} = (w_t, \Delta w_t, w_{s,t}, \psi_t^1, \psi_t^2)_{t=1}^T$ be the contract that the board offers a manager in the first period of her employment relationship. Recalling that compensation depends on the history of reports and cash flow realizations, let $\omega_t \in \{w_t, w_t + \Delta w_t, w_{s,t} + \bar{U}\}$ denote the

¹¹With continuous types or small changes to the manager’s type over time, the board is more likely to be more patient (Taylor, 2010; Garrett and Pavan, 2012).

¹²One could assume that the board believes that $\bar{\theta} > \theta_C$, while the manager believes that the board’s preferred way has a success probability of only $\bar{\theta}^m < \theta_C$. Such disagreement has been motivated with heterogeneous priors (Boot et al., 2008; Huang et al., 2016), overconfidence (Goel and Thakor, 2008; Gervais et al., 2011), and excessive pessimism or optimism (Coval and Thakor, 1998; Manove and Padilla, 1999). Heterogeneous beliefs might not converge, as the board’s alternative would pay off only if it is undertaken and then only at the end of the period. This alternative interpretation could be pertinent when the firm is doing things out of the ordinary and when the manager believes to understand the business better than an outside board. Indeed, 75% of CEOs are firm insiders (Gillan et al., 2009).

firm's wage bill in period t . The board's expected payoff in that period is

$$V_1(\mathbf{w}) = E \left[\sum_{i=1}^T \delta^{i-1} (q_i (x_i - \omega_i) + \tilde{q}_i \delta V^*) \right], \quad (3)$$

where E is the expectation over the future θ_t and x_t realizations; and q_i and \tilde{q}_i are the (endogenous) probabilities that the incumbent manager is still with the firm in period i and, respectively, leaves the firm by the end of that period. V^* denotes the board's equilibrium expected payoff from hiring a new manager starting from the first complete period of that manager. Finally, T is the manager's retirement age and, thus, represents her upper tenure limit within the employment relation. For convenience, t is reset to one for every new manager, so that t could be interpreted as her tenure while at the firm. The board's promise keeping constraint implies that the manager's expected payoff at any given t during her tenure is

$$U_t(\theta_{t-1}, \mathbf{w}) = E \left[\sum_{i=t}^T \delta^{i-t} (\bar{U} + q_i (\omega_i - c - \bar{U})) | \theta_{t-1} \right]. \quad (4)$$

Expression (4) states that the manager can obtain \bar{U} in every period until she leaves the labor market in T , but she might receive something different than \bar{U} while she is employed by the firm. The board's belief that $\bar{\theta} > \theta_C$ implies that it will always provide incentives for firm-specific human capital investments, since the incumbent manager adds value only if she is a good fit. What will be crucial for the analysis is that the manager's fit persistence implies that her payoff in t , $U_t(\theta_{t-1}, \mathbf{w})$, depends on her fit realization in $t - 1$. There is no such prior realization when she is hired, so for period one we write $U_1(\mathbf{w})$.

Using (4) to plug in for the manager's compensation in (3), the board's objective when hiring a manager is to choose \mathbf{w} to maximize

$$\max_{\mathbf{w}} E \left[\sum_{i=1}^T \delta^{i-1} (q_i (x_i - c - \bar{U}) + \tilde{q}_i \delta V^*) \right] - U_1(\mathbf{w}) + \sum_{i=1}^T \delta^{i-1} \bar{U}, \quad (5)$$

subject to the constraints that the contract \mathbf{w} is feasible, incentive compatible, satisfies promise keeping and the manager's participation constraint in every period. Clearly, in equilibrium the board's expected payoff in (5) must be equal to V^* . Hence, the board acts as a residual claimant and trades off maximizing the surplus generated from employing a manager with minimizing the manager's rent $U_1(\mathbf{w}) - \sum_{i=1}^T \delta^{i-1} \bar{U}$.

Specifying the relevant constraints requires some work. Assumption 1, together with

(1) and (2) will imply that the board will follow one of two strategies in any given period— (i) either pursue truthful reporting and replace a manager if she becomes a bad fit or (ii) abstain from offering incentives for truthful reporting and replace a manager if and only if she produces low cash flows. Section 3.1 derives how the manager’s compensation should be structured to satisfy the constraints characterizing each of these strategies. What is key is that in any given period t , the value of the manager’s promised continuation payoffs $U_{t+1}(\theta_t, \mathbf{w})$ will take on two values, depending on her fit realization (θ_A or θ_C) in t , so both continuation payoffs will serve as state variables for characterizing the optimal contract.

3.1 Voluntary and Performance-Induced Turnover

Suppose, first, that the board offers incentives for truthful reporting in some period t . In this case, the only optimal replacement strategy given the board’s ex post information is to replace a manager if and only if her fit is θ_C . That is, $\psi_t^1(\theta_C) = \text{replace}$, $\psi_t^1(\theta_A) = \text{keep}$, and $\psi_t^2(\theta_A, x_t) = \text{keep}$ regardless of x_t , unless the period coincides with the manager’s retirement age. By replacing a manager whose fit is θ_C , the board can increase the likelihood of high cash flows both in the current and the subsequent period (as $e_1 > e_{t+1}(\theta_C)$). By contrast, the positive correlation of fit between two neighboring periods ($e_{t+1}(\theta_A) > e_1$) together with $\theta_A > \bar{\theta}$ implies that it would be ex post suboptimal to replace an incumbent who is a good fit.

The incentive constraints that the manager reveals her fit truthfully and stays if her fit is θ_A or leaves with a severance package if her fit is θ_C are

$$w_t + \theta_A \Delta w_t + \delta U_{t+1}(\theta_A, \mathbf{w}) \geq w_{s,t} + \sum_{j=t}^T \delta^{j-t} \bar{U} \quad (6)$$

$$w_{s,t} + \sum_{j=t}^T \delta^{j-t} \bar{U} \geq w_t + \theta_C \Delta w_t + \delta U_{t+1}(\theta_C, \mathbf{w}). \quad (7)$$

where the manager’s report $\hat{\theta}_t$ is omitted from the notation, as the manager only obtains $w_{s,t}$ if reporting θ_C , and can obtain $\{w_t, \Delta w_t\}$ only if reporting θ_A . In a Markov environment, if the manager is truthful on the equilibrium path in periods t and $t + 1$, she is also truthful off the equilibrium path in $t + 1$ (i.e., after misreporting in t), as her true fit in t does not matter for her payoff in $t + 1$ *after* her new fit is realized. However, for the manager’s continuation payoff $U_{t+1}(\theta_C, \mathbf{w})$ in expressions (7) we still need to keep in mind that investing in firm-specific human capital might not be optimal after misreporting θ_C .¹³

¹³The manager’s continuation payoff in the final period is $\hat{U}_{T+1}(\theta_T, \mathbf{w}_{t+1}) = 0$.

To induce a manager whose fit is θ_{t-1} to invest in firm-specific human capital in period t , the contract must further satisfy

$$U_t(\theta_{t-1}, \mathbf{w}) = \left(\begin{array}{l} e_t(\theta_{t-1})(w_t + \theta_A \Delta w_t + \delta U_{t+1}(\theta_A, \mathbf{w})) \\ + (1 - e_t(\theta_{t-1})) \left(w_{s,t} + \sum_{j=t}^T \delta^{j-t} \bar{U} \right) - c \end{array} \right) \geq w_{s,t} + \sum_{j=t}^T \delta^{j-t} \bar{U}, \quad (8)$$

where the right-hand-side of (8) captures that a manager who does not invest in firm-specific human capital does not have a good fit with certainty and is, thus, replaced in date $\tau_t = 1$ of the period.

Conditions (6)–(8) illustrate the effect of costly firm-specific human capital investments on the manager’s compensation contract. Absent such investments, the board can pay the manager a fixed wage equal to her outside option, $w_t = \bar{U}$, and set her bonus and severance pay to zero, $w_{s,t} = \Delta w_t = 0$, in all periods. This would satisfy (6) and (7) with equality. Thus, it would not only ensure participation, but it would also eliminate the manager’s incentives to hide that her fit has deteriorated, making her private information inconsequential. However, because firm-specific human capital investments are costly, the manager might be able to extract strictly positive information rent

$$\nu_t(\theta_{t-1}, \mathbf{w}) := U_t(\theta_{t-1}, \mathbf{w}) - \sum_{j=t}^T \delta^{j-t} \bar{U}, \quad (9)$$

implying that she gets an “efficiency wage” higher than her outside option. This makes the manager reluctant to report θ_C , which would lead to her dismissal, unless she is offered severance pay. The latter effect will play a key role for the design of the optimal contract.

Evaluating the Manager Based on Firm Performance Suppose, next, that the board does not offer incentives for truthful reporting at the interim date of some period t .¹⁴ Since in this case, the board does not believe she can do better by replacing the manager, we have $\psi_t^1 = \textit{keep}$. Upon the subsequent cash flow realization, the only *ex post* optimal replacement strategies in that period are $\psi_t^2(x) = \textit{replace}$ and $\psi_t^2(x + \Delta x) = \textit{keep}$.¹⁵ For now it is assumed that the board can commit not to renegotiate to seek truthful reporting upon reaching such a period, but this assumption is relaxed in Section 3.2.4.

In a period in which the board follows such a replacement strategy, it still needs to make sure that investing in firm-specific human capital is better for the manager than not

¹⁴Since the contract is not conditional on the manager’s report $\hat{\theta}_t$, it is again without loss to omit $\hat{\theta}_t$ from the notation.

¹⁵The Appendix shows that these strategies are also *ex ante* optimal, as they spur effort incentives.

investing and forgoing the chance of being a good fit or leaving the firm

$$\begin{aligned}
U_t(\theta_{t-1}, \mathbf{w}) &= w_t + (\theta_C + e_t(\theta_{t-1}) \Delta\theta) \Delta w_t + \delta E_{\theta_{t-1}} [U_{t+1}^e(\theta_t, \mathbf{w})] - c \\
&\geq \max \left(w_t + \theta_C \Delta w_t + \delta U_{t+1}^e(\theta_C, \mathbf{w}), \sum_{j=t}^T \delta^{j-t} \bar{U} \right), \tag{10}
\end{aligned}$$

where the manager's continuation payoffs, depending on whether she already knows her fit θ_t in period t , are defined as

$$\begin{aligned}
E_{\theta_{t-1}} [U_{t+1}^e(\theta_t, \mathbf{w})] &= e_t(\theta_{t-1}) U_{t+1}^e(\theta_A, \mathbf{w}) + (1 - e_t(\theta_{t-1})) U_{t+1}^e(\theta_C, \mathbf{w}) \\
U_{t+1}^e(\theta_t, \mathbf{w}) &= \theta_t U_{t+1}(\theta_t, \mathbf{w}) + (1 - \theta_t) \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}.
\end{aligned}$$

Since in this case, the manager has no incentives to leave after learning that her fit in $\tau_t = 1$ is θ_C (i.e., (7) is violated), it holds¹⁶

$$w_t + \theta_C \Delta w_t + \delta U_{t+1}^e(\theta_C, \mathbf{w}) \geq \sum_{j=t}^T \delta^{j-t} \bar{U} + w_{s,t}. \tag{11}$$

Finally, note that if the board has not learned the manager's fit in period t , it will not do so at the beginning of the next period $t + 1$. This would require offering the manager the same information rent as when learning the manager's fit in period t , without allowing for the benefit of replacing the manager earlier (see Lemma 2 in the Appendix).

Replacement Strategies and Compensation What complicates the analysis of conditions (6)–(11) is that they depend on the compensation and truthful reporting policy in future periods as well as past history. The following proposition summarizes the implications of conditions (6)–(11) for the evolution of the manager's contract for any given reporting strategy, where the key state variables are the manager's continuation payoffs depending on her fit realizations.

Proposition 1 *The board pursues one of two replacement strategies in any given period t .¹⁷ The first strategy is to provide incentives for truthful reporting, in which case the*

¹⁶The reverse inequality together with (10) would imply that (6) and (7) are satisfied and would be in the truthful reporting case. Note that (11) implies that the manager stays also if her fit is θ_A and that the larger term in the max-term of (10) is the first one.

¹⁷We have not allowed for stochastic mechanisms in which the board randomizes between the two strategies in some periods. The reason is that committing to a randomization mechanism is not realistic

manager is replaced if and only if her fit is θ_C : $\psi_t^1(\theta_A) = \text{keep}$, $\psi_t^1(\theta_C) = \text{replace}$, $\psi_t^2(\theta_A, x_t) = \text{keep}$, regardless of x_t . Implementing this strategy in period t , requires offering

$$\Delta w_t = \begin{cases} \frac{c}{e_t(\theta_C)\Delta\theta} + \delta \frac{U_{t+1}(\theta_C, \mathbf{w}) - U_{t+1}(\theta_A, \mathbf{w})}{\Delta\theta} > 0 & \text{if truthful reporting in } t-1 \\ \max \left(\frac{c}{e_t(\theta_C)\Delta\theta} + \delta \frac{U_{t+1}(\theta_C, \mathbf{w}) - U_{t+1}(\theta_A, \mathbf{w})}{\Delta\theta}, \Delta w_{t-n}^{-1}(0) \right) & \text{otherwise} \end{cases} \quad (12)$$

$$w_t = 0 \quad (13)$$

$$w_{s,t} = \max \left(0, \theta_C \Delta w_t + \delta U_{t+1}(\theta_C, \mathbf{w}) - \sum_{j=t}^T \delta^{j-t} \bar{U} \right), \quad (14)$$

where $\Delta w_{t-n}^{-1}(0)$ is the minimum bonus in t after n periods without incentives for truthful reporting (and deferring bonuses), required to satisfy (10)-(11) for these n periods. The board always pursues truthful reporting in the final period T .¹⁸

The second strategy is not to seek truthful reporting ($\psi_t^1 = \text{keep}$) and replace the manager if and only if observing the low cash flow x at the end of the period ($\psi_t^2(x) = \text{replace}$, $\psi_t^2(x + \Delta x) = \text{keep}$). Implementing this alternative requires

$$\Delta w_t = 0 \quad (15)$$

$$w_t = \max \left(0, \sum_{j=t}^T \delta^{j-t} \bar{U}_j - \theta_C \Delta w_t - \delta U_{t+1}^e(\theta_C, \mathbf{w}) \right) \quad (16)$$

$$w_{s,t} = 0, \quad (17)$$

In the first period, $e_t(\theta_C)$ needs to be replaced by e_1 in all (12)–(17).

Part (i) of Proposition 1 shows that when the board seeks truthful reporting it cannot follow Lazear's (1979) classical prescription that, with risk neutral managers, bonuses should be delayed as much as possible (i.e., $\Delta w_t = 0$) to minimize the cost of incentivizing effort. The key driver for the difference in predictions is that investments in firm-specific human capital do not affect cash flows directly, but only indirectly over the manager's fit. This changes things dramatically, as then the manager's incentives must be generated by the difference in her continuation payoffs depending on whether her fit realization is θ_A or θ_C , and not, as is usual, depending on whether the firm's cash flow realization is high or low (to see this, plug in (7) into (8)). In particular, for $\Delta w_t = 0$, the difference

if the board is not indifferent between the two strategies in the period in question. And for the case in which it is indifferent, we have shown that such contracts are never optimal.

¹⁸In the last period, the main cost comes from the need to provide effort incentives, and incentivizing truthful reporting brings no further costs.

in the manager's continuation payoffs depending on whether her fit in period t was θ_A or θ_C would be insufficient to incentivize costly firm-specific human capital investments. This can be easily seen in the special case in which the correlation between periods is weak (i.e., $e(\theta_A) \approx e(\theta_C)$), in which case that difference is close to zero, as $U_{t+1}(\theta_A, \mathbf{w}) \approx U_{t+1}(\theta_C, \mathbf{w})$. Thus, we must have $\Delta w_t > 0$.

Part (ii) of Proposition 1 considers the case in which the manager is not offered incentives for truthful reporting in a given period. In this case, incentives are generated based on the difference in the firm's cash flow performance, and a version of Lazear's (1979) argument goes through: It is optimal to delay paying the manager a bonus until a period in which she truthfully reports her fit or until she reaches the maximal tenure limit. In this case, it is optimal to choose the continuation payoffs $U_{t+1}^e(\theta_C, \mathbf{w})$ and $U_{t+1}^e(\theta_A, \mathbf{w})$ such that Δw_t is at its feasibility bound of zero. This can be done by sufficiently increasing the manager's bonus in the first period with truthful reporting that follows such non-reporting period(s).

3.2 Contract Horizon and Turnover

Proposition 1 represents the manager's contract in terms of her continuation payoffs $U_{t+1}(\theta_A, \cdot)$ and $U_{t+1}(\theta_C, \cdot)$. These payoffs play the role of state descriptors, determining how much the manager gets paid, depending on whether she is offered incentives to report her fit truthfully and given that she is offered incentives to invest in firm-specific human capital. Since a manager's continuation payoffs are zero in the final period T at which she must retire ($U_{T+1}(\theta_T, \cdot) = 0$), proceeding recursively, her contract can be completely characterized for any truthful reporting strategy the board might pursue. Hence, to maximize the board's payoff (5), it remains to determine how often it is optimal to seek truthful reporting, subject to (12)–(17). The following example illustrates the main results when $T \leq 2$, which can be fully solved analytically.

Example 1: Illustration of Main Results Consider a labor market in which managers stay for at most two periods, i.e., $T = 2$, and assume the primitives take the values from the description of Figure 2. Suppose, first, that the board seeks truthful reporting in both periods and offers $\{w_1, w_2\} = \{0, 0\}$; $\{\Delta w_1, \Delta w_2\} = \{4.7, 7.4\}$, and $\{w_{s,1}, w_{s,2}\} = \{2.8, 2\}$.

We can calculate the manager's payoff in $t = 1$ and $t = 2$ recursively from

$$U_t(\theta_{t-1}, \mathbf{w}) = \begin{pmatrix} e_t(\theta_{t-1})(w_t + \theta_A \Delta w_t + \delta U_{t+1}(\theta_A, \mathbf{w})) \\ + (1 - e_t(\theta_{t-1})) \left(w_{s,t} + \sum_{j=t}^T \delta^{j-t} \bar{U} \right) - c \end{pmatrix} \text{ if truthful reporting in } t. \quad (18)$$

This gives us $U_2(\theta_A, \mathbf{w}) = 3.4$, $U_2(\theta_C, \mathbf{w}) = 3$, and $U_1(\mathbf{w}) = 4.7$ (where note that $e_t(\theta_{t-1}) = e_1$ in $t = 1$ and that $U_{T+1} = 0$). If the manager's outside opportunity pays $\bar{U} = 1$, we can now verify that condition (6) is lax, while (7) and (8) are satisfied with equality. If the outside option were lower, $\bar{U} = 0$, the incentive constraint (7) to truthfully report θ_C would not be satisfied, as then the manager would be more reluctant to lose her job. To satisfy (7), we would then have to increase the manager's severance pay to $\{w_{s,1}, w_{s,2}\}_{\bar{U}=0} = \{4.7, 3\}$. Two insights follow immediately. First, severance pay is needed to compensate the manager for forgoing future rent when truthfully reporting θ_C . *Severance pay must be higher in $t = 1$ than in $t = 2$* , as the manager needs to be compensated for forgoing rent in two periods. Second, *a manager with a higher outside option requires less severance to be honest*, and might be preferable for the board.

Suppose now that the board does not seek truthful reporting in the first period and offers $\{w_1, w_2\} = \{0, 0\}$; $\{\Delta w_1, \Delta w_2\} = \{0, 12.6\}$ and $\{w_{s,1}, w_{s,2}\} = \{0, 4\}$. In particular, note that this contract offers no severance pay in $t = 1$ and that the first-period bonus is delayed and paid conditional on the firm performing well also in $t = 2$. By plugging in, we can now verify that conditions (6)–(11) are satisfied. Furthermore, the manager's payoff in $t = 2$ can be calculated again from (18) as $U_2(\theta_A, \mathbf{w}) = 6.5$ and $U_2(\theta_C, \mathbf{w}) = 5.7$. The payoff in $t = 1$ can be recursively calculated from

$$U_t(\theta_{t-1}, \mathbf{w}) = \begin{pmatrix} w_t + (\theta_C + e_t(\theta_{t-1}) \Delta \theta) \Delta w_t \\ + \delta E_{\theta_{t-1}} [U_{t+1}^e(\theta_t, \mathbf{w})] - c \end{pmatrix} \text{ if no truthful reporting in } t. \quad (19)$$

If $\bar{U} = 1$, $U_1(\mathbf{w}) = 2.8$, which is 40% lower than with truthful reporting in both periods. Thus, there is a *trade-off between lowering the manager's expected pay and risking an inefficient replacement* decision by evaluating the manager based on the firm's cash flows.

Table 1 compares the board's residual claim (5) when sticking to each of the two strategies described above for every new hire. It illustrates two of the paper's main results. *As the manager's outside option \bar{U} decreases from 1 to 0* (i) *the manager becomes more expensive to hire* if the board seeks truthful reporting in both periods (last column). This is because she requires more severance pay. (ii) *Abstaining from offering incentives for truthful reporting becomes more attractive*, especially if the firm is small ($x = 100$,

$\{x, \Delta x\}$	\bar{U}	$V_{n,r}^*$	$V_{r,r}^*$
$\{100, 50\}$	0	2,536	2,527
	1	2,531	2,534
$\{1000, 500\}$	0	25,759	26,004
	1	25,754	26,011

Table 1: Board’s expected payoff. The table compares the board’s expected payoff $V_{r,r}^*$ from offering incentives for truthful reporting in both periods and from abstaining from offering such incentives in the first period, $V_{n,r}^*$, for different values of $x, \Delta x$ and \bar{U} .

$\Delta x = 50$).¹⁹ The rest of the paper generalizes and discusses the intuition for these insights. It further shows that, with longer time horizons ($T > 2$), even large firms will regularly abstain from offering incentives for truthful reporting (Figure 2). Readers mainly interested in the implications of the analysis can skip to Implications 1–7. \blacktriangle

3.2.1 The Cost-Benefit Mismatch of Incentivizing Truthful Reporting

Solving the board’s problem of optimally choosing the sequence of truthful reporting periods for $T > 2$ is not tractable. Numerically, this can be easily done by recursively deriving the manager’s payoff from (18)–(19) in every period for any truthful reporting policy the board can choose from, and then selecting the policy that maximizes (5). Still much of the intuition and many of the optimal contract’s properties can be derived analytically.

The first question that should be clarified is why the board might choose not to offer incentives for truthful reporting in all periods. The first-best replacement policy would require seeking truthful reporting in every period and hiring the manager with the longest time to retirement T , as the positive correlation of fit between periods ($e(\theta_A) > e_1$) implies that a manager who stays a good fit should be kept as long as possible. However, this policy might require giving up too much information rent to the manager. Using that (8) is binding for $\theta_{t-1} = \theta_C$ (Proposition 1), the manager’s expected payoff in a period with truthful reporting is

$$U_t(\theta_{t-1}, \mathbf{w}^r) = \left(\frac{e_t(\theta_{t-1})}{e_t(\theta_C)} - 1 \right) c + w_{s,t}^r + \sum_{j=t}^T \delta^{j-t} \bar{U}, \quad (20)$$

where the superscript r stands for truthful reporting. Thus, offering the manager severance pay as an incentive to retire voluntarily if her fit is not good leads to information rent of proportionate size.

¹⁹The derivations are in the Appendix. If $\bar{U} = 0$, we need to change $\Delta w_2 = 11$ and $w_{s,2} = 4.4$ and we have $U_1(w) = 1.9$.

Suppose now that the board seeks truthful reporting in every period. Plugging in for the severance pay $w_{s,t}^r$, the manager's expected rent (9) when she is hired in period one is²⁰

$$\begin{aligned}
\nu_1 &= \frac{\theta_C c}{e_1 \Delta \theta} + \delta \frac{\theta_A U_2(\theta_C, \mathbf{w}^r) - \theta_C U_2(\theta_A, \mathbf{w}^r)}{\Delta \theta} - \sum_{j=1}^T \delta^{j-1} \bar{U} \\
&= \frac{\theta_C c}{e_1 \Delta \theta} - \bar{U} - \delta \frac{\theta_C}{\Delta \theta} \left(\frac{\Delta e_2}{e_2(\theta_C)} \right) c + \delta w_{s,2}^r \\
&= \frac{\theta_C c}{e_1 \Delta \theta} - \bar{U} + \sum_{j=2}^T \delta^{j-1} \left(\frac{\theta_C}{\Delta \theta} \left(\frac{1 - \Delta e_j}{e_j(\theta_C)} \right) c - \bar{U} \right), \tag{21}
\end{aligned}$$

where $\Delta e_t = e_t(\theta_A) - e_t(\theta_C)$ captures the positive correlation (persistence) of fit across periods. This persistence helps to reduce the rent that needs to be promised to the manager, since being a good fit increases the likelihood of being a good fit also in the following period. Thus, if $\frac{\theta_C}{\Delta \theta} \left(\frac{1 - \Delta e_t}{e_t(\theta_C)} \right) c < \bar{U}$, the manager's rent decreases as T increases.

Proposition 2 *The board follows the first-best policy of hiring the manager with the longest time to retirement and incentivizing truthful reporting in all periods if*

$$\frac{\theta_C}{\Delta \theta} \left(\frac{1 - \Delta e_t}{e_t(\theta_C)} \right) c < \bar{U} \text{ in all } t. \tag{22}$$

If the reverse inequality holds, the board might find it optimal to set a limit on maximal tenure and/or abstain from seeking truthful reporting in some periods. This case features both voluntary and performance-induced turnover.

If condition (22) does not hold, the manager can expect an “efficiency” wage above her outside option in all periods until she is replaced. This makes her reluctant to truthfully report θ_C , especially in light of the fact that, by lying, she could stay on the job even following low cash flow realizations. Thus, the severance package needed to incentivize truthful reporting must be higher, the more periods she can potentially stay on the job (dashed line in Figure 2). This results in a mismatch between the costs and benefits of offering incentives for truthful reporting until T . With such a policy, severance pay compensates the manager as if she would always stay until the contract's end in T . However, the board does not realize the benefit of truthful reporting in some period t if the manager has been replaced by that point. Since the likelihood that the manager remains a good fit until the contract's end in T dwindles in T , it might be optimal to abstain from seeking

²⁰Note that in the first period, e_t is just the constant e_1 , and the first term in (20) is zero.

truthful reporting at least in some periods (risking an inefficiently retention or replacement decision) or to hire an older manager.

3.2.2 Abstaining from Incentives for Truthful Reporting

Not offering incentives for truthful reporting comes with the compelling advantage of reducing the rent that needs to be promised to the manager. This was already illustrated in Example 1. Lemma 4 in the Appendix shows that this holds quite generally: introducing a period without truthful reporting in a sequence of periods with truthful reporting, decreases the manager’s rent whenever the first-best condition (22) is not satisfied. This is because a period in which the manager is judged only based on performance cuts through her ability to stay with the firm by lying about her fit in all periods. The prospect of lower future rent, in turn, implies that the manager is truthful about her fit even when offered lower severance pay in all preceding periods. Thus, by choosing whether to seek truthful reporting, the board faces a trade-off between making an efficient replacement decision and minimizing the manager’s rent.

This trade-off is in the heart of Figure 2, which plots the optimal contract offered to the manager when the board determines the optimal sequence of truthful reporting periods that maximizes its expected payoff as well as a contract that always offers incentives for truthful reporting. The figure illustrates that the manager’s severance pay (and, thus, rent) is higher, the more periods with truthful reporting (and, thus, rent extraction) she has ahead of herself. However, by introducing a period without incentives for truthful reporting, the board not only saves the cost of paying severance when replacing the manager entirely based on underperformance, but can also afford to offer lower severance pay in all preceding periods. The figure also illustrates that the manager obtains a non-trivial bonus conditional on achieving high cash flows in periods with truthful reporting.

INSERT FIGURES 2 AND 3

A point to note in Figure 2 is that it is suboptimal to elicit the manager’s private information in every period even though the manager’s wage is only a very small fraction of the firm’s value. The reason can be traced back to the discussion following Proposition 2. Adding an additional period with truthful reporting increases almost linearly the cost of employing the manager in period one (see (21)). By contrast, the board’s benefit from this policy is realized only if the manager remains a good fit until that period. Figure 2 illustrates that the optimal policy halves the manager’s expected rent, while risking a wrong replacement decision in periods six and 11, which this manager reaches with only eight

and one percent probability, respectively. In what follows, the question is what determines how often the board will evaluate the manager’s fit based on the firm’s performance rather than relying on severance agreements to stimulate voluntary turnover.

Lemma 1 *Take any two contracts seeking a different level of truthful reporting from the manager over some maximal tenure length T . (i) The contract for which the manager’s rent decreases more strongly in \bar{U} becomes more attractive as \bar{U} increases. (ii) The contract for which the firm’s expected cash flows increase more strongly in Δx becomes more attractive as Δx increases.*

Focusing for now on the first part of Lemma 1, the natural question is when the manager’s rent decreases more strongly in \bar{U} . An important insight from Figure 3 is that the board seeks more often truthful reporting when the manager’s outside option \bar{U} is higher. This is only natural, since a higher outside option makes the manager less reluctant to report that her fit is θ_C and seek alternative employment. Hence, the rent that the board needs to promise her to reveal such fit is lower, making this policy more attractive.

This intuition can be derived analytically for two special cases. The first is when a short-term shock affects the manager’s outside option only in the first period of the employment relation. The second is when managers can be employed for at most two periods (i.e., $T \leq 2$). In this case, it can also be derived that incentivizing truthful reporting becomes more attractive as Δx increases, which parallels the second part of Lemma 1. This is because for larger firms and/or firms with higher growth prospects, there is more at stake from having the right manager in charge.

Proposition 3 *Factors affecting truthful reporting and performance evaluation:*

(i) *Consider a short-term shock that increases the manager’s outside option only in the first period. Such a shock makes seeking truthful reporting in the first period more attractive.*

(ii) *Suppose that the manager can be employed for at most two periods $T \leq 2$. Incentivizing truthful reporting becomes more attractive for the board as \bar{U} and Δx increase.*

To the extent that managers’ outside options are lower in industry downturns—e.g., because more firms are going bankrupt, fewer firms are being started, and there is more competition among the labor force for available positions—an immediate corollary is that:

Implication 1 *Turnover in downturns: (i) There is less truthful reporting in industry downturns. This implies less voluntary and more forced turnover in downturns, which*

*might appear to an outsider as a lack of relative performance evaluation.*²¹ (ii) *Despite being ex post more likely to replace managers in downturns, the board is ex ante more likely to retain managers who are not a good fit because it is offering less adequate incentives for voluntary turnover. This might exacerbate downturns.*

3.2.3 Implementation with Renewable Fixed-Term Contracts

How does the contract illustrated in Figure 2 map into contracts in practice, given that such contracts either contain ex ante severance agreements or they don't? A simple way to implement policies that alternate between offering and not offering incentives for truthful reporting (and, thus, severance pay) in regular intervals is with renewable fixed-term contracts (i) that stipulate severance pay for premature terminations as a multiple of the manager's bonus and remaining tenure;²² (ii) for which severance is not paid when not renewing the manager's contract at renewal dates; (iii) for which, absent termination, the contract continues as originally agreed upon.

This implementation is suitable, as the board can choose the end of the contract to coincide with a period in which it would be optimal not to seek truthful reporting. Specifically, the manager would have no incentives to report truthfully a deteriorating fit close to a renewal date, at which point the board can replace her without severance pay. In such cases, the board would have to judge the manager's fit solely based on her performance, and would renew the CEO's contract (according to the initial agreement) only if it is happy with that performance. Thus, both the board's and the manager's strategies would mimic those in a period without incentives for truthful reporting.

About 45% of CEO contracts in practice are fixed-term contracts that renew automatically, unless one of the parties objects (Gillan et al., 2009). The majority of such contracts contain ex ante severance agreements (Rau and Xu, 2013; Brown, 2015). In line with Proposition 1, these severance agreements are usually a multiple of managers' salary and bonus and can depend on their remaining tenure. Moreover, boards pay more attention to performance and the relation between turnover and performance is stronger close to renewal dates (Liu and Xuan, 2016; Cziraki and Groen-Xu, 2016). This is in line with the prediction that the board relies on the firm's performance rather than truthful reporting in renewal periods. Thus, the above results provide a simple intuition for the wide-spread

²¹Somewhat loosely speaking, one could think of this model as one in which abnormal and relative performance have already been filtered out.

²²Voluntary" turnover coupled with a severance pay needs to be initiated by the board, as severance pay cannot be claimed without a "good reason," such as a change of duty, diminution of pay, or relocation (Rau and Xu (2013)). This is not in conflict with the model, as reporting a bad fit triggers such termination.

use of such renewable fixed-term contracts. Based on Proposition 3, we predict:

Implication 2 *Determinants of contract horizon:* (i) *The length of renewable fixed-term contracts will be shorter in downturns.* (ii) *Larger firms and firms with better growth options will offer contracts with longer horizons. This will go hand-in-hand with higher (average) severance pay.*

3.2.4 Renegotiations and Hiring Older Managers

The preceding results show that it might be optimal for the board to abstain from offering incentives for truthful reporting in some periods in order to limit the manager’s rent. However, once reaching such a period, the board could offer to renegotiate the existing contract and restructure it in a way that offers incentives for truthful reporting, as this would increase the firm’s cash flows. There are several reasons why pursuing this strategy can become optimal ex post, even if it is not optimal ex ante. First, one benefit of not seeking truthful reporting in t is that it decreases the manager’s rent not only in t , but also in all preceding periods. However, the latter benefit ceases to exist once both parties arrive in t . Second, there is scope for renegotiations after the manager has invested in firm-specific human capital and the cost c in period t is sunk, as at this point incentivizing firm-specific human capital investment is no longer an objective. As is usual, though such renegotiations might be beneficial ex post, they reduce the board’s expected payoff ex ante.

Committing to avoid such renegotiations is relatively easy in the present context. In particular, if the board engages in renegotiations once, all future managers would expect the same and demand only renegotiation-proof contracts from then on. Since the firm is infinitely-lived, this “trigger strategy” would prevent the board from deviating from its commitment to avoid renegotiations if δ is sufficiently high.

Still, discussing the other extreme in which the potential for renegotiations forces the board to offer a contract that incentivizes truthful reporting in all periods is also interesting, as it has clear implications for the manager’s maximal tenure length T .^{23,24} In this case, the board’s problem is equivalent to that discussed in Proposition 2. Then, if the

²³There are no clear predictions regarding T from the previous section except that larger firms (in the sense of higher Δx) tend to offer longer contracts.

²⁴Indeed, renegotiations leading to increases in managers’ severance pay are common in practice. Among the cases in which there was a clear conflict with the board, in 42% of the time the original contracts were renegotiated and the departing manager received substantial severance pay (Goldman and Huang, 2011, 2015). For similar evidence from firms entering bankruptcy, see Eckbo et al. (2016). Both papers acknowledge the difficulty of distinguishing between forced and voluntary turnover and follow different classifications.

first-best condition (22) is not satisfied, the board might have to offer a shorter contract, as the manager's rent might otherwise become too high. A commitment to such tenure limits is credible, as T is chosen to coincide with the manager's retirement age.

To gain some intuition about the factors affecting the manager's maximal tenure limit, it is helpful to consider again condition (22). It suggests that a higher per-period outside option \bar{U} decreases the manager's rent. A more attractive outside opportunity makes the manager less reluctant to leave the firm, which reduces the severance pay she needs to be promised to truthfully report her fit. Thus, given that the cost of employing the manager longer is lower, while the benefit is unchanged, the board finds it optimal to offer contracts with longer horizons. Also similar to before, longer contracts are optimal if Δx is higher, as there is more at stake from holding on longer to a manager who is a good fit.

Proposition 4 *Suppose that the first-best condition (22) is not satisfied and that the board incentivizes truthful reporting in all periods. Then, the upper limit T on the manager's tenure is higher if her per-period outside option \bar{U} and cash flow upside Δx are higher.*

Recalling to the point that upper tenure limits are implemented by choosing T to coincide with the manager's retirement age, Proposition 4 implies:

Implication 3 CEO age: *Suppose that the first-best condition (22) is not satisfied and that the board incentivizes truthful reporting in all periods. (i) Then, the board needs to offer younger managers higher severance pay. (ii) Furthermore, the board prefers hiring an older manager (i.e., T is lower) if \bar{U} and Δx are lower. This implies that older managers are preferred in industry downturns and by firms with low growth potential.*

While the second part of Implication 3 has not been tested, the first part finds empirical support in Rau and Xu (2013).

3.3 Discussion and Extensions

3.3.1 Hiring Managers with Better Outside Options

Suppose now that the pool of potential managers differs according to their success likelihood e_t and their outside options \bar{U} . Furthermore, assume that condition (22) is not satisfied for any \bar{U} and e_t . All remaining parameters of the model remain the same.

Clearly, if all information was common knowledge, the board would prefer hiring the manager with the highest likelihood e_t of being a good fit and with the lowest outside option \bar{U} . However, when the manager's fit is her private information, and the board must

offer incentives for truthful reporting, it pays the manager an “efficiency wage,” which is above her outside option. In this case, hiring a manager with a higher outside option could be beneficial, since it reduces the need for generous severance pay $w_{s,t}$. This can be seen especially clearly in the extreme case in which the board stimulates truthful reporting in all periods (as in Section 3.2.4). Then, the board strictly prefers hiring a manager with a higher outside option. Thus, if the board is faced with the choice of selecting between a manager that has a higher likelihood e_t of not being a good fit or one with a higher outside option \bar{U} , it might prefer the manager with the higher outside option.

Proposition 5 *(i) Take any given truthful reporting policy the board is seeking to implement over a given maximal tenure length of T . If $(p(T) - \delta^T) > (1 - \delta) \frac{\partial}{\partial \bar{U}} U_1(T)$, the board’s payoff increases in \bar{U} for that policy.²⁵ Under truthful reporting in all periods (more likely if Δx is higher), the board always prefers hiring a manager with a higher outside option. (ii) Furthermore, the board might prefer a manager with a higher outside option \bar{U} to one who is more likely to be a good fit (higher e_t).*

Investments in general human capital, such as taking boards seats at different firms, increase CEOs’ outside options. Thus, it might seem surprising that boards tolerate such behavior given that it might distract managers, and CEOs could use it as a bargaining chip to get a higher salary. However, CEOs rarely leave the firm to become CEOs elsewhere and typically take a big pay cut in their new employment (Fee and Hadlock, 2004). Thus, if CEOs are paid anyway above their outside options, the more pertinent effect might be:

Implication 4 *Investments in general human capital:* *Investments in general human capital, increasing the manager’s outside options, make it cheaper to offer incentives that she is truthful about her fit. Thus, boards might tolerate such investments even if they come at the expense of investments in firm-specific human capital (lower e_t).*

3.3.2 Outside Options and Experience

Up to now, outside options were assumed to stay fixed over time. However, one could imagine that, as managers stay longer with the firm, their reputation in the labor market improves and, as a result, their outside options increase. One of the main points of the present paper is that such increases do not necessarily make the manager more expensive to the firm. In fact, the exact opposite might be the case. If the manager is paid an efficiency wage above her outside option, increases in that outside option imply that it

²⁵ $p(T)$ is defined in the Appendix. Note, however, that a higher \bar{U} might lead the board to choose incentivize a different reporting policy.

becomes easier to keep the manager honest. Thus, one could expect that the board relies more often on truthful revelation and less often on performance measures to judge the manager's fit. Further relating to the implementation of the optimal contract, we have:

Implication 5 *Experience*: *If managers' outside options increase with their tenure: (i) The relation between managerial turnover and firm performance will weaken with the manager's tenure. (ii) The length of renewable contracts would increase with managers' tenure.*

Another implication of the analysis is that boards will avoid damaging departing CEOs' outside options, as this would necessitate higher severance pay. Indeed, there is evidence that severance pay is higher when firms replace CEOs with a reputation for firm mismanagement (Goldman and Huang, 2015).

Implication 6 *Reputation*: *(i) When replacing CEOs, boards will avoid damaging their reputation, as this will require offering higher severance pay. (ii) CEOs with a reputation for mismanagement are especially costly to fire.*

3.3.3 Persistence of Fit and Contract Horizon

One of the assumptions in the analysis so far was that if a manager is a good fit in a given period, she is more likely to be a good fit also in the following period. What would be different about a model with zero correlation (i.e., with $e_t(\theta_A) = e_t(\theta_C) = e_1$) is that there would be no benefit from retaining a manager with a good fit, as her likelihood of being a good fit also in the following period would be the same as that of a new manager. Thus, if the board seeks truthful revelation in all periods, it would hire managers for one period only. Hiring, say, for two periods would be suboptimal, as it would imply that the manager is compensated as if she would always stay with the firm in both periods (Proposition 2). The remaining insights are unchanged. In particular, hiring for more than one period might be optimal if the board abstains from offering incentives for truthful revelation in some periods, as then it might be possible to provide cheaper incentives for investment in firm specific human capital (Proposition 1). By contrast, a model with perfect correlation ($e_t(\theta_A) = 1$ and $e_C(\theta_C) = 0$) gives a stark implication: The board chooses the longest time to retirement T , stimulates truthful reporting in the first period and retains the manager until T if and only if she is a good fit. Finally, though the comparative statics regarding the effect of an increase in correlation are not analytically tractable, numerically a weaker correlation leads to more periods with performance evaluation. This is because it becomes less valuable to incentivize truthful reporting, when a good fit today does not guarantee

good fit tomorrow. Overall, the prediction when the manager’s fit is more likely to change over time is:

Implication 7 *Fit persistence:* *Contract horizon is likely to be shorter and turnover will be more strongly tied to performance if firms are in dynamically changing environments, such as firms in the hightech or biotech industries, or if firms are in the process of undergoing change, selling major assets, or seeking diversification.*

Implication 7 is consistent with the empirical evidence of Wagner and Peters (2014) that CEOs of companies experiencing more volatile industry conditions are more likely to be forced out, and further highlights that CEO compensation and the likelihood of forced turnover are jointly determined by industry characteristics.

4 Conclusion

The paper develops a model of contract horizon and turnover in which managers’ fit with the firm evolves over time, and managers are better informed about such changes. The board can minimize the likelihood that a manager who has become a bad fit stays with the firm, but this is not always in shareholders’ best interest, as it would require paying managers generous incentive and severance packages. Thus, the board will sometimes judge the manager’s fit based on the firm’s performance. Though inefficient from the board’s perspective, as it does not preempt bad performance and would lead to inefficient replacement and retention decisions, abstaining from offering incentives for truthful reporting and evaluating the manager’s fit only based on her performance could keep her compensation from growing too large.

The main predictions from the analysis are as follows. First, most of the time, boards will offer adequate severance agreements that lead to what might appear as voluntary turnover of managers with deteriorating fit. However, they will abstain from such incentives in regular intervals and will judge the manager’s fit based on the firm’s underperformance. The resulting optimal contract can be implemented with renewable fixed-term contracts, stipulating ex ante severance pay as a multiple of the manager’s wage, but allowing to costlessly replace the manager when her term expires—contracts which are widely used in practice (Gillan et al., 2009; Rau and Xu, 2013). Thus, seemingly voluntary turnover, accompanied with severance pay, is likely to be common, if not the more common, form of turnover, as boards will seek to preempt bad performance from occurring by having a manager with a good fit in charge. This suggests that selection might be of

concern in empirical studies of the effectiveness of CEO contracts, neglecting that both voluntary and forced turnover can be the result of a deteriorating fit.

Second, when managers' outside options are low, they will be offered less often incentives for truthful reporting, and the board will have to judge more often their fit based on the firm's cash flow performance. This is because in such cases managers will be especially reluctant to lose their job, making it more likely that they will be judged based on the firm's performance. One implication of this result is that managers will have less adequate incentives to reveal a bad fit in industry downturns, which would result in less voluntary and more performance-induced turnover. There is, indeed, evidence for this result, but it has hitherto been interpreted as a lack of relative performance evaluation (Jenter and Kanaan, 2015). Furthermore, the stronger reliance on performance-, rather than "voluntary" based turnover in downturns is more likely to leave firms with managers who are not a good fit, even if the board subsequently seems overly active to replace the manager in case of underperformance. This might exacerbate downturns. Another implication of a more frequent reliance on performance measures (at renewal dates) implies that renewable contracts will be of shorter length in downturns. The paper further derives predictions relating firms' growth prospects and size to the length of managers' contracts. Specifically, contract length will be longer and, thus, severance pay will be larger for larger firms and firms with better growth prospects.

Third, in some cases the board will not be able to commit not to renegotiate the manager's contract in times that the manager is not offered incentives for truthful reporting. In such cases, it is optimal to set upper tenure limits, which can be implemented by hiring older managers whose retirement age coincides with such limits. Such strategy helps to keep the manager's pay from growing too large, as younger manager would need to be offered larger severance packages. An important factor that affects tenure limits is again the manager's outside option, suggesting that boards would be more likely to hire older CEOs in industry downturns. Fourth, the paper outlines that there can be a trade-off between hiring a manager with a higher outside option and one who is likely to be a better fit. While such a trade-off would not exist in a world in which information is common knowledge, hiring a manager with a higher outside option could lower the incentive and severance pay firms need to offer to their managers. However, this insight—that a higher outside option helps to keep the manager honest—implies that firms might prefer hiring a manager with high outside options even if it is unlikely that she will be a better fit. The same idea could also shed some light on why boards might tolerate investments in general human capital even if they come at the expense of firm-specific human capital investments.

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Appendix

Lemma 2 *If it is not optimal to learn the manager's fit in period $t - 1$, it would also not be optimal to learn that fit in the beginning of the following period t .*

Proof of Lemma 2. Suppose that \mathbf{w} is an optimal contract that does not induce truthful reporting in period $t - 1$, but induces truthful reporting in the beginning of period t . Let $\tilde{w}_{s,t}$ be the severance pay paid to the manager in the beginning of period t for disclosing that her fit realization in $t - 1$ is θ_C . Truthful reporting at the beginning of period t after no truthful reporting in period $t - 1$ requires that

$$U_t(\theta_A, \mathbf{w}) \geq \sum_{j=t}^T \delta^{j-t} \bar{U}_j + \tilde{w}_{s,t} = U_t(\theta_C, \mathbf{w}). \quad (23)$$

Multiplying all sides of (23) with δ and adding $w_{t-1} + \theta_A \Delta w_{t-1}$ on both sides of the inequality, we obtain

$$\begin{aligned} & w_{t-1} + \theta_A \Delta w_{t-1} + \delta U_t(\theta_A, \mathbf{w}) \\ \geq & w_{t-1} + \theta_A \Delta w_{t-1} + \delta \left(\sum_{j=t}^T \delta^{j-t} \bar{U}_j + \tilde{w}_{s,t} \right) \\ = & w_{t-1} + \theta_C \Delta w_{t-1} + \delta \left(\sum_{j=t}^T \delta^{j-t} \bar{U}_j + \tilde{w}_{s,t} \right) + \Delta \theta \Delta w_{t-1} \\ \geq & \sum_{j=t-1}^T \delta^{j-t+1} \bar{U}_j + w_{s,t-1} + \tilde{w}_{t-1} + \Delta \theta \Delta w_{t-1} \end{aligned} \quad (24)$$

where the last inequality follows from the period $t - 1$ analogue of (11); where we use that $\widehat{U}_t(\theta_C, \mathbf{w}) = \sum_{j=t}^T \delta^{j-t} \bar{U}_j + \tilde{w}_{s,t}$; and where we define \tilde{w}_{t-1} as the difference between the left- and the right-hand-side of the period $t - 1$ analogue of (11).²⁶ Consider now the requirements for truth-telling in an equilibrium in which the manager reports truthfully already in period $t - 1$

$$w_{t-1} + \theta_A \Delta w_{t-1} + \delta U_t(\theta_A, \mathbf{w}) \geq w_{s,t-1} + \sum_{j=t-1}^T \delta^{j-t+1} \bar{U}_j \geq w_{t-1} + \theta_C \Delta w_{t-1} + \delta \widehat{U}_t(\theta_C, \mathbf{w}).$$

²⁶Note, that all subscripts are with respect to $t - 1$ rather than t as in (11).

From the first and the last line of (24), we see that a manager with fit θ_A would not have mimicked a manager with fit θ_C if she were asked to report that fit in period $t - 1$ (cf. (6)) given a severance pay offer of $\widehat{w}_{s,t-1} := w_{s,t-1} + \widetilde{\omega}_{t-1}$. Furthermore, from the third and the fourth line of (24), we obtain that a manager with fit θ_C would have been indifferent to disclosing her fit also in period $t - 1$ (cf. (7)) if she was compensated for doing so with $\widehat{w}_{s,t-1} = w_{s,t-1} + \widetilde{\omega}_{t-1}$. Thus, the manager's expected rent is the same regardless of whether she reports in period $t - 1$ or in the beginning of period t . However, learning the manager's fit in period $t - 1$ increases the board's payoff, contradicting that \mathbf{w} is optimal and proving the claim. **Q.E.D.**

Proof of Proposition 1. The main technical step in the proof is to determine which constraints shape the manager's compensation contract. In a period with truthful reporting, the manager's severance pay $w_{s,t}$ is determined by the binding incentive constraint (7). If there is truthful reporting also in the preceding period, Δw_t is determined from the effort constraint (8); otherwise, it is set high enough that it compensates the manager for not receiving a bonus in the preceding periods without truthful reporting; w_t is set to zero to minimize the cost of incentivizing effort. For periods without truthful reporting, the the binding constraints are the feasibility condition that $\Delta w_t \geq 0$ (i.e., bonuses are, indeed, deferred) together with the interim participation constraint (11), which pins down w_t (to zero, unless the manager is paid her outside option); severance is clearly suboptimal in such periods (i.e., $w_{s,t} = 0$). The technical details bring little further insights and are, thus, relegated to Lemma 5 in Appendix B.

It remains to argue that the board will always seek truthful reporting in period T . Observe, first, that if the board seeks truthful reporting in the final period, we have

$$\begin{aligned} \Delta w_t &= \max \left(\Delta w_{T-n}^{-1}(0), \frac{c}{e_T(\theta_C) \Delta \theta} \right) \\ w_{s,T} &= \max(0, \theta_C \Delta w_T - \bar{U}), \end{aligned}$$

where $\Delta w_{T-n}^{-1}(0) = 0$ if the commutative deferred bonus in case there is no truthful reporting in the preceding n periods. Instead, if the board seeks no truthful reporting in the final period, it can no longer delay payments, and it must offer a payment that satisfies (44)–(45), while also making it optimal to set $\Delta w_t = 0$ in the immediately preceding

periods without truthful reporting (in case there are such periods). Thus,

$$\begin{aligned}\Delta w_t &= \max \left(\Delta w_{T-n}^{-1}(0), \frac{c}{e_T(\theta_C) \Delta \theta} \right) \\ w_t &= \max(0, \bar{U} - \theta_C \Delta w_T).\end{aligned}$$

Plugging into the manager's payoff U_T , we obtain that this payoff is identical in both cases. Intuitively, this is because the manager's rent in the final period is defined by the need to offer incentives for investment in firm-specific human capital and that the board keeps her past promises. Thus, the board will seek truthful reporting in the final period. **Q.E.D.**

Proof of Proposition 2. We, first, introduce some notation and then argue to a contradiction.

Step 1. Notation. Let the likelihood that the manager retains her job depending on whether there is truthful reporting and depending on the manager's fit from the previous period be defined as

$$\mathbf{e}_t = \begin{cases} \begin{matrix} \text{if } t = 1 \\ \begin{pmatrix} e_1 & 0 \end{pmatrix} \end{matrix} & \begin{matrix} \text{if } 1 < t \leq T \\ \begin{pmatrix} e_t(\theta_A) & 0 \\ e_t(\theta_C) & 0 \end{pmatrix} \end{matrix} & \text{truthful reporting} \\ \begin{pmatrix} e_1 \theta_A & (1 - e_1) \theta_C \end{pmatrix} & \begin{pmatrix} e_t(\theta_A) \theta_A & (1 - e_t(\theta_A)) \theta_C \\ e_t(\theta_C) \theta_A & (1 - e_t(\theta_C)) \theta_C \end{pmatrix} & \text{otherwise} \end{cases}.$$

The vector/matrix representation will be useful to minimize notation. Analogously, let the probability of replacement in any given period be defined as

$$\mathbf{p}_t = \begin{cases} \begin{matrix} \text{if } t = 1 \\ 1 - e_1 \end{matrix} & \begin{matrix} \text{if } 1 < t \leq T \\ \begin{pmatrix} 1 - e_t(\theta_A) \\ 1 - e_t(\theta_C) \end{pmatrix} \end{matrix} & \text{truthful reporting} \\ \begin{matrix} e_1(1 - \theta_A) \\ + (1 - e_1)(1 - \theta_C) \end{matrix} & \begin{pmatrix} e_t(\theta_A)(1 - \theta_A) + (1 - e_t(\theta_A))(1 - \theta_C) \\ e_t(\theta_C)(1 - \theta_A) + (1 - e_t(\theta_C))(1 - \theta_C) \end{pmatrix} & \text{otherwise} \end{cases}.$$

We can define now the discounted likelihood of replacement (and, thus, of obtaining V^* from hiring a new manager) over the course of the entire potential employment relation as

$$p(T) := \delta \mathbf{p}_1 + \sum_{i=2}^{T-1} \delta^i \Pi_{k=1}^{i-1} \mathbf{e}_k \mathbf{p}_i + \delta^T \Pi_{k=1}^{T-1} \mathbf{e}_k \mathbf{1}, \quad (25)$$

which corresponds to $E \left[\sum_{i=1}^T \delta^{i-1} \tilde{q}_i \right] \delta$ in expression (5). Note that the replacement probability in the final period T is $\mathbf{1} = (1; 1)$. Similarly, we can define the expected amount that the outgoing manager would be paid by the outside labor market upon her dismissal as²⁷

$$h(\bar{U}, T) := \delta \mathbf{p}_1 \sum_{j=2}^T \delta^{j-2} \bar{U}_j + \sum_{i=2}^{T-1} \left(\delta^i \Pi_{k=1}^{i-1} \mathbf{e}_k \mathbf{p}_i \sum_{j=k+1}^T \delta^{j-k-1} \bar{U}_j \right),$$

which corresponds to $\sum_{i=1}^T \delta^{i-1} \bar{U} - E \left[\sum_{i=1}^T \delta^{i-1} q_i \bar{U} \right]$ in expression (5). Since \bar{U} is the same in all periods, we obtain

$$\begin{aligned} h(\bar{U}, T) & : = \frac{\bar{U}}{1-\delta} \left(\delta \mathbf{p}_1 (1 - \delta^{T-1}) + \sum_{i=2}^{T-1} \delta^i \Pi_{k=1}^{i-1} \mathbf{e}_k \mathbf{p}_i (1 - \delta^{T-i}) \right) \\ & = \frac{\bar{U}}{1-\delta} \left(-\mathbf{p}_1 \delta^T + \delta \mathbf{p}_1 + \underbrace{\sum_{i=2}^{T-1} \delta^i \Pi_{k=1}^{i-1} \mathbf{e}_k \mathbf{p}_i}_{p(T) - \delta^T \Pi_{k=1}^{T-1} \mathbf{e}_k \mathbf{1}} - \delta^T \sum_{i=2}^{T-1} \Pi_{k=1}^{j-1} \mathbf{e}_k \mathbf{p}_i \right) \\ & = \frac{\bar{U}}{1-\delta} (-\mathbf{p}_1 \delta^T + p(T) - \delta^T \Pi_{k=1}^{T-1} \mathbf{e}_k \mathbf{1} - \delta^T (\mathbf{e}_1 - \Pi_{k=1}^{T-1} \mathbf{e}_k) \mathbf{1}) \\ & = \frac{\bar{U}}{1-\delta} (-\delta^T + p(T)). \end{aligned} \tag{26}$$

Denoting further $s_1(T) = E \left[\sum_{i=1}^T \delta^{i-1} q_i (x_i - c) \right]$ and expressing $U_1(\mathbf{w})$ as $\nu_1(\mathbf{w}, T) + \sum_{j=1}^T \delta^{j-1} \bar{U}_j$ using (9), the board's equilibrium expected payoff in period one (5) can be stated as

$$V^* = -\nu_1(\mathbf{w}, T) - \sum_{j=1}^T \delta^{j-1} \bar{U}_j + s_1(T) + h(\bar{U}, T) + p(T) V^*, \tag{27}$$

The functional dependence on T makes explicit that the maximal tenure length is T . Using (26), we can simplify (27) to

$$V^*(T) = \frac{s_1(T) - \nu_1(\mathbf{w}, T)}{1 - p(T)} - \frac{\bar{U}}{1 - \delta}. \tag{28}$$

Step 2. *Optimality of Upper Tenure Limits and/or Abstaining from Incentives for Truthful Reporting.* We argue to a contradiction. Suppose that the board incentivizes

²⁷To be precise, in case the manager reveals that she is a bad fit, she receives \bar{U} from the outside labour market in the period in which she is fired, but the firm hires a new manager for \bar{U} for the remainder of the period, and the two terms cancel out in board's expected payoff.

truthful reporting in all period. We have

$$\begin{aligned}
s_1(T) & : = x + (\bar{\theta} + e_1 (\theta_A - \bar{\theta})) \Delta x - c \\
& + \left(\delta e_1 + \sum_{j=2}^{T-1} \delta^j e_1 \Pi_{i=2}^j e_i (\theta_A) \right) (x + (\bar{\theta} + e (\theta_A) (\theta_A - \bar{\theta})) \Delta x - c) \\
& = x + (\bar{\theta} + e_1 (\theta_A - \bar{\theta})) \Delta x - c \\
& + \left(\delta e_1 \frac{(1 - e (\theta_A)^{T-1} \delta^{T-1})}{1 - e (\theta_A) \delta} \right) (x + (\bar{\theta} + e (\theta_A) (\theta_A - \bar{\theta})) \Delta x - c). \quad (29)
\end{aligned}$$

where, given the Markov structure, it is without loss to omit the subscripts of $e(\theta_A)$. Furthermore

$$\begin{aligned}
1 - p(T) & = 1 - \left(\delta (1 - e_1) + \sum_{j=2}^{T-1} \delta^j e_1 e (\theta_A)^{j-2} (1 - e (\theta_A)) + \delta^T e_1 e (\theta_A)^{T-2} \right) \\
& = (1 - \delta) \left(1 + \frac{\delta e_1 (1 - e (\theta_A)^{T-1} \delta^{T-1})}{1 - e (\theta_A) \delta} \right) \quad (30)
\end{aligned}$$

Plugging in for $s_1(T)$, $p(T)$, as well as for $h(T)$ from (26) and $v_1(T)$ from (21), (28) becomes

$$\begin{aligned}
V^* & = \frac{\left(x + (\bar{\theta} + e_1 (\theta_A - \bar{\theta})) \Delta x - c + \left(\delta e_1 \frac{(1 - e (\theta_A)^{T-1} \delta^{T-1})}{1 - e (\theta_A) \delta} \right) (x + (\bar{\theta} + e (\theta_A) (\theta_A - \bar{\theta})) \Delta x - c) \right. \\
& \quad \left. - \left(\frac{\theta_{CC}}{e_1 \Delta \theta} - \bar{U} + \frac{\delta (1 - \delta^T)}{1 - \delta} \left(\frac{\theta_C}{\Delta \theta} \left(\frac{1 - \Delta e_t}{e_t (\theta_C)} \right) c - \bar{U} \right) \right) \right)}{(1 - \delta) \left(1 + \frac{\delta e_1 (1 - e (\theta_A)^{T-1} \delta^{T-1})}{1 - e (\theta_A) \delta} \right)} \\
& \quad - \frac{\bar{U}}{1 - \delta}.
\end{aligned}$$

It is now sufficient to show that increasing tenure $T \rightarrow \infty$, can make the board's expected payoff V^* negative. This is the case if

$$\left(\frac{\theta_C}{\Delta \theta} \left(\frac{1 - \Delta e_t}{e_t (\theta_C)} \right) c - \bar{U} \right) > \frac{1 - \delta}{\delta} \left(\frac{(x + (\bar{\theta} + e_1 (\theta_A - \bar{\theta})) \Delta x - c) - \frac{\theta_{CC}}{e_1 \Delta \theta}}{+ \frac{\delta e_1}{1 - e (\theta_A) \delta} (x + (\bar{\theta} + e (\theta_A) (\theta_A - \bar{\theta})) \Delta x - c - \bar{U})} \right) \quad (31)$$

The key observation now is that the RHS of (31) decreases towards zero as δ increases towards one. This reflects that the manager's rent increases linearly in T (but for discounting) even though the likelihood that the manager stays one period longer (and, thus, that the board enjoys the benefit of offering longer employment) is only $e(\theta_A)$. By con-

trast, the LHS of (31) is independent of δ and positive if (22) is not satisfied. Thus, for any parameter constellation, there is a threshold $\widehat{\delta}$ such that for $\delta > \widehat{\delta}$, this condition is satisfied. Hence, in these cases the board will always deviate from a policy of pursuing truthful reporting in all periods without a maximum tenure limit. **Q.E.D.**

Proof of Lemma 1. Consider an equilibrium candidate featuring n periods with truthful reporting. Let $V_n^*(T)$ and $V_{n+k}^*(T)$ be of equal maximal tenure T with V_{n+k}^* featuring k more period of truthful reporting. In what follows, it is sufficient to argue that

$$\frac{\partial}{\partial \bar{U}} (V_{n+k}^*(T) - V_n^*(T)) > 0 \quad (32)$$

$$\frac{\partial}{\partial \Delta x} (V_{n+k}^*(T) - V_n^*(T)) > 0. \quad (33)$$

The increasing differences will imply that the $V_{n+k}^*(T)$ offer becomes increasingly more attractive for the board as \bar{U} and Δx increase. Plugging in from (28), (32) and (33) can be rewritten as

$$\begin{aligned} \frac{\partial}{\partial \bar{U}} (V_{n+k}^*(T) - V_n^*(T)) &= \frac{\partial}{\partial \bar{U}} \left(\frac{-v_1(\mathbf{w}_{n+k}, T)}{1 - p_{n+k}(T)} - \frac{-v_1(\mathbf{w}_n, T)}{1 - p_n(T)} \right) \\ \frac{\partial}{\partial \Delta x} (V_{n+k}^*(T) - V_n^*(T)) &= \frac{\partial}{\partial \Delta x} \left(\frac{s_{1,n+k}(T)}{1 - p_{n+k}(T)} - \frac{s_{1,n}(T)}{1 - p_n(T)} \right) \end{aligned}$$

proving the claim. **Q.E.D.**

Proof of Proposition 3. (i) Consider a shock that only increases the manager's outside option in period one. Clearly, the board's preference for truthful reporting when hiring a new manager after this period is unchanged by this shock. Let the board's expected payoff when hiring a new manager after period one be V^* . For period one, the board's payoff is

$$V = s_1(T) + p(T)V^* + h(\bar{U}, T) - U_1(\mathbf{w}, T).$$

Since the manager's outside option in period one, \bar{U}_1 , does not enter $h(\bar{U}, T)$, it only affects $U_1(\mathbf{w}, T)$ in this expression. From (20) and (38), this payoff depends on \bar{U}_1 only if the manager extracts no rent in period one (i.e., if $w_{s,1} = 0$ in case of truthful reporting, and $w_1 > 0$ in case of no truthful reporting). In this case, a unit increase in \bar{U}_1 leads to a unit increase in $U_1(\mathbf{w}, T)$ regardless of whether there is truthful reporting in that period. If the manager extracts no rent, there is no effect.

In (39), we have shown that the manager's rent is lower if she is not incentivized to

report truthfully. Thus, there is a range of parameters for which the manager extracts rent when offered incentives for truthful reporting, but not without such incentives, in period one. For this range, an increase in \bar{U}_1 makes offering incentives for truthful reporting in period one more attractive (otherwise, there is no effect).

(ii) Suppose that the manager lives for at most two periods and because the first-best condition (22) is not satisfied. If employing a manager for one period only, the board always seeks truthful reporting by Proposition 1. Thus, the proposition is based on the case with $T = 2$. We start by deriving the separate components of (28) and then plug into (32) and (33).

In the final period, the board always seeks truthful reporting by Proposition 1, implying that

$$\begin{aligned} U_2(\theta_1, \mathbf{w}_2) &= e_2(\theta_1)(w_2 + \theta_A \Delta w_2) + (1 - e_2(\theta_1))(w_{s,2} + \bar{U}) - c \\ &= (\theta_C + e_2(\theta_1) \Delta \theta) \Delta w_2 - c. \end{aligned}$$

where we use that $w_{s,2} = \theta_C \Delta w_2 - \bar{U}$ and $w_2 = 0$. If the board does not seek truthful reporting in the first period, the manager's bonus in the second period must be such that her bonus in period one can be set to zero. Thus, Δw_2 must be such that

$$\begin{aligned} 0 = \Delta w_1 &= \frac{c}{e_1 \Delta \theta} + \delta \frac{U_{t+1}^e(\theta_C, \mathbf{w}) - U_{t+1}^e(\theta_A, \mathbf{w})}{\Delta \theta} \\ &= \frac{c}{e_1 \Delta \theta} + \delta \frac{\theta_C((\theta_C + e_2(\theta_C) \Delta \theta) \Delta w_2 - c) + (1 - \theta_C) \bar{U} - \theta_A((\theta_C + e_2(\theta_A) \Delta \theta) \Delta w_2 - c) - (1 - \theta_A) \bar{U}}{\Delta \theta}, \end{aligned}$$

implying that $\Delta w_2 = \max\left(\frac{\frac{c}{e_1 \Delta \theta} + c + \bar{U}}{\delta(\theta_A e_2(\theta_A) + \theta_C(1 - e_2(\theta_C)))}, \frac{c}{e_2(\theta_C) \Delta \theta}\right)$. If the second term is larger, $U_1(\mathbf{w}^{nr})$ is independent of \bar{U} . If the first term is larger, we have

$$\begin{aligned} \nu_1(\mathbf{w}^{nr}, 2) &= \delta E_{\theta_0} [U_2^e(\theta_t, \mathbf{w})] - c - \bar{U}(1 + \delta) \\ &= \delta \left(\theta_C \left((e_C \theta_A + (1 - e_C) \theta_C) \frac{\left(\frac{c}{e_1 \Delta \theta} + c + \bar{U}\right)}{\delta(\theta_A e_A + (1 - e_C) \theta_C)} - c \right) + (1 - \theta_C) \bar{U} \right) - \bar{U}(1 + \delta) \\ &= \theta_C \left(\frac{(e_C \theta_A + (1 - e_C) \theta_C)}{\delta(\theta_A e_A + (1 - e_C) \theta_C)} \left(\frac{1}{e_1 \Delta \theta} + 1 \right) - \delta \right) c \\ &\quad + \left(\frac{\theta_C (e_C \theta_A + (1 - e_C) \theta_C)}{\delta(\theta_A e_A + (1 - e_C) \theta_C)} - 1 - \delta \theta_C \right) \bar{U}. \end{aligned}$$

If the board does not seek truthful reporting in the first period, then by (21) the manager's rent is simply

$$\nu_1(\mathbf{w}^r, 2) = \frac{\theta_C}{\Delta\theta} \left(\frac{1}{e_1} + \delta \left(\frac{1 - \Delta e_j}{e_C} \right) \right) c - \bar{U} (1 + \delta).$$

By plugging $\nu_1(\mathbf{w}^r, 2)$ and $\nu_1(\mathbf{w}^{nr}, 2)$ into (32), we obtain that

$$\begin{aligned} & \frac{\partial}{\partial \bar{U}} \left(\frac{-\nu_1(\mathbf{w}^r, 2)}{1 - p^r(2)} - \frac{-\nu_1(\mathbf{w}^{nr}, 2)}{1 - p^{nr}(2)} \right) \\ &= \frac{1 + \delta}{1 - \delta(1 - e_1) - \delta^2 e_1} - \frac{-\delta \left(\frac{\theta_C(e_C \theta_A + (1 - e_C)\theta_C)}{\delta(\theta_A e_A + (1 - e_C)\theta_C)} + (1 - \theta_C) \right) + (1 + \delta)}{1 - \delta(1 - e_1 \theta_A - (1 - e_1)\theta_C) - \delta^2(e_1 \theta_A + (1 - e_1)\theta_C)} \\ &= \frac{(1 + \delta)\delta(E\theta - e_1) + \left(\theta_C \frac{(e_C \theta_A + (1 - e_C)\theta_C)}{(\theta_A e_A + (1 - e_C)\theta_C)} + \delta(1 - \theta_C) \right) (1 + \delta e_1)}{(1 - \delta)(1 + \delta e_1)(1 + \delta E\theta)} \\ &> \delta \frac{(1 + \delta)(E\theta - e_1) + (1 - \theta_C)(1 + \delta e_1)}{(1 - \delta)(1 + \delta e_1)(1 + \delta E\theta)} \end{aligned}$$

where $E\theta := e_1 \theta_A + (1 - e_1) \theta_C$. After some transformations, the last expression becomes

$$\frac{\delta(\theta_C + \theta_A e_1 - 2\theta_C e_1) + (\theta_A - \theta_C)e_1 + 1 - e_1}{(1 - \delta)(1 + \delta e_1)(1 + \delta E\theta)} > 0.$$

Hence, (32) is positive, proving the claim.

Approaching (33) similarly, we have

$$\begin{aligned} & \frac{s_1^r(2)}{1 - p^r(2)} - \frac{s_1^{nr}(2)}{1 - p^{nr}(2)} \\ &= \frac{x + (e_1 \theta_A + (1 - e_1)\bar{\theta}) \Delta x - c + \delta e_1 (x + (e_A \theta_A + (1 - e_A)\bar{\theta}) \Delta x - c)}{(1 - \delta)(1 + \delta e_1)} \\ & \quad - \frac{x + (e_1 \theta_A + (1 - e_1)\theta_C) \Delta x - c + \delta \left(\begin{array}{l} e_1 \theta_A (x + (e_A \theta_A + (1 - e_A)\bar{\theta}) \Delta x - c) \\ + (1 - e_1)\theta_C (x + (e_C \theta_A + (1 - e_C)\bar{\theta}) \Delta x - c) \end{array} \right)}{(1 - \delta)(1 + \delta E\theta)} \end{aligned}$$

which after some transformations becomes

$$\frac{\Delta x}{(1 - \delta)(1 + e_1 \delta)(1 + \delta E\theta)} \left(\begin{array}{l} \delta(\theta_A - \bar{\theta})((e_A - e_1)(e_1 - E\theta) + \theta_C \Delta e(1 - e_1)(1 + \delta e_1)) \\ + (\bar{\theta} - \theta_C)(1 - e_1)(1 + \delta e_1) \end{array} \right)$$

which is strictly positive even if $e_1 < E\theta$, as then

$$\begin{aligned}
& (e_A - e_1)(e_1 - E\theta) + \theta_C \Delta e (1 - e_1)(1 + \delta e_1) \\
& > \Delta e (\theta_C (1 - e_1)(1 + \delta e_1) - (E\theta - e_1)) \\
& > \Delta e (\theta_C (1 - e_1) + e_1 - e_1 \theta_A - (1 - e_1) \theta_C) = \Delta e (e_1 - e_1 \theta_A) > 0
\end{aligned}$$

Hence, expression (33) is positive, proving also the second statement. **Q.E.D.**

Proof of Proposition 4. First, we argue that

$$\frac{\partial}{\partial \bar{U}} (V^*(T') - V^*(T)) = \frac{\frac{\partial}{\partial \bar{U}} h(T')(1 - p(T)) - \frac{\partial}{\partial \bar{U}} h(T)(1 - p(T'))}{(1 - p(T))(1 - p(T'))} > 0 \quad (34)$$

where $T' = T + 1$. To obtain the equality in (34), we use that when condition (22) does not hold, the manager's expected payoff $U_1(\mathbf{w}, T)$ is independent of \bar{U} (cf. (20)). The increasing difference in (34) will imply that the T' offer becomes increasingly more attractive as \bar{U} increases.

Recalling from (26) that $h(T) = \frac{\bar{U}}{1-\delta} (-\delta^T + p(T)) = \frac{\bar{U}}{1-\delta} (1 - \delta^T + p(T) - 1)$ and plugging in from (30), we can express the numerator in the LHS of (34) as

$$\begin{aligned}
& \frac{1}{1-\delta} ((1 - \delta^{T+1} + p(T') - 1)(1 - p(T)) - (1 - \delta^T + p(T) - 1)(1 - p(T'))) \\
& = \frac{1}{1-\delta} ((1 - \delta^{T+1})(1 - p(T)) - (1 - \delta^T)(1 - p(T'))) \\
& = (1 - \delta^{T+1}) \left(1 + \frac{\delta e_1 (1 - (\delta e_A)^{T-1})}{1 - \delta e_A} \right) - (1 - \delta^T) \left(1 + \frac{\delta e_1 (1 - (\delta e_A)^T)}{1 - \delta e_A} \right)
\end{aligned}$$

which after some transformations becomes

$$\begin{aligned}
& \frac{\delta^T}{1 - \delta e_A} \left((1 - \delta)(1 - \delta e_A) + e_1 \left(\delta(1 - \delta) + (e_A)^{T-1} (\delta^{T+1}(1 - e_A) - (1 - \delta e_A)) \right) \right) \\
& \geq 0.
\end{aligned}$$

To see the last inequality, observe that expression (35) is positive if the term in brackets following e_1 is positive. If it is negative, expression (35) would decrease in e_1 , so it would

obtain its minimum value for $e_1 = e_A$

$$\delta^T \left(\frac{\left(1 - \delta + (e_A)^T \delta^{T+1} (1 - e_A)\right)}{1 - \delta e_A} - (e_A)^T \right).$$

The sign of this expression is the same as the sign of the term in brackets. The minimum of that term is zero, which is obtained for $\delta = 1$.²⁸ Hence, for any T , $\delta \in [0, 1]$, $e_A \in [0, 1]$, $e_1 \in [0, e_A]$, (35) is (weakly) positive, and it is strictly positive for $e_A < 1$ and $\delta < 1$, implying that we have strictly increasing differences in (34).

Next, we argue that

$$\frac{\partial}{\partial \Delta x} (V^*(T') - V^*(T)) = \frac{\frac{\partial}{\partial \Delta x} s_1(T') (1 - p(T)) - \frac{\partial}{\partial \Delta x} s_1(T) (1 - p(T'))}{(1 - p(T)) (1 - p(T'))} > 0. \quad (36)$$

Observe first that from (29), we have

$$\frac{\partial}{\partial \Delta x} s_1(T) = (\bar{\theta} + e_1(\theta_A - \bar{\theta})) + \delta e_1 \frac{\left(1 - e(\theta_A)^{T-1} \delta^{T-1}\right)}{1 - e(\theta_A) \delta} (\bar{\theta} + e(\theta_A)(\theta_A - \bar{\theta})).$$

Plugging in for $p(T)$, (36) becomes

$$\begin{aligned} & \left((\bar{\theta} + e_1(\theta_A - \bar{\theta})) + \delta e_1 \frac{\left(1 - e_A^T \delta^T\right)}{1 - e_A \delta} (\bar{\theta} + e_A(\theta_A - \bar{\theta})) \right) (1 - \delta) \left(1 + \frac{\delta e_1 \left(1 - e_A^{T-1} \delta^{T-1}\right)}{1 - e_A \delta} \right) \\ & - \left((\bar{\theta} + e_1(\theta_A - \bar{\theta})) + \delta e_1 \frac{\left(1 - e_A^{T-1} \delta^{T-1}\right)}{1 - e_A \delta} (\bar{\theta} + e_A(\theta_A - \bar{\theta})) \right) (1 - \delta) \left(1 + \frac{\delta e_1 \left(1 - e_A^T \delta^T\right)}{1 - e_A \delta} \right) \\ & = \delta^T e_1 (e_A - e_1) e^{T-1} (1 - \delta) (\theta_A - \bar{\theta}) > 0 \end{aligned}$$

proving the claim. **Q.E.D.**

Proof of Proposition 5. Recall from Lemma 1 that we can express

$$V^*(T) = \frac{s_1(T) + \frac{\bar{U}}{1-\delta} (p(T) - \delta^T) - U_1(T)}{1 - p(T)}.$$

²⁸We have

$$\frac{\partial}{\partial \delta} \left(\frac{\left(1 - \delta + (\delta e_A)^T \delta (1 - e_A)\right)}{1 - \delta e_A} - (e_A)^T \right) = (1 - e_A) \frac{T (\delta e_A)^T (1 - \delta e_A) + (\delta e_A)^T - 1}{(1 - \delta e_A)^2}$$

This term is nonpositive, as the maximum value (of zero) of the numerator is obtained for $\delta e_A = 1$.

Hence, $\frac{\partial}{\partial \bar{U}} V^*(T) > 0$ as long as $(p(T) - \delta^T) > (1 - \delta) \frac{\partial}{\partial \bar{U}} U_1(T)$. **Q.E.D.**

Omitted Derivations in Main Text

Lemma 3 *A sufficient condition for (2) to hold is*

$$\begin{aligned} & \frac{e_C \theta_A}{e_C \theta_A + (1 - e_C) \theta_C} e_A + \frac{(1 - e_C) \theta_C}{e_C \theta_A + (1 - e_C) \theta_C} e_C \\ > e_1 > \frac{e_A (1 - \theta_A)}{e_A (1 - \theta_A) + (1 - e_A) (1 - \theta_C)} e_A + \frac{(1 - e_A) (1 - \theta_C)}{e_A (1 - \theta_A) + (1 - e_A) (1 - \theta_C)} e_C. \end{aligned} \quad (37)$$

Proof of Lemma 3 The second inequality in (2) is most difficult to satisfy if underperformance in period t should (ex post) make it optimal to replace a manager even if her fit in $t - 1$ was θ_A . The first inequality is most difficult to satisfy if it should be ex post optimal to keep the manager after realizing the high cash flow in t even if her fit in $t - 1$ was θ_C . These conditions are captured by (37). Intuitively, they require that the board is willing to change her belief about the manager completely based on the firm's cash flows in period t . Note that for this sufficient condition to hold, the correlation between t and $t - 1$ (which is captured by $\Delta e = e_A - e_C$) cannot be too large. **Q.E.D.**

Calculating the Board's Expected Payoff in Example 1 In equilibrium, the board's expected payoff is V^* . Hence, we can rewrite (5) as

$$V^* = \frac{\sum_{i=1}^2 \delta^{i-1} \bar{U} - U_1(\mathbf{w}) + E \left[\sum_{i=1}^2 \delta^{i-1} q_i (x_i - c - \bar{U}) \right]}{1 - E \left[\sum_{i=1}^2 \delta^{i-1} \tilde{q}_i \right] \delta}.$$

If the board seeks truthful reporting in both periods, this expression becomes

$$V^* = \frac{-U_1(\mathbf{w}) + \left(\begin{array}{c} x + (\bar{\theta} + e_1 (\theta_A - \bar{\theta})) \Delta x - c \\ + \delta e_1 (x + (\bar{\theta} + e_2 (\theta_A) (\theta_A - \bar{\theta})) \Delta x - c) \end{array} \right) + \delta (1 - e_1) \bar{U}}{1 - \delta (1 - e_1) - \delta^2 e_1},$$

If instead, the board seeks truthful reporting only in the second period, we have

$$V^* = \frac{-U_1(\mathbf{w}) + \left(\begin{array}{c} (x + (\theta_C + e_1 (\theta_A - \theta_C)) \Delta x - c) \\ + \delta e_1 \theta_A (x + (\bar{\theta} + e_2 (\theta_A) (\theta_A - \bar{\theta})) \Delta x - c) \\ + \delta (1 - e_1) \theta_C (x + (\bar{\theta} + e_2 (\theta_C) (\theta_A - \bar{\theta})) \Delta x - c) \end{array} \right) + \delta \left(\begin{array}{c} e_1 (1 - \theta_A) \\ + (1 - e_1) (1 - \theta_C) \end{array} \right) \bar{U}}{1 - (\delta (e_1 (1 - \theta_A) + (1 - e_1) (1 - \theta_C)) + \delta^2 (e_1 \theta_A + (1 - e_1) \theta_C))}.$$

By plugging in for $\{x, \Delta x\}$, \bar{U} , and $U_1(\mathbf{w})$, we obtain the values in Table 1.

Lemma 4 *Suppose that the board pursues truthful reporting in all periods. Introducing a period without truthful reporting in period $t < T$, reduces the manager's rent.*

Proof of Lemma 4. Suppose that, following truthful reporting in $t - 1$, the board abstains from offering such incentives in period t , but otherwise follows the same policy as in the previous section.²⁹ Plugging in from Proposition 1, the manager's expected payoff in period t can be stated as

$$\begin{aligned}
U_t(\theta_{t-1}, \mathbf{w}^{nr}) &= w_t^{nr} + (\theta_C + e_t(\theta_{t-1}) \Delta\theta) \left(\frac{c}{e_t(\theta_C) \Delta\theta} + \delta \frac{U_{t+1}^e(\theta_C, \mathbf{w}) - U_{t+1}^e(\theta_A, \mathbf{w})}{\Delta\theta} \right) \\
&\quad + \delta e(\theta_{t-1}) U_{t+1}^e(\theta_A, \mathbf{w}^{nr}) + \delta (1 - e(\theta_{t-1})) U_{t+1}^e(\theta_C, \mathbf{w}^{nr}) - c \\
&= \frac{\theta_A \delta (U_{t+1}^e(\theta_C, \mathbf{w}^{nr}) - \theta_C U_{t+1}^e(\theta_A, \mathbf{w}^{nr}))}{\Delta\theta} + \left(\frac{\frac{\theta_C}{\Delta\theta} + e_t(\theta_{t-1})}{e_t(\theta_C)} - 1 \right) c \\
&= \delta \frac{\theta_A \theta_C (U_{t+1}(\theta_C, \mathbf{w}^{nr}) - U_{t+1}(\theta_A, \mathbf{w}^{nr}))}{\Delta\theta} + \sum_{j=t+1}^T \delta^{j-t} \bar{U}_j \\
&\quad + \left(\frac{\frac{\theta_C}{\Delta\theta} + e_t(\theta_{t-1})}{e_t(\theta_C)} - 1 \right) c. \tag{38}
\end{aligned}$$

where the superscript nr highlights that there is no truthful reporting in period t . Subtracting (38) from (20), we obtain

$$\begin{aligned}
&\delta \frac{\theta_A U_{t+1}(\theta_C, \mathbf{w}^r) - \theta_C U_{t+1}(\theta_A, \mathbf{w}^r)}{\Delta\theta} \\
&\quad - \left(\delta \frac{\theta_A \theta_C (U_{t+1}(\theta_C, \mathbf{w}^{nr}) - U_{t+1}(\theta_A, \mathbf{w}^{nr}))}{\Delta\theta} + \sum_{j=t+1}^T \delta^{j-t} \bar{U}_j \right) \\
&= \delta \left(\frac{\theta_A \nu_{t+1}(\theta_C, \mathbf{w}^r) - \theta_C \nu_{t+1}(\theta_A, \mathbf{w}^r)}{\Delta\theta} - \frac{\theta_A \theta_C (\nu_{t+1}(\theta_C, \mathbf{w}^{nr}) - \nu_{t+1}(\theta_A, \mathbf{w}^{nr}))}{\Delta\theta} \right) \\
&\geq \frac{\delta}{\Delta\theta} (\theta_A (1 - \theta_C) \nu_{t+1}(\theta_C, \mathbf{w}^r) - \theta_C (1 - \theta_A) \nu_{t+1}(\theta_A, \mathbf{w}^r)) \\
&> \frac{\delta}{\Delta\theta} (1 - \theta_C) (\theta_A \nu_{t+1}(\theta_C, \mathbf{w}^r) - \theta_C \nu_{t+1}(\theta_A, \mathbf{w}^r)) > 0 \tag{39}
\end{aligned}$$

where the first inequality follows from the fact that when there is truthful reporting in t , \mathbf{w}^{nr} minimizes $\nu_{t+1}^{nr}(\theta_C, \mathbf{w}) - \nu_{t+1}^{nr}(\theta_A, \mathbf{w})$ (in expression 38), and the last inequality follows from the assumption that (22) is not satisfied. **Q.E.D.**

²⁹We look at the case in which $w_t = 0$. If $w_t > 0$, the manager's rent is zero, and the result is immediate.

Appendix B: Proof of Lemma 5

For the proofs below, it will be useful to reformulate the constraints given by (6)–(11).

(i) Condition (8) that the manager invests in firm-specific human capital can be restated as

$$\Delta w_t \geq \frac{\frac{c}{e_t(\theta_{t-1})} - w_t - \delta U_{t+1}(\theta_A, \mathbf{w}) + w_{s,t} + \sum_{j=t}^T \delta^{j-t} \bar{U}_j}{\theta_A} \quad (40)$$

From (6) and (7) and the feasibility constraint that $\Delta w \geq 0$, we have

$$\begin{aligned} & \frac{w_{s,t} - w_t + \sum_{j=t}^T \delta^{j-t} \bar{U}_j - \delta \hat{U}_{t+1}(\theta_C, \mathbf{w})}{\theta_C} \\ & \geq \Delta w_t \geq \max \left(0, \frac{w_{s,t} - w_t + \sum_{j=t}^T \delta^{j-t} \bar{U}_j - \delta U_{t+1}(\theta_A, \mathbf{w})}{\theta_A} \right) \end{aligned} \quad (41)$$

implying that if (40) is satisfied, then so is (6). Hence, it is possible to find a Δw_t that satisfies the above constraints if

$$\begin{aligned} & \frac{w_{s,t} - w_t + \sum_{j=t}^T \delta^{j-t} \bar{U}_j - \delta \hat{U}_{t+1}(\theta_C, \mathbf{w})}{\theta_C} \\ & \geq \Delta w_t \geq \max \left(0, \frac{\frac{c}{e_t(\theta_{t-1})} + w_{s,t} - w_t - \delta U_{t+1}(\theta_A, \mathbf{w}) + \sum_{j=t}^T \delta^{j-t} \bar{U}_j}{\theta_A} \right). \end{aligned} \quad (42)$$

The first inequality together with the feasibility constraint on $w_{s,t}$ can be stated as

$$w_{s,t} \geq \max \left(0, w_t - \sum_{j=t}^T \delta^{j-t} \bar{U}_j + \theta_C \Delta w_t + \delta \hat{U}_{t+1}(\theta_C, \mathbf{w}) \right). \quad (43)$$

Thus, to incentivize truthful reporting, the board needs to offer the manager a bonus (42) and a severance pay (43). The claim that $\psi^2(\theta_A, x_t) = \textit{keep}$ follows from the arguments in the main text.

(ii) From (10), (11), and feasibility, we have:

$$\Delta w_t \geq \max \left(0, \frac{\frac{c}{e_t(\theta_{t-1})} + \delta U_{t+1}^e(\theta_C, \mathbf{w}) - \delta U_{t+1}^e(\theta_A, \mathbf{w})}{\Delta \theta} \right) \quad (44)$$

$$w_t \geq \left(0, \sum_{j=t}^T \delta^{j-t} \bar{U}_j + w_{s,t} - \delta U_{t+1}^e(\theta_C, \mathbf{w}) - \theta_C \Delta w_t \right). \quad (45)$$

In what follows, we take the board's truthful reporting policy as given and derive the

structure of the compensation contract that minimizes $U_1(\mathbf{w})$, while satisfying conditions (42)–(45). The proof initially assumes that the board seeks to minimize the manager’s expected payoff U_t in any given period t for any given reporting strategy the board seeks to implement. At the end of the proof, it is shown that minimizing U_t helps to minimize U_{t-1} and, thus, preceding recursively, one minimizes the manager’s expected payoff all the way to period one. This achieves the objective of maximizing the board’s expected payoff in (5) for the chosen reporting policy. The proof boils down to showing the following claim:

Lemma 5 (i) *If the board seeks truthful reporting in period t , condition (43) is binding. Condition (42) is also being if the board seeks truthful reporting in the preceding period.*
(ii) *Conditions (44)–(45) are binding in a period without truthful reporting.*

We consider four main cases depending on whether there is truthful reporting in period t , and $t + 1$. For these proofs, it is assumed that there is truthful reporting in period $t - 1$, but towards the end we show that the cases in which there is no truthful reporting in period $t - 1$ lead to the same results.

Truthful Reporting in periods t . We show the claim by induction by arguing first that it is always satisfied in period 1. We argue to a contradiction. Suppose that the claim is not true and that the board seeks to implement truthful reporting in period 1. Recall that $e_1(\theta_A) = e_1(\theta_C) = e_1$ in period $t = 1$. Setting $\{w_1, \Delta w_1, w_{s,1}\}$ to their minimal values maximizes the board’s expected payoff, as it minimizes the manager’s payoff, without affecting her incentives in the following periods. Thus, in period one (42), (43), and $w_1 \geq 0$ are satisfied with equality.

We now argue that if the claim is satisfied for all periods up to period t , then it must also be satisfied in period $t + 1$. Recall that for any given reporting policy, the board seeks to minimize the manager’s payoff U_{t+1} , U_t , etc. The problem with minimizing $\{w_{t+1}, \Delta w_{t+1}, w_{s,t+1}\}$ by satisfying (42) and (43) in period $t + 1$ with equality (as dictated by Proposition 1) is that we need to take into account how these contract terms affect the manager’s payoff (over her continuation payoffs) also in the preceding periods.

Case 1: Truthful reporting in periods t and $t + 1$. The manager’s expected payoff in period t is

$$U_t(\theta_{t-1}, \mathbf{w}) = e_t(\theta_{t-1}) (w_t + \theta_A \Delta w_t + \delta U_{t+1}(\theta_A, \mathbf{w})) + (1 - e(\theta_{t-1})) \left(w_{s,t} + \sum_{j=t}^T \delta^{j-t} \bar{U}_j \right) - c.$$

Using the induction hypothesis (12)–(14) to plug into w_t , Δw_t , and $w_{s,t}$, this payoff becomes

$$e_t(\theta_{t-1}) \left(w_t + \frac{\theta_{AC}}{e_t(\theta_C) \Delta\theta} + \frac{\theta_A \delta \widehat{U}_{t+1}(\theta_C, \mathbf{w}) - \theta_C \delta U_{t+1}(\theta_A, \mathbf{w})}{\Delta\theta} \right) \\ + (1 - e(\theta_{t-1})) \max \left(\sum_{j=t}^T \delta^{j-t} \overline{U}_j, \frac{\theta_{CC}}{e_t(\theta_C) \Delta\theta} + \delta \frac{\theta_A \widehat{U}_{t+1}(\theta_C, \mathbf{w}) - \theta_C U_{t+1}(\theta_A, \mathbf{w})}{\Delta\theta} \right) - c.$$

In what follows, it is shown that choosing $\{w_{s,t+1}, w_{t+1}, \Delta w_{t+1}\}$ as dictated in Proposition 1 minimizes

$$A_{t+1}(\mathbf{w}) := \theta_A \widehat{U}_{t+1}(\theta_C, \mathbf{w}) - \theta_C U_{t+1}(\theta_A, \mathbf{w}), \quad (46)$$

and, thus, minimizes $U_t(\theta_{t-1}, \mathbf{w})$.

Observe that truthful reporting in $t + 1$ requires that $w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \overline{U}_j \geq w_{t+1} + \theta_C \Delta w_{t+1} + \delta U_t + U_{t+2}(\theta_C, \mathbf{w})$. Hence, if the manager does not invest in firm-specific human capital in $t + 1$ (in which case she is type θ_C in $t + 1$), her payoff in that period is at least $w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \overline{U}_j$. We now argue that $\widehat{U}_{t+1}(\theta_C, \mathbf{w}) = U_{t+1}(\theta_C, \mathbf{w}) \geq w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \overline{U}_j$ (where recall that $U_{t+1}(\theta_C, \mathbf{w})$ means that the manager invests in firm-specific human capital in $t + 1$). Suppose not, so that $\widehat{U}_{t+1}(\theta_C, \mathbf{w}) = w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \overline{U}_j > U_{t+1}(\theta_C, \mathbf{w})$. This is not sustainable, as increasing w_{t+1} or Δw_{t+1} would decrease (46) by only affecting $U_{t+1}(\theta_A, \mathbf{w})$ and would, thus, make the board better off. But increasing Δw_{t+1} also increases $U_{t+1}(\theta_C, \mathbf{w})$, and will eventually make investing in firm-specific human capital more attractive. Hence, we must have $\widehat{U}_{t+1}(\theta_C, \mathbf{w}) = U_{t+1}(\theta_C, \mathbf{w}) \geq w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \overline{U}_j$, which is equivalent to

$$\Delta w_{t+1} \geq \frac{\frac{c}{e_{t+1}(\theta_C)} - w_{t+1} + w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \overline{U}_j - \delta U_{t+2}(\theta_A, \mathbf{w})}{\theta_A}. \quad (47)$$

Expression (47) is the $t + 1$ analogue of (42). Thus, (47) guarantees truthful reporting of θ_A as well as incentives for investing in firm-specific human capital in $t + 1$ regardless of the manager's fit θ_t in the preceding period. Recall that truthful reporting in period $t + 1$ would further require (analogous to the first inequality in (42)) that

$$\frac{w_{s,t+1} - w_{t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \overline{U}_j - \delta \widehat{U}_{t+2}(\theta_C, \mathbf{w})}{\theta_C} \geq \Delta w_{t+1}. \quad (48)$$

In what follows, we show that (47), (48), and $w_{t+1} \geq 0$ will be binding.

To find the contract parameters $\{w_{s,t+1}, w_{t+1}, \Delta w_{t+1}\}$ that minimize (46), subject to (47), (48), and $w_{s,t+1}, w_{t+1}, \Delta w_{t+1} \geq 0$, we apply Kuhn Tucker's Theorem. Define the

function

$$\begin{aligned}
& \mathcal{L}(\mathbf{w}, \Lambda) \\
= & -(\theta_A e_{t+1}(\theta_C) - \theta_C e_{t+1}(\theta_A))(w_{t+1} + \theta_A \Delta w_{t+1} + \delta U_{t+2}(\theta_A, \mathbf{w})) \\
& -(\theta_A(1 - e_{t+1}(\theta_C)) - \theta_C(1 - e_{t+1}(\theta_A))) \left(w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j \right) + \Delta \theta_C \\
& + \lambda \left(\frac{\Delta w_{t+1} - \frac{c}{e_{t+1}(\theta_C)} - w_{t+1} + w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j - \delta U_{t+2}(e_{t+2}(\theta_A), \mathbf{w})}{\theta_A} \right) \\
& + \mu \left(\frac{w_{s,t+1} - w_{t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j - \delta \hat{U}_{t+2}(\theta_C, \mathbf{w})}{\theta_C} - \Delta w_{t+1} \right) \\
& + \kappa w_{s,t+1} + \rho w_{t+1} + \chi \Delta w_{t+1}
\end{aligned}$$

where the first two lines correspond to (46),³⁰ and $\Lambda = \{\lambda, \mu, \kappa, \rho, \chi\}$ is the set of weakly positive Kuhn Tucker multipliers. Taking the first order conditions

$$\begin{aligned}
\frac{\partial \mathcal{L}(\mathbf{w}, \Lambda)}{\partial w_{s,t+1}} &= 0 = -(\theta_A(1 - e_{t+1}(\theta_C)) - \theta_C(1 - e_{t+1}(\theta_A))) - \lambda \frac{1}{\theta_A} + \mu \frac{1}{\theta_C} + \kappa \\
\frac{\partial \mathcal{L}(\mathbf{w}, \Lambda)}{\partial \Delta w_{t+1}} &= 0 = -(\theta_A e_{t+1}(\theta_C) - \theta_C e_{t+1}(\theta_A)) \theta_A + \lambda - \mu + \chi \\
\frac{\partial \mathcal{L}(\mathbf{w}, \Lambda)}{\partial w_{t+1}} &= 0 = -(\theta_A e_{t+1}(\theta_C) - \theta_C e_{t+1}(\theta_A)) + \lambda \frac{1}{\theta_A} - \mu \frac{1}{\theta_C} + \rho,
\end{aligned}$$

we obtain from the second and third conditions that $\theta_A \rho = \mu \frac{\Delta \theta}{\theta_C} + \chi$. From the first and third conditions, we further have $\kappa + \rho = \Delta \theta$. Finally, from the second condition, we have

$$\lambda = (\theta_A e_{t+1}(\theta_C) - \theta_C e_{t+1}(\theta_A)) \theta_A + \mu - \chi.$$

Assuming now that $\Delta w_{t+1} \geq 0$ and $w_{s,t+1} \geq 0$ are not binding—i.e., $\chi = 0$ and $\kappa = 0$ —we have: $\rho = \Delta \theta$, $\mu = \theta_A \theta_C$, and $\lambda = ((\theta_A e_{t+1}(\theta_C) - \theta_C e_{t+1}(\theta_A)) + \theta_C) \theta_A > 0$. Thus, $\rho, \mu, \lambda > 0$, implying that (47), (48), $w_{t+1} \geq 0$ must be binding. It is now straightforward to verify that this implies

$$\begin{aligned}
\Delta w_{t+1} &= \frac{c}{e_{t+1}(\theta_C) \Delta \theta} + \frac{\delta U_{t+2}(\theta_C, \mathbf{w}) - \delta U_{t+2}(\theta_A, \mathbf{w})}{\Delta \theta} \\
w_{s,t+1} &= \max \left(0, \theta_C \Delta w_{t+1} + \delta \hat{U}_{t+2}(\theta_C, \mathbf{w}) - \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j \right),
\end{aligned}$$

³⁰The first two lines are the negative of (46), since the objective is to minimize (46).

which is the $t + 1$ analogue of (12)–(14), as was to be shown.

If, instead $w_{s,t+1} \geq 0$ is binding, the manager extracts no rent in period $t + 1$. For this case we argue in the main text that this would also imply that she extracts no rent in period t and the board will incentivize truthful reporting in all preceding periods following Proposition 1, making the proposed contract optimal. The same arguments will apply to Case 3 below. We verify below that $\Delta w_{t+1} > 0$.

Case 2: Truthful reporting in period t and no truthful reporting in period $t + 1$.

In the case of no truthful reporting in period $t + 1$, it is clearly optimal to set $w_{s,t+1} = 0$. Similar to case 1, we can show that the board would like to minimize (46), subject to $U_{t+1}(\theta_C, \mathbf{w}) \geq w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j$. The difference is that, absent truthful reporting in $t + 1$, the manager's payoff in that period is

$$\begin{aligned} U_{t+1}(\theta_t, \mathbf{w}) &= w_{t+1} + (\theta_C + e_{t+1}(\theta_t) \Delta\theta) \Delta w_{t+1} - c \\ &\quad + e_{t+1}(\theta_t) \delta U_{t+2}^e(\theta_A, \mathbf{w}) + (1 - e_{t+1}(\theta_t)) \delta U_{t+2}^e(\theta_C, \mathbf{w}). \end{aligned} \quad (49)$$

We now argue that it would be optimal that the manager invests in firm specific human capital also out-of equilibrium (i.e., if she misreports θ_C in t): $\hat{U}_{t+1}(\theta_C, \mathbf{w}) = U_{t+1}(\theta_C, \mathbf{w})$. Suppose not, then

$$\hat{U}_{t+1}(\theta_C, \mathbf{w}) = w_{t+1} + \theta_C \Delta w_{t+1} + \delta U_{t+2}^e(\theta_C, \mathbf{w}) \geq w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j. \quad (50)$$

But then to minimize (46), it would be optimal to increase Δw_{t+1} .³¹ Just as in Case 1, this would make investing in firm-specific capital more attractive, so that eventually, we must have

$$\begin{aligned} \hat{U}_{t+1}(\theta_C, \mathbf{w}) &= U_{t+1}(\theta_C, \mathbf{w}) \\ &= w_{t+1} + (\theta_C + e_{t+1}(\theta_C) \Delta\theta) \Delta w_{t+1} + E_{\theta_t} [U_{t+2}^e(\theta_{t+1}, \mathbf{w})] - c \geq w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j \end{aligned}$$

³¹We would have then $\frac{\partial A_{t+1}(\mathbf{w})}{\partial \Delta w_{t+1}} = (\theta_A \theta_C - \theta_C (\theta_C + e_{t+1}(\theta_C) \Delta\theta)) < 0$.

There are now no confounding effects between minimizing (46) and minimizing $\{w_{t+1}, \Delta w_{t+1}\}$ in this case, as plugging (49) into (46), we obtain

$$\begin{aligned}\frac{\partial A_{t+1}(\mathbf{w})}{\partial w_{t+1}} &= \Delta\theta \\ \frac{\partial A_{t+1}(\mathbf{w})}{\partial \Delta w_{t+1}} &= (\theta_A (\theta_C + e_{t+1} (\theta_C) \Delta\theta) - \theta_C (\theta_C + e_{t+1} (\theta_A) \Delta\theta)) \\ &= \theta_C \Delta\theta - e_{t+1} (\theta_A) \theta_C \Delta\theta + e_{t+1} (\theta_C) \theta_A \Delta\theta > 0.\end{aligned}$$

Thus, $A_{t+1}(\mathbf{w})$ increases in w_{t+1} and Δw_{t+1} , and to minimize (46), we have to minimize w_{t+1} and Δw_{t+1} subject to (51) and the analogue of (44)–(45) for period $t + 1$, as was to be shown. We verify at the end that for these conditions, we will have that $\Delta w_{t+1} = 0$.

Finally, using some of the derivations in Section 3.2, it can be verified that for the contract specified in the Lemma, we would always have $\Delta w_t > 0$ (and so $\chi = 0$ in case 1 above) when there is truthful reporting in period t . To see this plug into Δw_t from (20) in case of truthful reporting in $t + 1$ to obtain

$$\Delta w_t = \left(\frac{1}{e_t (\theta_C) \Delta\theta} - \delta \frac{\Delta e_{t+1}}{e_{t+1} (\theta_C) \Delta\theta} \right) c > 0.$$

In case of no truthful reporting in $t + 1$, we obtain the same expression by plugging in from (38). **Q.E.D.**

No Truthful Reporting in period t . We continue in the steps laid out above. Suppose we have no truthful reporting in t . The aim is to minimize the manager’s payoff

$$\begin{aligned}U_t(\theta_{t-1}, \mathbf{w}) &= w_t + (\theta_C + e_t (\theta_{t-1}) \Delta\theta) \Delta w_t - c \\ &\quad + e_t (\theta_{t-1}) \delta U_{t+1}^e(\theta_A, \mathbf{w}) + (1 - e_t (\theta_{t-1})) \delta U_{t+1}^e(\theta_C, \mathbf{w}).\end{aligned}\tag{52}$$

subject to (44) and (45). Clearly, in $t = 1$, the choice of w_1 , Δw_1 , and $w_{s,1}$ has no effect on the payoffs in neither previous (as there are none) nor following periods. Thus, the aim is to minimize both Δw_1 and w_1 , implying that conditions (44) and (45) will hold with equality. This proves the first induction step.

Case 3: No truthful reporting in period t and truthful reporting in period $t + 1$. Observe that if choosing the compensation contract both in period t and $t + 1$ as dictated in Proposition 1, would imply that $w_t > 0$, the manager’s participation constraint in period t is binding—i.e., $U_t(\theta_{t-1}, \mathbf{w}) = \sum_{j=t}^T \delta^{j-t} \bar{U}_j$. Thus, the $t + 1$ choice must indeed have

been optimal. Suppose, instead, that the zero lower bound on w_t is binding, i.e., $w_t = 0$ (as choosing the compensation contract both in period t and $t + 1$ as dictated in Proposition 1 would imply the infeasible $w_t < 0$). We show that this $t + 1$ choice would still be optimal. Using the induction hypothesis that (44) is binding to plug into the manager's payoff (52) in period t , we have

$$\begin{aligned}
& (\theta_C + e_t(\theta_{t-1}) \Delta\theta) \max \left(0, \frac{\frac{c}{e_t(\theta_C)} + \delta (U_{t+1}^e(\theta_C, \mathbf{w}) - U_{t+1}^e(\theta_A, \mathbf{w}))}{\Delta\theta} \right) - c \\
& + e_t(\theta_{t-1}) \delta U_{t+1}^e(\theta_A, \mathbf{w}) + (1 - e_t(\theta_{t-1})) \delta U_{t+1}^e(\theta_C, \mathbf{w}) \\
= & \begin{cases} \frac{\theta_A \delta U_{t+1}^e(\theta_C, \mathbf{w}) - \theta_C U_{t+1}^e(\theta_A, \mathbf{w})}{\Delta\theta} + \left(\frac{e_t(\theta_{t-1})}{e(\theta_C)} - 1 + \frac{\theta_C}{e_t(\theta_C) \Delta\theta} \right) c & \text{if } \Delta w_t \geq 0 \\ e_t(\theta_{t-1}) \delta U_{t+1}^e(\theta_A, \mathbf{w}) + (1 - e_t(\theta_{t-1})) \delta U_{t+1}^e(\theta_C, \mathbf{w}) - c & \text{if } \Delta w_t = 0 \end{cases}. \quad (53)
\end{aligned}$$

Clearly if $\Delta w_t = 0$, the objective would be to minimize all of $\{w_{s,t+1} w_{t+1}, \Delta w_{t+1}\}$ subject to (47), (48), and $w_{t+1} \geq 0$, which would prove the claim. Thus, it remains to consider the case in which $\Delta w_t \geq 0$. From (44) and the requirement that it should apply to both θ_C and θ_A , $\Delta w_t \geq 0$ would require that

$$\begin{aligned}
0 & \leq \frac{\frac{c}{e_t(\theta_C)} + \delta (U_{t+1}^e(\theta_C, \mathbf{w}) - U_{t+1}^e(\theta_A, \mathbf{w}))}{\Delta\theta} \\
& = \frac{\frac{c}{e_t(\theta_C)} + \delta \left(\theta_C U_{t+1}(\theta_C, \mathbf{w}) - \theta_A U_{t+1}(\theta_A, \mathbf{w}) + \Delta\theta \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j \right)}{\Delta\theta}. \quad (54)
\end{aligned}$$

To minimize the first line of (53), we need to minimize

$$\begin{aligned}
& \theta_A U_{t+1}^e(\theta_C, \mathbf{w}) - \theta_C U_{t+1}^e(\theta_A, \mathbf{w}) \\
= & \theta_A \theta_C (U_{t+1}(\theta_C, \mathbf{w}) - U_{t+1}(\theta_A, \mathbf{w})) + \Delta\theta \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j
\end{aligned} \quad (55)$$

or, thus, equivalently to minimize

$$U_{t+1}(\theta_C, \mathbf{w}) - U_{t+1}(\theta_A, \mathbf{w}) \quad (56)$$

subject to (47), (48), (54), and $w_{s,t+1}, w_{t+1}, \Delta w_{t+1} \geq 0$. Hence, define

$$\begin{aligned}
& \mathcal{L}(\mathbf{w}, \Lambda) \\
&= - (e_{t+1}(\theta_C) - e_{t+1}(\theta_A)) (w_{t+1} + \theta_A \Delta w_{t+1} + \delta U_{t+2}(\theta_A, \mathbf{w})) \\
&\quad - ((1 - e_{t+1}(\theta_C)) - (1 - e_{t+1}(\theta_A))) \left(w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j \right) \\
&\quad + \lambda \left(\frac{\Delta w_{t+1} - \frac{c}{e_{t+1}(\theta_C)} - w_{t+1} + w_{s,t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j - \delta U_{t+2}(\theta_A, \mathbf{w})}{\theta_A} \right) \\
&\quad + \mu \left(\frac{w_{s,t+1} - w_{t+1} + \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j - \delta \hat{U}_{t+2}(\theta_C, \mathbf{w})}{\theta_C} - \Delta w_{t+1} \right) \\
&\quad + \kappa w_{s,t+1} + \rho w_{t+1} + \chi \Delta w_{t+1} \\
&\quad + \sigma \left(\theta_C U_{t+1}(\theta_A, \mathbf{w}) - \theta_A U_{t+1}(\theta_A, \mathbf{w}) + \Delta \theta \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j + \frac{c}{\delta e(\theta_A)} \right),
\end{aligned}$$

where $\Lambda = \{\lambda, \mu, \kappa, \rho, \chi, \sigma\}$ is the set of weakly positive Kuhn Tucker multipliers. Taking the first order conditions

$$\begin{aligned}
\frac{\partial \mathcal{L}(\mathbf{w}, \Lambda)}{\partial w_{s,t+1}} = 0 &= - ((1 - e_{t+1}(\theta_C)) - (1 - e_{t+1}(\theta_A))) \\
&\quad + \sigma (\theta_C (1 - e_{t+1}(\theta_C)) - \theta_A (1 - e_{t+1}(\theta_A))) - \lambda \frac{1}{\theta_A} + \mu \frac{1}{\theta_C} + \kappa \\
\frac{\partial \mathcal{L}(\mathbf{w}, \Lambda)}{\partial \Delta w_{t+1}} = 0 &= - (e_{t+1}(\theta_C) - e_{t+1}(\theta_A)) \theta_A \\
&\quad + \sigma (\theta_C e_{t+1}(\theta_C) - \theta_A e_{t+1}(\theta_A)) \theta_A + \lambda - \mu + \chi \\
\frac{\partial \mathcal{L}(\mathbf{w}, \Lambda)}{\partial w_{t+1}} = 0 &= - (e_{t+1}(\theta_C) - e_{t+1}(\theta_A)) \\
&\quad + \sigma (\theta_C e_{t+1}(\theta_C) - \theta_A e_{t+1}(\theta_A)) + \lambda \frac{1}{\theta_A} - \mu \frac{1}{\theta_C} + \rho
\end{aligned}$$

we obtain from the second and third condition that $\mu \frac{\Delta \theta}{\theta_C} = \theta_A \rho - \chi$. From the first and third condition, we have $\sigma = \frac{\kappa + \rho}{\Delta \theta}$. Hence, if $\rho > 0$ then $\sigma > 0$, implying that (54) is binding and $\Delta w_t = 0$. Otherwise, if $\Delta w_t > 0$, (54) must be lax and we must have $\sigma = 0$. However, this would imply that $\kappa = \rho = 0$, and further that $\mu = \chi = 0$. But then the RHS of the second first order condition would be strictly positive, leading to a contradiction. Hence, we must have $\Delta w_t = 0$. Suppose now that $\kappa = 0$. In this case, $\sigma = \frac{\kappa + \rho}{\Delta \theta}$ implies that $\rho > 0$, which then implies that $\mu > 0$. If, instead, $\kappa > 0$ (i.e., $w_{s,t+1} = 0$), the proposed contract is still optimal, as in this case the manager's payoff is equal to her outside option

and she extracts not rent.

Case 4: No truthful reporting in periods t and $t + 1$. Observe that, if setting $\{w_{s,t+1}w_{t+1}, \Delta w_{t+1}\}$ as dictated by Proposition 1 would imply that $w_t > 0$, the manager extracts no rent. Hence, this strategy is (weakly) optimal. Suppose now that the zero-lower bound $w_t \geq 0$ is binding, i.e., $w_t = 0$, (as these contract parameters would imply the infeasible $w_t < 0$). In this case, (53) implies that the board's objective is to minimize

$$U_{t+1}(\theta_C, \mathbf{w}) - U_{t+1}(\theta_A, \mathbf{w}) \quad \text{if } \Delta w_t \geq 0 \\ e_t(\theta_{t-1}) \delta U_{t+1}^e(\theta_A, \mathbf{w}) + (1 - e_t(\theta_{t-1})) \delta U_{t+1}^e(\theta_C, \mathbf{w}) \quad \text{if } \Delta w_t = 0, \quad (57)$$

subject to the $t + 1$ equivalent of (44) and (45), and the feasibility restrictions. In the latter case ($\Delta w_t = 0$), it is clearly optimal to minimize w_{t+1} and Δw_{t+1} , proving the claim for this case. To show the former case ($\Delta w_t \geq 0$), we now argue similar to case 3. Since

$$U_{t+1}(\theta_t, \mathbf{w}) = w_{t+1} + (\theta_C + e_{t+1}(\theta_t) \Delta \theta) \Delta w_{t+1} - c \\ + e_t(\theta_t) \theta_A \delta U_{t+2}(\theta_A, \mathbf{w}) + (1 - e_{t+1}(\theta_t)) \theta_C \delta U_{t+2}(\theta_C, \mathbf{w}) \\ + (e_t(\theta_t) (1 - \theta_A) + (1 - e_{t+1}(\theta_t)) (1 - \theta_C)) \left(\sum_{j=t+2}^T \delta^{j-t-2} \bar{U}_j \right),$$

neglecting all terms that do not depend on $\{w_{s,t+1}w_{t+1}, \Delta w_{t+1}\}$ from this payoff, to minimize the first line in (57), we can define

$$\mathcal{L}(\mathbf{w}, \Lambda) \\ = - (e_{t+1}(\theta_C) - e_{t+1}(\theta_A)) \Delta \theta \Delta w_{t+1} \\ + \lambda \left(\Delta \theta \Delta w_{t+1} + \delta (e_t(\theta_t) U_{t+2}^e(\theta_A, \mathbf{w}) - U_{t+2}^e(\theta_C, \mathbf{w})) - \frac{c}{e_t(\theta_t)} \right) \\ + \mu \left(w_{t+1} + \theta_C \Delta w_{t+1} + \delta U_{t+2}^e(\theta_C, \mathbf{w}) - \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j - w_{s,t+1} \right) \\ + \kappa w_{s,t+1} + \rho w_{t+1} + \chi \Delta w_{t+1} \\ + \sigma \left(\theta_C U_{t+1}(\theta_A, \mathbf{w}) - \theta_A U_{t+1}(\theta_C, \mathbf{w}) + \Delta \theta \sum_{j=t+1}^T \delta^{j-t-1} \bar{U}_j + \frac{c}{\delta e(\theta_C)} \right).$$

Taking the first order condition with respect to Δw_{t+1} , we have

$$\begin{aligned} \frac{\partial \mathcal{L}(\mathbf{w}, \Lambda)}{\partial \Delta w_{t+1}} = 0 = & - (e_{t+1}(\theta_C) - e_{t+1}(\theta_A)) \Delta \theta + \lambda \Delta \theta + \mu \theta_C + \chi \\ & + \sigma (\theta_C (\theta_C + e_{t+1}(\theta_A)) \Delta \theta - \theta_A (\theta_C + e_{t+1}(\theta_C)) \Delta \theta). \end{aligned} \quad (58)$$

Since the first line in (58) is positive, it must be that $\sigma > 0$ as the term following σ can be rewritten as $-\theta_C (1 - e_{t+1}(\theta_A)) - e_{t+1}(\theta_C) \theta_A \Delta \theta$, which is strictly negative. Hence, both in Case 3 and 4, we have that $\sigma > 0$, implying that $\Delta w_t = 0$ as claimed in the second part of Lemma ???. For completeness, note that from (53), we know that it is optimal to minimize w_{t+1} and $w_{s,t+1}$, as this minimizes the manager's payoff, while relaxing the $t+1$ analogue of (45). This proves (15)–(17) of Proposition 1.

Finally, we show that minimizing U_t minimizes U_{t-1} , and thus, proceeding recursively, minimizes the manager's payoff all the way to period one. From (53), this is clearly the case if period $t-1$ does not offer incentives for truthful reporting, as then $\Delta w_{t-1} = 0$. To see that this is true also if there is truthful reporting in period $t-1$, plug in for w_t , Δw_t and $w_{s,t}$ into the period $t-1$ analogue to (46)

$$\begin{aligned} & \theta_A \widehat{U}_t(\theta_C, \mathbf{w}) - \theta_C U_t(\theta_A, \mathbf{w}) \\ = & (\theta_A e_t(\theta_C) - \theta_C e_t(\theta_A)) (w_t + \theta_A \Delta w_t + \delta U_{t+1}(\theta_A, \mathbf{w})) \\ & + (\theta_A (1 - e_t(\theta_C)) - \theta_C (1 - e_t(\theta_A))) \left(w_{,st} + \sum_{j=t}^T \delta^{j-t} \overline{U}_j \right) - \Delta \theta_C \\ = & \varrho + \Delta \theta \delta \frac{\theta_A \widehat{U}_{t+1}(\theta_C, \mathbf{w}) - \theta_C U_{t+1}(\theta_A, \mathbf{w})}{\Delta \theta} \end{aligned}$$

where ϱ stands for terms that are not related to contract provisions. We can see now that minimizing (46) minimizes the last expression, proving the claim.

Cases 5–8. No truthful reporting in period $t-1$. Finally, suppose that there is no truthful reporting in period $t-1$. To see that the proof for the remaining four cases is identical to those above, it is sufficient to show that choosing $\{w_{t+1}, \Delta w_{t+1}, w_{s,t+1}\}$ to minimize the manager's payoff in t again boils down to minimizing (46) in the case of truthful reporting in period t and (53) in the case of no truthful reporting in period $t-1$ respectively. This can be easily verified by using the induction hypothesis to plug in for the manager's payoff in period t . We omit the details, as the derivations are straightforward.

Finally, in the main text we argued that absent incentives for truthful reporting, re-

placing the manager following a low cash flow realization is optimal also from an ex ante perspective. The proof is a straightforward modification of Cases 2 and 4. Let the probability of replacing a manager following a low cash flow realization be γ . Absent truthful reporting in $t + 1$, the manager's expected payoff becomes

$$\begin{aligned}
U_{t+1}(\theta_t, \mathbf{w}) &= w_{t+1} + (\theta_C + e_{t+1}(\theta_t) \Delta\theta) \Delta w_{t+1} - c & (59) \\
&+ e_{t+1}(\theta_t) \left(\begin{aligned} &(\theta_A + (1 - \theta_A)(1 - \gamma_{t+1})) \delta U_{t+2}(\theta_A, \mathbf{w}) \\ &+ (1 - \theta_A) \gamma_{t+1} \delta \sum_{j=t+2}^T \delta^{j-t-2} \bar{U}_j \end{aligned} \right) \\
&+ (1 - e_{t+1}(\theta_t)) \left(\begin{aligned} &(\theta_C + (1 - \theta_C)(1 - \gamma_{t+1})) \delta U_{t+2}(\theta_C, \mathbf{w}) \\ &+ (1 - \theta_C) \gamma_{t+1} \delta \sum_{j=t+2}^T \delta^{j-t-2} \bar{U}_j \end{aligned} \right).
\end{aligned}$$

We can now follow the same steps as in Cases 2 and 4 to argue that setting $\gamma_{t+1} = 1$ minimizes (46) and (53), respectively. **Q.E.D.**

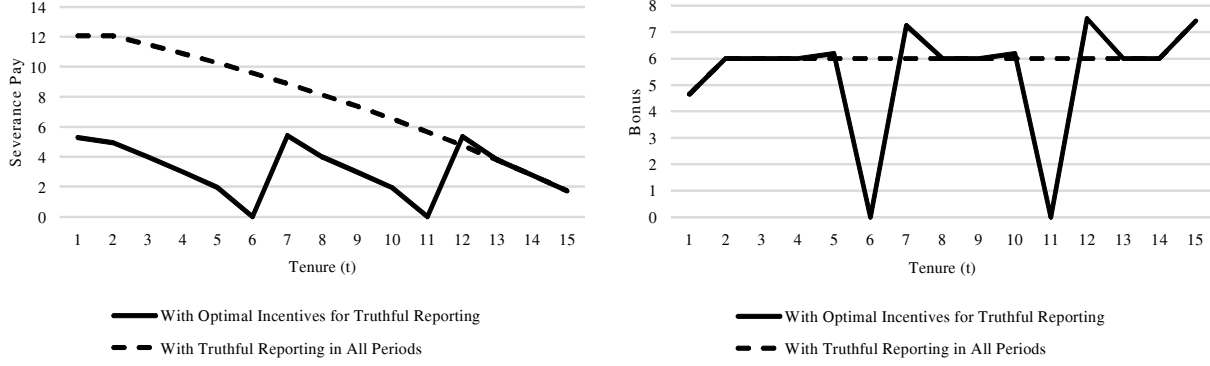


Figure 2: Optimal Incentives for Truthful Reporting vs. Truthful Reporting in All Periods. The figure compares the board’s choice of optimal contract with one that always offers incentives for truthful reporting over a maximal tenure length of fifteen periods. The dips in bonus and severance pay correspond to periods in which the board does not offer incentives for truthful reporting. In terms of implementation, the dips would correspond to the term-ends of renewable fixed-term contracts. The simulations are performed with $e_1 = 0.55$, $e(\theta_A) = 0.65$, $e(\theta_C) = 0.45$, $c = 1$, $\theta_A = 0.7$, $\theta_C = 0.4$, $\bar{\theta} = 0.48$, $\delta = 0.95$, $x = 1000$ and $\Delta x = 500$, $\bar{U} = 1.25$. The figure illustrates that, even though the manager’s pay is small relative to the firm’s size, the decision to elicit the manager’s private information is not trivial, as the likelihood that the manager is still with the firm in periods six and 11 is small.

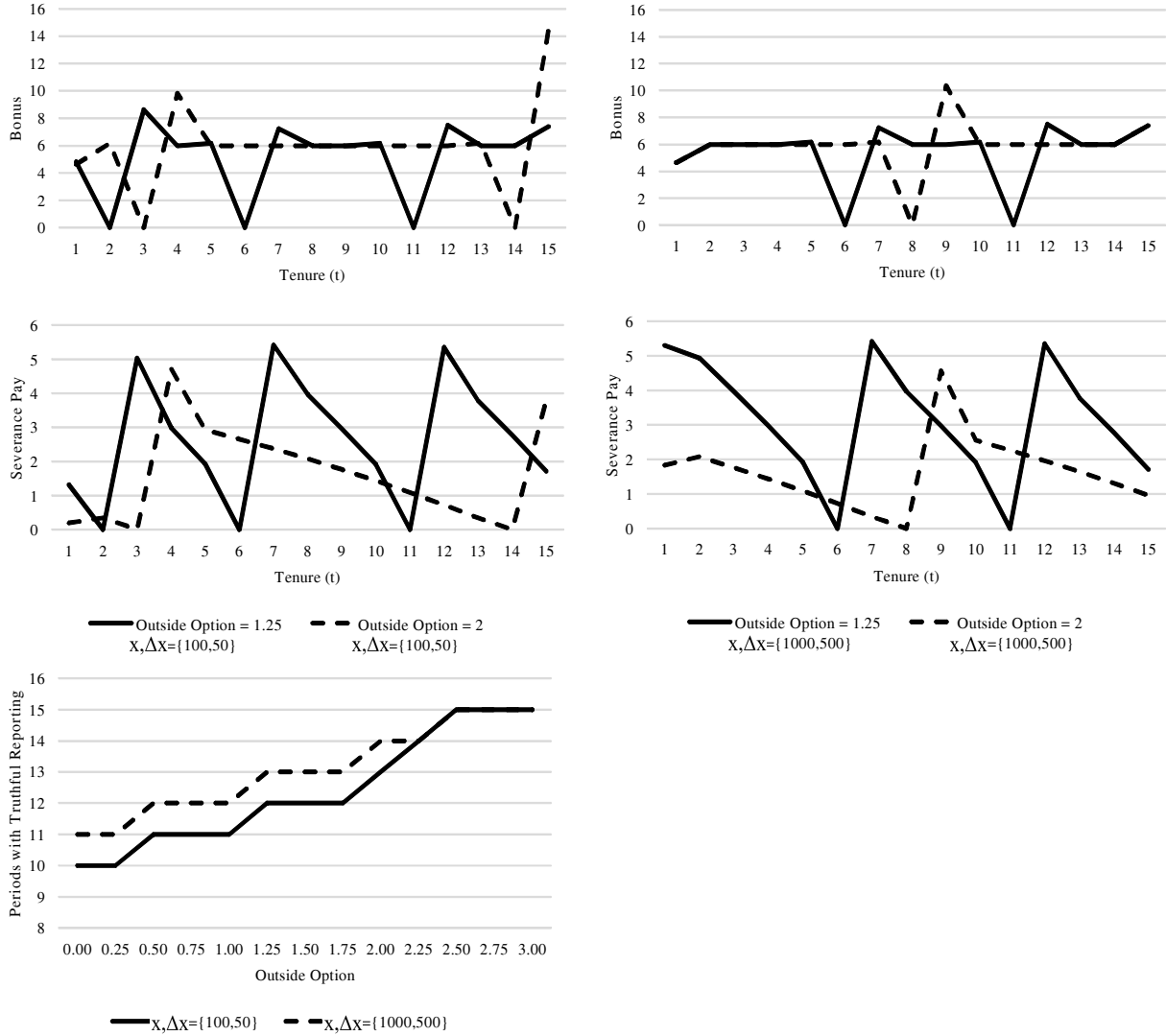


Figure 3: **Comparative Statics.** The figure presents the board’s choice of optimal contract over a maximal tenure length of fifteen periods depending on the manager’s outside option. The dips in bonus and severance pay correspond to periods in which the board does not offer incentives for truthful reporting. In terms of implementation, the dips would correspond to the term-ends of renewable fixed-term contracts. The simulations are performed with $e_1 = 0.55$, $e(\theta_A) = 0.65$, $e(\theta_C) = 0.45$, $c = 1$, $\theta_A = 0.7$, $\theta_C = 0.4$, $\bar{\theta} = 0.48$, $\delta = 0.95$, $\{x, \Delta x\} = \{100, 50\}$ and $\{1000, 500\}$, respectively. The figure illustrates that, even though the manager’s pay is small relative to the firm’s size, the decision to elicit the manager’s private information is not trivial and depends on her size and outside options.