Job Matching with Prior Information and Managerial Appointment Contract*

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ABSTRACT

When a candidate for the top management position is pre-associated with the firm, prior information exists that partially reveals his suitability for the position. In a dynamic framework of job matching, we show that in the presence of such pre-appointment information, the firm’s decision on managerial appointment differs in significant ways between inside and outside candidates. The differences involve the timing of appointment (as when an inside or outside manager is appointed) and the terms of employment contract (pay amount, pay-performance sensitivity, and termination). The model provides a unified job-matching explanation of a variety of phenomena in managerial departure and succession.

*JEL classification: G30; J33; J63

Key words: Pre-appointment Information, Job Matching, Employment Contract

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I. Introduction

Management change gives rise to various economic and organizational issues. These issues involve two interrelated dimensions of management change: the departure of the incumbent and the appointment of the successor. While the extensive investigation of the existent literature of management turnover has focused on the first dimension, little has been done to explain the link between the two. This is an important issue to be addressed since, in particular, many empirical regularities of the second dimension cannot be explained by the various theories intended for the first dimension and have remained puzzling. To fill a gap in this literature, we propose a job-matching model in the presence of prior information on job candidates. This information, non-existent in previous matching models, is shown to be a powerful element that enables the job matching mechanism to explain important empirical regularities involving both dimensions.

The job-matching hypothesis of Jovanovic (1979) is widely used to explain macroeconomic phenomena such as job separation, the natural rate of unemployment (Sargent, 1987) and the wage-tenure relationship (Abraham and Farber, 1987), it is seldom used to explain top management change. This seems surprising given the important role of top managers and the reliance of this role on the match between them and their companies. Except for Allgood and Farrell (2003), which provides evidence on the role of job matching in the managerial departure-tenure relationship,\(^1\) the existent literature of management turnover has focused on the monitoring role of the board and investors: when poorly performing managers are replaced, the threat of dismissal works as an incentive scheme disciplining top managers.\(^2\)

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\(^1\) Hayes, Oyer, and Schaefer (2006) propose the concept of co-worker complementarity, a notion related to job matching, to explain the association between CEO turnover and the change of non-CEO managers.

\(^2\) In addition to the monitoring by the board of directors (Fama, 1980), mutual monitoring among the firm’s managers (Fama and Jensen, 1983) and by holders of large blocks (Shleifer and Vishny, 1986) are also expected. The managerial discipline argument predicts a negative relationship between firm performance and managerial
When a firm changes its manager, it makes two interdependent decisions, typically, at the same time: to terminate the incumbent manager and appoint the successor. The dismissal-incentive argument explains managerial departure, but it is silent about managerial succession. Indeed, previous studies have identified regularities of chief executive officer (CEO) succession that are difficult to explain by dismissal incentives. For instance, firms tend to hire an outsider to succeed a poorly performing CEO; outside CEOs are paid significantly higher than inside CEOs but are less likely to survive the first contract; and inside succession dominants outside succession while firm performance significantly improves following an outside succession relative to an inside one. Apart from some informal or mutually-unrelated arguments, these observations have by and large remained unexplained.

In this paper, we present a job-matching model of managerial employment contract, which, with pre-appointment information, generates a series of coherent predictions of management departure and succession. The model has two periods, where the manager’s productivity depends on the quality of matching between him and his firm, and the contract specifies managerial pay in each period and a termination condition based on the matching quality observed at the end of the first period.

The key feature of this model is the role of pre-appointment information on manager candidates’ potential matching with the firm at the top-management position. This information is

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3 Warner, Watts, and Wruck (1988) and Parrino (1997) note the pattern that outside CEO successions are more likely to follow poor performance. This pattern is often explained by a firm’s intention to shake up poorly performing management.

4 For example, Huson, Malatesta, and Parrino (2004) document that the firm’s accounting performance improves following the appointment of an outsider (rather than an insider) CEO, associated with which are turnover announcement positive average abnormal stock returns.
partially revealed in a candidate’s role in, or association with, the firm before he takes the pursued position. Standard matching models do not consider this information, but treat matching as a pure experience good in the sense that the quality of matching is not revealed, even partially, before a worker is employed and his performance at the appointed position is observed. This treatment is suitable for employees of low-level positions (e.g., assembly workers), where the job candidates are typically previously unassociated with the company and thus the concept of pre-appointment information of job matching does not apply. For the top management position, however, the job candidates include non-CEO executives, who are important insiders and have already played a significant role within the current management team. For such candidates, it is expected that the firm’s current status and functioning are partially informative of their potential suitability for the top executive position. The direct implication of pre-appointment information is that inside candidates are initially different from outside competitors. By incorporating this information into a standard matching model, we show that job matching presents a powerful mechanism that explains various managerial-turnover related phenomena, intuitively and consistently, differentiating between inside and outside managers.

We describe pre-appointment information using the firm’s existing (past and current) performance. This information has immediate implications to the firm’s appointment decision facing the choice between inside and outside manager candidates. When the information reflects an insider’s matching prospect, it would be favorable (unfavorable) to him when the firm’s existing performance is strong (weak), revealing higher (lower) likelihood of a good match from him than from an outsider. Therefore, it is optimal for the firm to appoint an inside (outside)

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5 Allgood, Farrell, and Kamal (2012) find that new CEOs of longer tenures have higher initial compensation packages. They interpret this finding as evidence that boards have pre-appointment information on the new CEO’s matching quality. Fee, Edward, and Hadlock (2004) report that non-CEO turnover is also sensitive to a firm’s stock return performance.
manager when the firm’s existing performance is strong (weak). This insider-outsider difference in the timing of appointment yields an important result of our model: Inside managers start with a higher probability of good match than do outside ones. This result leads to significant differences in managerial appointment and compensation between inside and outside managers. These differences include more frequent termination of outside managers, than that of inside ones, and consequently higher compensation to such managers in their early career. The competitive managerial labor market in our model determines higher pay to outside successors as a premium compensating them for taking higher risk of having an unsuccessful match. Moreover, because outside managers are appointed at a bad time, they are in a better position to improve the firm’s performance than insider managers. These predictions are highly consistent with the empirical observations indicated above.

We then extend the base matching model by incorporating the mechanism of incentive contracting, assuming that managers are risk averse and moral hazard problems arise. The extended model generates new predictions for managerial incentives, further distinguishing between insiders and outsiders: Since outsiders are appointed with greater uncertainty of matching (because of uninformative pre-appointment information), which reduces their marginal utility of incentive pay, their compensation package has an initially lower pay-performance sensitivity than that of insiders. Being unique to our model, this result derives from the interaction of job matching and incentive contracting. This prediction points out a new direction of empirical examination that has largely been ignored in the literature.

The prediction that insiders are initially associated with stronger compensation incentives has a further implication: insiders are advantaged over outsides in the contest to become the top manager. This implication is consistent with the phenomenon that when a CEO is changed, the
successor is often appointed through internal promotion rather than external hiring. Chan (1996) and Agrawal, Knoeber, and Tsoulouhas (2006) view this phenomenon as evidence of an advantage of internal promotion in providing incentives to non-CEO managers; they argue that internal promotion has an advantage over external recruitment because it provides better incentives to all workers. Our model provides an alternative explanation: since insiders face lower uncertainty of job matching (as a consequence of pre-appointment information, no matter whether this information is favorable or unfavorable), they are willing to accept compensation packages that are more closely linked to their company’s performance.

This paper proceeds as follows. Section II describes the base model and characterizes the employment contract for the new manager in terms of job matching in the presence of pre-appointment information. In Section III, the base model is extended to allow incentive contracting, where the contract depends on the mechanisms of job matching and incentives simultaneously. Section IV concludes.

II. Base Model

II.A. Pre-appointment Information of Job Matching

We consider the matching between a firm and his top manager, the chief executive officer (CEO), where the quality of matching is either good or bad. With half of the population of managers having the potential to form a good match with a new employer, the prior probability of each manager having a good match is one half. This assumption means that the quality of a new match is initially unknown. This assumption highlights the nature of job matching: matching as an experience good is firm-specific.

While the quality of matching is not directly observed, it is revealed by useful information as described as follows. Assuming away matching-unrelated factors such as managerial ability
and working incentives (we consider incentive contracting in Section III), the manager’s productivity and thus the firm’s output exclusively depends on the quality of matching. The output level can be high or low, denoted by $H$ and $L$ respectively. For a good match, the firm has a probability of $p_G$ to produce at the high level and a probability of $1 - p_G$ to produce at the low level, and for a bad match the probabilities become $p_B$ and $1 - p_B$, respectively, where $p_G > p_B$.

We now apply this concept to pre-appointment matching, which determines a manager candidate’s matching quality using pre-appointment information. For this purpose, we further specify the prior probabilities as:

$$p_G = \frac{1}{2} + \frac{\delta}{2}; \quad p_B = \frac{1}{2} - \frac{\delta}{2},$$

where $0 \leq \delta \leq 1$. We use $\delta$ to characterize the effect of pre-appointment information. There are three typical cases of the value of $\delta$ as explained below. The symmetric treatment of the effect of $\delta$ is for analytical easy and interpretation convenience purposes and is inessential.

(i) For the current manager, $\delta = 1$. Under this assumption, there is no uncertainty in production after the firm’s performance by the manager is observed; hence one period of performance is sufficiently informative of the manager’s productivity, revealing the quality of his matching with the firm perfectly. Assuming away uncertainty in job matching after a manager is hired, this assumption allows us to focus on the role of pre-appointment matching in the following two cases.

(ii) For an inside candidate contending for the top management position, $0 < \delta < 1$. On the one hand, insiders are typically non-CEO executives, who have already played an active role within the current management team and exerted an influence on the firm’s performance. In other words, there is an effect of pre-appointment information about his potential matching as the
top manager, for which $\delta > 0$. On the other hand, as a non-CEO executive, an insider’s impact on the firm must be weaker than that of the CEO and different from what he could impact as in the top manager capacity. Therefore, any existing information about an insider’s role in the firm is only partially informative of his matching potential at the top manager post and hence the pre-appointment matching effect must be limited. This further requires $\delta < 1$. We use $\delta_1$ to denote the value of $\delta$ for an inside manager candidate, which satisfies $0 < \delta_1 < 1$.

(iii) For an outside candidate for the CEO position, $\delta = 0$. Under this assumption, outsiders are completely unassociated with the firm so there is no information about their potential matching with the firm before they take the position. Given that our main concern is the matching mechanism, outsiders’ work experiences at other firms that reflect his general managerial ability are not relevant here. Therefore, there is no useful pre-appointment information of job matching for outside candidates.

One apparent source of pre-appointment information is the firm’s existing (historical and current) performance. With this information, we can update the prior probabilities using the Bayesian rule to obtain the posterior probabilities: 6

$$
\text{Prob}(\text{Good}|Y_{-1} = H) = \frac{1 + \delta}{2}; \quad \text{Prob}(\text{Good}|Y_{-1} = L) = \frac{1 - \delta}{2}
$$

(2)

where $Y_{-1}$ represents the firm’s performance in the previous year that is realized and observed at the end of the year.

The firm will produce for multiple periods. To avoid analytical complexity due to infinite

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6 The posterior probabilities in their general forms are \( \text{Prob}(\text{Good}|Y_t = H) = \frac{p_G}{p_G + p_B} \) and \( \text{Prob}(\text{Good}|Y_t = L) = \frac{1 - p_G}{2 - p_G - p_B} \).
horizons of managerial life and firm production, we assume that a manager can work for up to two periods at the top position. Each period is contractual, which can cover more than one year. This assumption can be understood in terms of a two-period project: The project is to be completed in two periods and a manager can be hired to complete one or both periods.

At a certain point during its production, the firm faces a management succession problem: the current CEO is retiring and a new one needs to be appointed. Specifically, at the end of the previous period \( t = 0 \), the firm needs to appoint a new CEO for two periods of production. There are two representative candidates for the top management position, one insider and one outsider. The employment contract for the new manager is a package that specifies a constant pay for each period, \( W_1 \) and \( W_2 \), and a provision for termination contingent on the quality of matching observed at the end of the first period. Figure 1 depicts the timeline of the contract. When the manager is terminated after the first period, a new CEO will be hired to complete the second-period production, while the terminated one will go back to the labor market and seek for a new employer for one period of employment. The terminated manager will face an uncertainty in the second period: With probability \( \varphi \) he will be hired by another firm, and with probability \( 1 - \varphi \) he will be unemployed.

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7 This assumption, which confines managerial tenure to two periods, is inessential. While two periods are sufficient for the model to characterize the firm's decision and managerial contract in a dynamic framework, they avoid the model structure becoming unnecessarily technically complex. 

8 Fee, Edward, and Hadlock (2004) find that about 40% of executives under the age of 50 (such executives are unlikely subject to a normal retirement effect) at departure eventually find a new employer in an executive capacity.
Three points are worth noting here. First, the firm’s decision contains two dimensions: managerial appointment and managerial compensation. The first dimension determines new manager appointment at the beginning of the first period, and managerial replacement or continuation at the end of the first period. This dimension entails the choice of $\delta$ among the three values, 0, $\delta_i$, and 1 (with respect to the representative outsider, the representative insider, and the incumbent CEO, respectively). The second dimension determines managerial pay in each period. The second point is that although the current CEO’s departure is indicated as normal retirement, the reason for his departure is inessential to the firm’s decision on management succession. Because the matching mechanism is the main concern, what matters is the firm’s existing performance that reflects a candidate’s matching potential summarized in the probability parameter $\delta$. Third, both the inside and outside manager candidates are risk neutral and their pay in each period are constant, meaning that the model does not consider managerial incentives. This assumption will be relaxed in Section III, where the matching mechanism is interacted with that of incentive contracting.
II.B. Solution

To solve the model by backward reduction, we start with the second period solution. No matter who will be the CEO for the second period, the pay contract must satisfy:

\[ W_2 \geq R_0, \]  \hspace{1cm} (3)

where \( R_0 \) is the constant reservation wage. Because a manager’s alternative choice to the second period contract is to work for another firm and thus start a new match, he would face the same opportunity cost no matter whether he was initially appointed as an insider or an outsider CEO.

With the observed firm output, \( Y_1 \), the firm’s decision at the end of the first period is to choose the second-period manager and determine the pay contract to maximize the expected profit of the second period. That is,

\[ \max_{\delta, W_2} E(Y_2 - W_2 | Y_1) \quad \text{s.t.} \quad 0 \leq \delta \leq 1, \quad W_2 \geq R_0 \]  \hspace{1cm} (4)

where \( \delta = 0, \delta_1 \) or 1. Our first proposition follows immediately.

**Proposition 1.** At the end of the first period, the incumbent CEO is retained when the first-period performance is strong (i.e., \( Y_1 = H \)), and he is replaced by an outsider when the first-period performance is weak (i.e., \( Y_1 = L \)).

**Proof:** See Appendix A.

This is a direct result of job matching, which predicts a negative relationship between the probability of CEO departure and firm performance. This relationship has been extensively examined in the managerial turnover literature since the 1980s, following Coughlan and Schmidt (1985). However, except Allgood and Farrell (2003) which applies the job matching concept to
We now analyze the first-period contract for the new manager at the beginning of the first period. If, according to the termination condition specified in Proposition 1, the manager is terminated at the end of the first period, he has probability $\varphi$ to be hired by another firm for the second period, receiving $W_2 = R_0$, or has probability $1 - \varphi$ to become unemployed, earning nothing at $W_2 = 0$. Here, for simplicity, we have assumed zero utility for the unemployed; this assumption does not materially affect the solution. The manager candidate’s objective is to maximize his expected total pay of two periods.

Ignoring the time value of money, the new manager’s expected total pay conditional on the firm’s existing output is $E(W_1 + W_2 \mid Y_0)$. This amount must satisfy his reservation wage:

$$E(W_1 + W_2 \mid Y_0) \geq 2R_0. \quad (5)$$

Alternatively, the right-hand side can be a more general increasing function of $R_0$. Because any candidate’s career opportunity cost is determined by a different, new match with a different firm, it must be the same for all candidates.

The firm determines the employment contract to maximize its expected profit from the two-period production. Because the incumbent manager is leaving, the firm’s decision at the beginning is to appoint a new manager by choosing between the insider and the outsider by solving the following problem:

$$\begin{align*}
\text{Maximize} & \quad \mathbb{E}\left[(Y_1 - W_1) + (Y_2 - W_2) \mid Y_0\right] \\
\text{subject to} & \quad 0 \leq \delta < 1; \quad E(W_1 + W_2 \mid Y_0) \geq 2R_0; \quad W_2 \geq R_0.
\end{align*} \quad (6)$$

The equilibrium is characterized by our second proposition:
Proposition 2. (i) An insider is appointed as the new CEO when the firm’s existing performance is strong (i.e., $Y_0 = H$), and an outsider is appointed as the new CEO when the firm’s existing performance is weak (i.e., $Y_0 = L$). (ii) The likelihood of the new CEO having a good match is $\frac{1 + \delta}{2}$ if he is an insider, and $\frac{1}{2}$ if he is an outsider. (iii) The first-period pay to the new manager is $W_1 = R_0 + \frac{(1 - \delta)(1 - \varphi)R_0}{2}$ if he is an insider and $W_1 = R_0 + \frac{(1 - \varphi)R_0}{2}$ if he is an outsider.

Proof: See Appendix B.

This proposition presents an important result of our model. The first part determines the new CEO appointment contingent on the firm’s existing performance. This result is directly obtained from the presumption that pre-appointment information is partially informative of an inside candidate’s matching prospect: It is favorable to him when the performance is strong and unfavorable when the performance is weak. As a result, insiders are more (less) likely to be appointed as the new CEO than outsiders following years of good (bad) performance. With this result, the role of pre-appointment information is no different from the intuition that all insiders receive credits for the firm’s good performance but share the blame for bad performance.

This insider-outsider difference leads to the second part of the proposition: Inside managers are with initially higher probabilities of a good match than inside ones. This is a powerful result, of which the direct implication is that outside managers are more likely to be terminated in their early career. In addition, because pre-appointment information is uninformative of outsiders’ quality of matching, outside successions are initially associated with
higher uncertainty. Another implication of this result is different compensations to inside and outside successors. In the competitive managerial labor market, all candidates have the same opportunity cost; hence, for the outsider to attain the same expected career wealth, he needs to receive a premium in the first period so that his expected loss due to a higher likelihood of determination and possible unemployment in the second period is covered. This leads to the third part of the proposition: The first-period pay to the outside manager is higher than that to the inside manager by $\frac{\delta (1-\varphi) R_0}{2}$, which is the expected loss to the outsider, relative the insider, due to his higher probability of determination after the first period and higher probability of second-period unemployment. This premium increases with the effect of pre-appointment information (as $\delta$ increases) and the second-period unemployment cost (as $\varphi$ decreases).

The insider-outsider difference in the likelihood of good matching also has implications about the firm’s performance following the new manager’s appointment. On the one hand, insiders and outsiders differ in the quality of matching, which presents a fundamental initial difference that favors insiders. On the other hand, being appointed at a different state of firm performance, insiders and outsiders are in different positions to change the firm’s performance, with the contrasted firm performance favoring outsiders. The following proposition summarizes the effect of the new manager on the firm’s performance, distinguishing between inside and outside successions.

**Proposition 3.** *The difference in the expected profit of the first period between inside and*
outside succession is:

$$E(\Pi_1)_{\text{Inside succession}} - E(\Pi_1)_{\text{Outside succession}} = \frac{\delta}{2} \left[ (H - L) + (1 - \varphi)R_0 \right],$$

(7)

and the difference in the expected profit change from the pre-appointment period to the first period between inside and outside succession is:

$$E(\Delta \Pi_1)_{\text{Outside succession}} - E(\Delta \Pi_1)_{\text{Inside succession}} = (H - L) - \frac{\delta}{2} \left[ (H - L) + (1 - \varphi)R_0 \right].$$

(8)

where $0 < \delta < 1$.

**Proof:** See Appendix C.

The first term in (8) presents the performance difference in the pre-appointment period, which favors the outsider in terms of performance change. The second term presents a fundamental performance effect of the expected quality of matching, which is higher with the insider than with the outsider. The third term presents a cost to the firm because of the premium paid to the outsider over that to the insider. When the first two terms (the performance effects) dominate the third term (the compensation effect), which is expected to be the case in reality, the observed total performance improvement is higher in an outside succession than in an inside succession.

An interesting implication of this result is that the difference in the first two terms is not a real performance effect, but a misleading phenomenon due to the fact that outsiders start with a bad situation that is bound to improve.

**III. Job Matching in Incentive Contract**

**III.A. Uncertainty in Job-Matching and Moral Hazard**
We now examine managerial incentive contract in the presence of job matching. In the base model, managers are risk-neutral so their utility only depends on the amount of pay.

Managers are now risk-averse, so their utility will also depend on the uncertainty of pay. There are now two sources of uncertainty, one from job matching and the other, as in standard incentive contract models, from a random disturbance in output. We redefine the firm’s production as:

\[ Y_t = m_t + e_t + \varepsilon_t, \quad t = 1, 2 \]  

where \( m_t \) is the quality of matching, which equals \( H \) for a good match and \( L \) for a bad one, \( e_t \) is managerial effort, which is nonnegative, and \( \varepsilon \) is a random term following a normal distribution of zero mean, \( N(0, \sigma_\varepsilon) \). For technical convenience, \( \varepsilon \) is assumed to be uncorrelated to the uncertainty in matching quality.

The pay contract for the manager is, as usual, a linear function of output:

\[ W_t = \alpha_t + \beta_t Y_t, \quad t = 1, 2. \]  

The expected pay and pay variance are, respectively,

\[ E(W_t) = \alpha_t + \beta_t m_t + \beta_t \varepsilon_t, \quad Var(W_t) = \beta_t^2 \left[ \sigma_{m,t}^2 + \sigma_\varepsilon^2 \right], \quad i = 1, 2. \]

We need to determine the expected level and the variance of the quality of matching, \( \bar{m}_t \) and \( \sigma_{m,t}^2 \), respectively. With output being a continuous function of managerial effort, we redefine the pre-appointment information as \( Y > M \) and \( Y < M \), where \( M = \frac{H + L}{2} \). As will be shown below, the choice of the average level of output, \( M \), as the criterion output is purely for analytical convenience purposes, which does not materially impact the model’s results. The posterior
probabilities are accordingly refined as:

\[ \text{Prob}(m = H | Y_{t-1} > M) = \frac{1 + \delta}{2} \quad \text{and} \quad \text{Prob}(m = H | Y_{t-1} < M) = \frac{1 - \delta}{2}. \]

Noting that both \( \bar{m}_t \) and \( \sigma_{m,t}^2 \) are a function of \( Y_{t-1} \), we have:\(^{10}\)

\[ \bar{m}_t(Y_{t-1} > M) = \frac{H + L}{2} + \frac{\delta(H - L)}{2} \quad \text{and} \quad \bar{m}_t(Y_{t-1} < M) = \frac{H + L}{2} - \frac{\delta(H - L)}{2}, \]

\[ \sigma_{m,t}^2(Y_{t-1} > M) = \sigma_{m,t}^2(Y_{t-1} < M) = \left(1 - \delta^2 \right) \left( \frac{H - L}{2} \right). \]

After the previous year’s performance is observed, the expected quality of matching becomes fully revealed (\( \delta = 1 \)) for the incumbent and totally uninformative (\( \delta = 0 \)) for the outsider. The standard deviation is the same between the two cases of \( Y_{t-1} \). This is because the uncertainty in matching is similarly reduced by the pre-appointment information no matter whether the information is favorable or unfavorable.

**III.B. Solution**

With backward reduction, we start with the second-period solution. Given pay contract:

\[ W_2 = \alpha_2 + \beta_2 Y_2, \quad (11) \]

the risk-averse manager maximizes his expected utility, \( E(U) \). The utility function is increasing in pay and decreasing in managerial effort, which, conditional on the first-period output, can be specified as:

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\(^{10}\) See Appendix D for the derivation of \( \bar{m}_t \) and \( \sigma_{m,t}^2 \).
\[ E(U(W_2 - C_2 | Y_1)) = E \left( U \left( \alpha_2 + \beta_2(m_2 + e_2 + \frac{1}{2}ke_2 | Y_1) \right) \right), \]

where the cost of effort is \( C_2 = \frac{1}{2}ke_2 \) and \( k > 0 \). It is simplified using the expected utility equivalent relationship:

\[
E(U(W_2 - C_2 | Y_1)) \approx E(W_2 - C_2 | Y_1) - \frac{1}{2} \rho \text{Var}(W_2 - C_2 | Y_1)\\
= \alpha_2 + \beta_2 \bar{m}_2(Y_1) + \beta_2 e_2 - \frac{1}{2}ke_2 - \frac{1}{2} \beta_2^2 \rho \left[ \sigma_{m,2}^2(Y_1) + \sigma_{e}^2 \right],
\]

where \( \rho \) is the coefficient of absolute risk aversion. The first-order condition from the manager’s problem gives the incentive compatibility constraint (ICC):

\[ \beta_2 - ke_2 = 0. \]  

(12)

The firm’s expected profit from the second period production is:

\[ E(Y_2 - W_2 | Y_1) = -\alpha_2 + (1 - \beta_2) [\bar{m}_2(Y_1) + e_2]. \]

The firm’s decision is to appoint the manager (the choice of \( \delta \)) and determine the pay contract (the choice of \( \alpha_2 \) and \( \beta_2 \)) for the second period to maximize the expected profits, subject to the ICC and the following participation constraint (PC):

\[ E(U(W_2 - C_2 | Y_1)) \geq R_0 \]  

(13)

The solution to the firm’s problem leads to the following proposition:

**Proposition 4:** (i) At the end of the first period, the incumbent CEO is retained if the firm’s first-period performance is strong (i.e., \( Y_1 > M \)), and he is replaced by an outsider if the performance is weak (i.e., \( Y_1 < M \)) and the following condition holds:
\[
\frac{H-L}{2} > \frac{\rho \delta \left( \frac{H-L}{2} \right)^2}{1 + k \rho \left[ (1-\delta^2) \left( \frac{H-L}{2} \right)^2 + \sigma_e^2 \right]}, \text{ where } 0 < \delta < 1.
\]

(ii) The pay-performance sensitivity is

\[
\beta_2 = \frac{1}{1 + k \rho \sigma_e^2} \quad \text{and} \quad \beta_2 = \frac{1}{1 + k \rho \left( \frac{H-L}{2} \right)^2 + \sigma_e^2}
\]

for the retained and newly hired CEO, respectively.

**Proof:** See Appendix D.

The first part of the proposition is similar to, but somewhat different from, the base model result. The difference comes from the stronger condition for outsider replacement: In addition to weak performance of the first period, condition (14) has to be satisfied. The left-hand side of this condition is the marginal benefit of reduced \( \delta \) due to reduced likelihood of low quality of matching, and the right-hand side is the marginal cost of reduced \( \delta \) due to reduced working incentives caused by increased uncertainty of matching. We call condition (14) “the matching dominance condition.” Therefore, when the matching effect dominants the incentive effect, outside succession occurs when the first-period performance is weak, as with the base model.

An interesting implication of this additional condition for outside succession is that due to the incentive effect, managerial turnover is less frequent than the base model predicts. …

The second part of the proposition indicates that the pay-performance sensitivity is lower for a newly hired manager than for a retained incumbent. The reason is that newly hired managers are associated with higher uncertainty in the quality of matching, which reduces the effectiveness of incentive contracting and thus increases agency costs.
The difference in the pay-performance sensitivity between the retained CEO and the newly hired CEO implies an upward sloped career profile of managerial incentives … consistent with Gibbons and Murphy (1992) …

We now turn to the first-period contract. The manager’s two year expected utility is assumed to be the sum of his expected utility of each year, which is written as:

\[
E(U_{1+2}) = E(U_1 \mid Y_0) + \text{Prob}(m_1 = H \mid Y_0)E(U_2 \mid m_1 = H) + \left[1 - \text{Prob}(m_1 = H \mid Y_0)\right]\phi E(U_2 \mid m_1 = L) \\
= \alpha_1 + \beta_m \bar{m}(Y_0) + \beta_1 e_1 - \frac{1}{2} \kappa e_1^2 - \frac{1}{2} \beta_1^2 \rho \left[\sigma^2_{m,1}(Y_0) + \sigma^2_\epsilon\right] + \text{Prob}(m_1 = H \mid Y_0)E(U_2 \mid m_1 = H) + \left[1 - \text{Prob}(m_1 = H \mid Y_0)\right]\phi E(U_2 \mid m_1 = L)
\]

Under the assumption that the quality of matching is revealed after the first-period production regardless of the manager’s effort in the first period, the manager’s effort input \(e_1\) will have no effect on his quality of matching and hence his decision on \(e_2\).\(^\text{11}\) Therefore, we have the first period incentive compatibility constraint (ICC\(_1\)):

\[
\beta_1 - \kappa e_1 = 0 \tag{16}
\]

The firm’s expected two-period profits are:

\[
E(\Pi_{1+2}) = E\left[(Y_1 - W_1) + (Y_2 - W_2)\mid Y_0\right] \\
= -\alpha_1 + (1 - \beta_1)\left[\bar{m}(Y_0) + e_1\right] + E(Y_2 - W_2 \mid m_1 = L) + \text{Prob}(m_1 = H \mid Y_0)\Delta\Pi_2^{H-L}
\]

where \(\Delta\Pi_2^{H-L} = E(Y_2 - W_2 \mid m_1 = H) - E(Y_2 - W_2 \mid m_1 = L)\).

The firm’s maximizes the expected profits by choosing the new manager between the inside and outsides and determining the two-period compensation package, subject to the
incentive compatibility constraints and participation constraints. That is,

$$\begin{align*}
\max_{\delta, \alpha_1, \alpha_2, \beta_1, \beta_2} E(I_{t+2}) &= E[(Y_1 - W_1) + (Y_2 - W_2)N_0] \\
\text{s.t.} \quad &\beta_1 - k\epsilon_1 = 0, \quad \beta_2 - k\epsilon_2 = 0, \quad E(U_2) \geq R_0, \quad E(U_{t+2}) \geq 2R_0, \quad \text{where} \quad 0 \leq \delta < 1.
\end{align*}$$

The solution of the firm’s problem yields the following major result of the extended model:

**Proposition 5:** (i) An insider is appointed as the new CEO when the firm’s existing performance is strong (i.e., $Y_0 > M$), and an outsider is appointed as the new CEO when the performance is weak (i.e., $Y_0 < M$) and the matching dominance condition (14) holds. (ii) The likelihood of the new CEO having a good match with the firm is within the range from $\frac{1}{2}$ to $\frac{1+\delta}{2}$ if he is an insider, and is $\frac{1}{2}$ if he is an outsider. (iii) The pay-performance sensitivity and expected pay to the new manager in the first period are

$$\beta_1 = \frac{1}{1 + k\rho \left[ (1-\delta^2) \left( \frac{H-L}{2} \right)^2 + \sigma^2 \right]} \quad \text{and} \quad E(W_1) = R_0 + \frac{(1-\delta)(1-\varphi)R_0}{2} + \frac{\beta_1}{2k},$$

respectively, if he is an insider, and are

$$\beta_1 = \frac{1}{1 + k\rho \left[ \left( \frac{H-L}{2} \right)^2 + \sigma^2 \right]} \quad \text{and} \quad E(W_1) = R_0 + \frac{(1-\varphi)R_0}{2} + \frac{\beta_1}{2k},$$

respectively, if he is an outsider. $0 < \delta < 1$.

**Proof:** See Appendix E.
This proposition is directly comparable with the base model counterpart, Proposition 2. The first part determines new CEO appointment contingent on the firm’s existing performance, with strong performance favoring insiders and weak performance favoring outsiders. By requiring the marginal benefit of pre-appointment information from job matching to dominant that from incentive pay, the matching dominance condition reduces the frequency of outsider appointment. This result is consistent with the prominent phenomenon that internal promotion dominants external hiring in managerial replacement.12 Chan (1996) and Agrawal, Knoeber, and Tsoulouhas (2006) argue that this is because internal promotion has an advantage over external hiring because it provides promotion incentives to all workers. According to Casamatta and Guembel (2010), managerial legacies may also play a role favoring insiders when the legacy potential of a firm’s strategy makes an outside succession more expensive. Our result points out an unaddressed advantage of inside managers in incentive contracting: Because useful pre-appointment information reduces insiders’ uncertainty in job matching, they are initially associated with lower agency costs than outside managers are.

The second part of Proposition 5 remains the same as the base model result, which further verifies that outside managers are associated with higher probabilities of early career termination than inside ones.

The third part presents, perhaps, the most innovative result of the model, which predicts contrasted differences in the incentive contract for the new manager between inside and outside successions. On the one hand, there is an unambiguous difference in the pay-performance sensitivity. Because of reduced uncertainty in job matching by pre-appointment information, the

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12 Denis and Denis (1995) and Warner, Watts, and Wruck (1988) find that less than 20% of corporate executives were appointed from outside the firm. By examining CEO successions from 1971 to 1994, Huson, Parrino, and Starks (1998) find that outside succession has increased over time.
sensitivity is greater for insiders. This beneficial incentive effect directly depends on the magnitude of $\delta$. On the other hand, there is an ambiguous difference in the amount of total pay between inside and outside managers. From results (18) and (19), we have:

$$E(W_t)_{\text{Outsider}} - E(W_t)_{\text{Insider}} = \frac{\delta}{2} (1 - \varphi) R_0 - \frac{1}{2k} \left( \beta_t|_{\text{Insider}} - \beta_t|_{\text{Outsider}} \right) \quad \text{where} \quad 0 < \delta < 1.$$  (20)

The first component of the outsider-insider difference is positive and the second term negative. The positive component presents a premium or insurance pay to an outsider that is needed to offset his expected loss due to higher probability of termination, after the first period, than his insider peers. The negative component presents a difference in incentive pay, which results from the outsider’s weaker pay-performance link. Therefore, the total difference depends on the relative strength of the job matching mechanism and the incentive contracting mechanism.

Previous studies have compared the timing of appointment and the level of pay between inside and outside CEO successors. It seems surprising that no study so far has compared incentive strength between them. Our model’s unambiguous predictions of lower pay-performance sensitivity and higher insurance pay to outside successors than the inside counterparts point out an unexplored direction of empirical investigation. Arising from the interaction of job matching and incentive contracting, these predictions are unique to our model and can be directly tested.

It is worth noting that the matching dominance condition can be violated. For this reason, the firm’s choice between the inside and outside candidates becomes more complicated than the proposition predicts because an insider could also be appointed in the state of poor performance. As shown in the proof, after taking into account this complicity, the insider’s likelihood of having a good match with the firm and his expected pay are revised as, respectively,
\[ \frac{1}{2} < \text{Prob}(\text{Good})_{\text{Insider}} < \frac{1 + \delta}{2}, \]  

\[ R_0 + \left( \frac{1 - \delta}{2} \right) (1 - \phi) R_w + \frac{\beta_i}{2k} < E(W_{i1})_{\text{Insider}} < R_0 + \left( \frac{1 - \phi}{2} \right) R_w + \frac{\beta_i}{2k}. \]  

These generalized results are qualitatively the same as those in Proposition 5, although the average insider now has a lower likelihood of good matching and thus receives higher pay.

**Proposition 6.** When the matching dominance condition (14) holds, the difference in the expected profit of the first period between inside and outside succession is:

\[ E(\Pi_{1i})_{\text{Inside succession}} - E(\Pi_{1o})_{\text{Outside succession}} = \frac{\delta(H - L)}{2} + \frac{\Delta \beta_i}{2k} + \frac{\delta(1 - \phi) R_w}{2}, \]  

and the difference in the expected profit change from the pre-appointment period to the first period between outside and inside succession is:

\[ E(\Delta \Pi_{1i})_{\text{Outside succession}} - E(\Delta \Pi_{1i})_{\text{Inside succession}} = \Delta \Pi_0 - \left[ \frac{\delta(H - L)}{2} + \frac{\Delta \beta_i}{2k} + \frac{\delta(1 - \phi) R_w}{2} \right], \]  

where \( \Delta \beta_i = \beta_i(\delta > 0) - \beta_i(\delta = 0) \) and \( \Delta \Pi_0 = \Pi_0(Y_0 > M) - \Pi_0(Y_0 < M) \).

Proof: See Appendix F.

Results (23) and (24) are qualitatively same as the base model results (7) and (8). The only difference is the effect of working incentives captured by the term \( \frac{\Delta \beta_i}{2k} \), which increases the inside-outside difference in profits and decreases outside-inside difference in profits change. As shown in the proof of the proposition, the results can be generalized by allowing inside succession in the state of poor performance:
\[
\frac{\Delta \beta_i}{2k} < E(\Pi_1)_{\text{Inside Succession}} - E(\Pi_1)_{\text{Outside Succession}} < \frac{\delta(H - L)}{2} + \frac{\Delta \beta_i}{2k} + \frac{\delta(1 - \varphi)R_0}{2},
\]
\[
\Delta \Pi_0 - \left[ \frac{\delta(H - L)}{2} + \frac{\Delta \beta_i}{2k} + \frac{\delta(1 - \varphi)R_0}{2} \right] < E(\Delta \Pi_1)_{\text{Outside Succession}} - E(\Delta \Pi_1)_{\text{Inside Succession}} < \Delta \Pi_0 - \frac{\Delta \beta_i}{2k}.
\]

where \(0 < \delta < 1\).

These generalized results are qualitatively the same as those in the proposition, although the average inside-outside difference in profits is reduced due to those insiders who take the position in a bad stage of pre-appointment performance and, consequently, the average outside-inside difference in profits change is increased. Again, in our model, the positive component of the outside-inside difference in performance change is only driven by the outside-inside difference in performance during the pre-appointment period.

**IV. Conclusion**

Manager candidates are often associated with the firm before they are appointed. Hence, pre-appointment information exists that helps reveal the candidates’ suitability for the top management position. By incorporating this information into a standard matching model, we have shown that the employment contract for new managers differs in significant ways between inside and outside successors. The predicted differences explain, from the job matching mechanism, a variety of phenomena in managerial departure and succession, that largely remain unexplained. In particular, the model has a novel prediction for incentive contract between inside and outside new managers: Because useful pre-appointment information reduces the uncertainty in matching for insiders, the optimal contract entails a higher pay-performance sensitivity and lower fixed pay to inside successors than to outside ones. This prediction is a unique result deriving from the interaction of the job matching and incentive contracting mechanisms, and can
be directly tested using executive compensation data.

**Appendix A. Proof of Proposition 1**

The firm’s output in the first period can be high or low. When the output is high (i.e. $Y_1 = H$), the posterior probability is $\text{Prob}(\text{Good}|Y_1 = H) = \frac{1 + \delta}{2}$. Then the expected profit is:

$$E(Y_2 - W|Y_1 = H) = \text{Prob}(\text{Good}|Y_1 = H)E(Y_2|\text{Good}) + [1 - \text{Prob}(\text{Good}|Y_1 = H)]E(Y_2|\text{Bad}) - W_2$$

$$= \left(\frac{1 + \delta}{2}\right)\left(\frac{1 + \delta}{2}\right)H + \left(\frac{1 - \delta}{2}\right)L + \left(\frac{1 - \delta}{2}\right)H + \left(\frac{1 + \delta}{2}\right)L - W_2$$

$$= H - \frac{(H - L)(1 - \delta^2)}{2} - W_2.$$

The Lagrange function of the firm’s problem is

$$\Gamma = H - \frac{(H - L)(1 - \delta^2)}{2} - W_2 + \lambda_1 (1 - \delta) + \lambda_2 (W_2 - R_0),$$

where $\lambda_1$ and $\lambda_2$ are two constraint multipliers. The first-order derivatives are:

$$\frac{\partial \Gamma}{\partial \delta} = (H - L)\delta - \lambda_1; \quad \frac{\partial \Gamma}{\partial W_2} = -1 + \lambda_2; \quad \frac{\partial \Gamma}{\partial \lambda_1} = 1 - \delta; \quad \text{and} \quad \frac{\partial \Gamma}{\partial \lambda_2} = W_2 - R_0.$$

The first-order condition $\frac{\partial \Gamma}{\partial \delta} = 0$ requires simultaneously $\delta > 0$ and $\lambda_1 > 0$, or simultaneously $\delta = 0$ and $\lambda_1 = 0$. Because the second-order derivative $\frac{\partial^2 \Gamma}{\partial \delta^2}$ is always positive, there must be $\delta > 0$ and hence $\lambda_1 > 0$, which further requires $\frac{\partial \Gamma}{\partial \lambda_1} = 0$ or $\delta = 1$. Furthermore, $\frac{\partial \Gamma}{\partial W_2} = 0$ determines $\lambda_2 > 1$, which leads to $\frac{\partial \Gamma}{\partial \lambda_2} = 0$ and hence $W_2 = R_0$. Therefore, the firm’s optimal decision is:

$$\delta = 1 \quad \text{and} \quad W_2 = R_0. \quad (A.1)$$

It is optimal for the firm to retain the incumbent CEO and pay the reservation wage so that
Max \( E(Y_2 - W_2 \mid Y_1) = H - R_0 \).

When the output in the first period is low (i.e., \( Y_1 = L \)), the posterior probability becomes

\[
\text{Prob}(\text{Good} \mid Y_1 = L) = \frac{1 - \delta}{2}
\]

Then the expected profit is:

\[
E(Y_2 - W_2 \mid Y_1 = L) = \frac{H + L}{2} - \frac{(H - L)\delta^2}{2} - W_2.
\]

The Lagrange function of the firm’s problem in this case is

\[
\Gamma = \frac{H + L}{2} - \frac{(H - L)\delta^2}{2} - W_2 + \lambda_1(1 - \delta) + \lambda_2(W_2 - R_0),
\]

In the similar solution strategy, we determine the firm’s optimal decision:

\[
\delta = 0 \quad \text{and} \quad W_2 = R_0.
\]

Therefore, it is optimal to hire an outsider to replace the CEO for the second-period production so that \( \text{Max} \ E(Y_2 - W_2 \mid Y_1) = \frac{H + L}{2} - R_0 \).

Appendix B. Proof of Proposition 2

When the new manager’s match with the firm is good, Proposition 1 determines that he is retained for the second period; otherwise, he has to leave and, with likelihood \( \varphi \), find another job for the second period. Using this condition and \( W_2 = R_0 \), we obtain the candidate’s expected two-period compensation:

\[
E(W_1 + W_2 \mid Y_0) = W_1 + \text{Prob}(\text{Good} \mid Y_0)E(W_2 \mid \text{Good}) + [1 - \text{Prob}(\text{Good} \mid Y_0)]E(W_2 \mid \text{Bad})
\]

\[
= W_1 + \text{Prob}(m_1 = G \mid Y_0)(1 - \varphi)R_0 + \varphi R_0
\]

With \( W_2 = R_0 \), the firm’s objective function is:
\[ E[(Y_1 - W_1) + (Y_2 - W_2)] \]
\[ = \text{Prob}(\text{Good}|Y_0)E(Y_1 + Y_2|\text{Good}) + [1 - \text{Prob}(\text{Good}|Y_0)]E(Y_1 + Y_2|\text{Bad}) - W_1 - R_0 \]
\[ = \text{Prob}(\text{Good}|Y_0)(H + H) + [1 - \text{Prob}(\text{Good}|Y_0)]\left( L + \frac{H + L}{2} \right) - W_1 - R_0 \]
\[ = \frac{H + 3L}{2} + \frac{3(H - L)}{2}\text{Prob}(\text{Good}|Y_0) - W_1 - R_0. \]

The Lagrange function is:
\[ \Gamma = \frac{H + 3L}{2} + \frac{3(H - L)}{2}\text{Prob}(\text{Good}|Y_0) - W_1 - R_0 + \lambda_1 (1 - \delta) + \lambda_2 \left[ W_1 + \frac{1}{2} (1 - \varphi)(1 + \delta)R_0 + \varphi R_0 - 2R_0 \right]. \]

We now discuss the solution for the two cases of \( Y_0 \) separately.

**Case 1: \( Y_0 = H \).**

With \( \text{Prob}(\text{Good}|Y_0 = H) = \frac{1 + \delta}{2} \), the Lagrange function is:
\[ \Gamma = \frac{H + 3L}{2} + \frac{3(H - L)(1 + \delta)}{4} - W_1 - R_0 + \lambda_1 (1 - \delta) + \lambda_2 \left[ W_1 + \frac{1}{2} (1 - \varphi)(1 + \delta)R_0 + \varphi R_0 - 2R_0 \right]. \]

The first-order derivatives are:
\[ \frac{\partial \Gamma}{\partial \delta} = \frac{3}{4} (H - L) - \lambda_1 + \frac{1}{2} \lambda_2 (1 - \varphi)R_0; \]
\[ \frac{\partial \Gamma}{\partial W_1} = -1 + \lambda_2; \]
\[ \frac{\partial \Gamma}{\partial \lambda_1} = 1 - \delta; \]
\[ \frac{\partial \Gamma}{\partial \lambda_2} = W_1 + \frac{1}{2} (1 - \varphi)(1 + \delta)R_0 + \varphi R_0 - 2R_0. \]
The first-order condition \( \frac{\partial \Gamma}{\partial W_1} = 0 \) determines \( \lambda_2 = 1 \), which in turn requires \( \frac{\partial \Gamma}{\partial \lambda_2} = 0 \) and hence,

\[
W_1 = R_0 + \frac{(1 - \delta)(1 - \varphi)R_0}{2}.
\]

Further, because \( \delta < 1 \), we have \( \frac{\partial \Gamma}{\partial \lambda_4} = 1 - \delta > 0 \) and hence \( \lambda_4 = 0 \). With \( \lambda_1 = 0 \) and \( \lambda_2 = 1 \), there is always \( \frac{\partial \Gamma}{\partial \delta} > 0 \). Therefore, the firm’s optimal decision is:

\[
0 < \delta < 1; \quad W_1 = R_0 + \frac{(1 - \delta)(1 - \varphi)R_0}{2}; \quad W_2 = R_0
\]

(A.3)

If there are more than one inside candidate, the firm needs to appoint the one who has the highest \( \delta \) (i.e. who has played a role in the firm that is only second to that of the CEO).

So the likelihood of good match for the new manager is \( \text{Prob}(\text{Good}|Y_0 = H) = \frac{1 + \delta}{2} \), where

\[
0 < \delta < 1, \quad \text{and the firm’s expected profit is:}
\]

\[
E \left[ (Y_1 - W_1) + (Y_2 - W_2) | Y_0 \right] = \frac{5H + 3L}{4} + \frac{3(H - L)\delta}{4} - \left[ 4 + (1 - \delta)(1 - \varphi) \right] R_0.
\]

Case 2: \( Y_0 = L \).

With \( \text{Prob}(\text{Good}|Y_0 = L) = \frac{1 - \delta}{2} \), the Lagrange function becomes:

\[
\Gamma = \frac{H + 3L}{2} + \frac{3(H - L)(1 - \delta)}{4} - W_1 - R_0 + \lambda_1 (1 - \delta) + \lambda_2 \left\{ W_1 + \frac{1}{2} (1 - \varphi)(1 - \delta) R_0 + \varphi R_0 - 2R_0 \right\}.
\]

From the first-order conditions, we obtain the firm’s optimal decision in this case:

\[
\delta = 0; \quad W_1 = R_0 + \frac{(1 - \varphi)R_0}{2}; \quad W_2 = R_0.
\]

(A.4)
The likelihood of good match for the new manager is \( \text{Prob}(\text{Good}|Y_0 = L) = \frac{1}{2} \) and the firm’s expected profit is:

\[
E[(Y_1 - W_1) + (Y_2 - W_2)|Y_0] = \frac{5H + 3L}{4} - \frac{(5 - \varphi)R_0}{2}.
\]

**Appendix C. Proof of Proposition 3**

With the first-period pay \( W_1(Y_0 = H) = R_0 + \frac{(1 - \delta_1)(1 - \varphi)R_0}{2} \) to an inside successor and \( W_1(Y_0 = L) = R_0 + \frac{(1 - \varphi)R_0}{2} \) to an outside successor (Proposition 2), we have:

\[
E(\Pi_1|Y_0 = H) = \text{Prob}(\text{Good}|H)E(Y_1|\text{Good}) + [1 - \text{Prob}(\text{Good}|H)]E(Y_1|\text{Bad}) - W_1 \\
= \left( \frac{1 + \delta_1}{2} \right)H + \left( \frac{1 - \delta_1}{2} \right)L - R_0 - \frac{(1 - \delta_1)(1 - \varphi)R_0}{2}
\]

\[
E(\Pi_1|Y_0 = L) = \text{Prob}(\text{Good}|L)E(Y_1|\text{Good}) + [1 - \text{Prob}(\text{Good}|L)]E(Y_1|\text{Bad}) - W_1 \\
= \frac{1}{2}H + \frac{1}{2}L - R_0 - \frac{1}{2}(1 - \varphi)R_0
\]

Therefore, we have:

\[
E(\Pi_1|Y_0 = H) - E(\Pi_1|Y_0 = L) = \frac{\delta_1}{2}[(H - L) + (1 - \varphi)R_0].
\]

\[
E(\Delta \Pi_1|Y_0 = H) - E(\Delta \Pi_1|Y_0 = L) = [E(\Pi_1|Y_0 = H) - (H - W_0)] - [E(\Pi_1|Y_0 = L) - (L - W_0)] \\
= \frac{\delta_1}{2}[(H - L) + (1 - \varphi)R_0] - (H - L).
\]

**Appendix D. Proof of Proposition 4**

We first determine \( \bar{m}_t \) and \( \sigma_{m,t}^2 \) as a function of the pre-appointment information, \( Y_{t-1} \).
When \( Y_{t-1} > M \), we have:

\[
\bar{m}_i(Y_{t-1} > M) = \text{Prob}(m_t = H|Y_{t-1} > M) \times H + [1 - \text{Prob}(m_t = H|Y_{t-1} > M)] \times L
\]

\[
= \left( \frac{1 + \delta}{2} \right) H + \left( \frac{1 - \delta}{2} \right) L = \frac{H + L}{2} + \frac{\delta(H - L)}{2};
\]

\[
\sigma_{m,i}^2(Y_{t-1} > M) = \text{Prob}(m_t = H|Y_{t-1} > M)[H - \bar{m}_i(Y_{t-1} > M)]^2 + [1 - \text{Prob}(m_t = H|Y_{t-1} > M)][L - \bar{m}_i(Y_{t-1} > M)]^2
\]

\[
= \left( \frac{1 + \delta}{2} \right) \left( H - \frac{H + L}{2} - \frac{\delta(H - L)}{2} \right)^2 + \left( \frac{1 - \delta}{2} \right) \left( L - \frac{H + L}{2} - \frac{\delta(H - L)}{2} \right)^2 = \left( 1 - \delta^2 \right) \left( \frac{H - L}{2} \right)^2.
\]

Similarly, we obtain \( \bar{m}_i \) and \( \sigma_{m,i}^2 \) for the case of \( Y_{t-1} < M \):

\[
\bar{m}_i(Y_{t-1} < M) = \frac{H + L}{2} - \frac{\delta(H - L)}{2}, \quad \sigma_{m,i}^2(Y_{t-1} < M) = \left( 1 - \delta^2 \right) \left( \frac{H - L}{2} \right)^2.
\]

We now obtain the solution for the first-period contract. Using the binding ICC, the Lagrange function for the firm’s second-period problem is:

\[
\Gamma = -\alpha_2 + (1 - \beta_2) \left[ \bar{m}_2(Y_1) + \frac{\beta_2}{k} \right] + \lambda_1 \left\{ \alpha_2 + \beta_2 \bar{m}_2(Y_1) + \frac{\beta_2^2}{2k} - \frac{1}{2} \beta_2 \rho \sigma_{m,2}^2(Y_1) + \sigma_\epsilon^2 \right\} - R_0,
\]

where \( \lambda_1 \) is the multiplier for the participation constraint. The first-order derivatives are:

\[
\frac{\partial \Gamma}{\partial \alpha_2} = -1 + \lambda_1;
\]

\[
\frac{\partial \Gamma}{\partial \beta_2} = -\bar{m}_2(Y_1) - \frac{2\beta_2}{k} + \frac{1}{k} + \lambda_1 \left\{ \bar{m}_2(Y_1) + \frac{\beta_2}{k} - \beta_2 \rho \sigma_{m,2}^2(Y_1) + \sigma_\epsilon^2 \right\};
\]

\[
\frac{\partial \Gamma}{\partial \lambda_1} = \alpha_2 + \beta_2 \bar{m}_2(Y_1) + \frac{\beta_2^2}{2k} - \frac{1}{2} \beta_2 \rho \sigma_{m,2}^2(Y_1) + \sigma_\epsilon^2 - R_0.
\]

Letting the first two constraints be binding and solving them simultaneously gives:
\[
\beta_2 = \frac{1}{1 + k\rho \sigma_m^2 (Y_1) + \sigma_e^2} = \frac{1}{1 + k\rho \left(1 - \delta^2 \frac{(H - L)^2}{2} + \sigma_e^2\right)}.
\]

(A.9)

With \( \lambda_i > 0 \), the participation constraint is binding, which allows us to determine the constant component of pay:

\[
\alpha_2 = R_0 - \beta_2 \left[ \bar{m}_2(Y_1) - \frac{1}{2k} \right] - \frac{\beta_2^2}{k}.
\]

(A.10)

The firm’s expected profit is:

\[
E(Y_2 - W_2 \mid Y_1) = -\alpha_2 + (1 - \beta_2) \left[ \bar{m}_2(Y_1) + \frac{\beta_2}{k} \right] = \bar{m}_2(Y_1) + \frac{\beta_2}{2k} - R_0.
\]

(A.11)

The first term presents the effect of matching quality on the firm’s profits. The second presents the effect of managerial incentives on firm performance.

There are two cases. In the first case, \( Y_1 > M \) and the expected profit is:

\[
E(Y_2 - W_2 \mid Y_1 > M) = \frac{H + L}{2} + \frac{\delta(H - L)}{2} + \frac{1/2k}{1 + k\rho \left(1 - \delta^2 \frac{(H - L)^2}{2} + \sigma_e^2\right)} - R_0,
\]

which is maximized at \( \delta = 1 \). That is, when the firm’s existing performance is strong, it is optimal for the firm to retain the incumbent manager. The pay contract is:

\[
\beta_2 = \frac{1}{1 + k\rho \sigma_e^2}; \quad \alpha_2 = R_0 - \beta_2 \left( H - \frac{1}{2k} \right) - \frac{\beta_2^2}{k}.
\]

(A.12)

In the second case, \( Y_1 < M \) and the expected profit becomes:

\[
E(Y_2 - W_2 \mid Y_1 < M) = \frac{H + L}{2} - \frac{\delta(H - L)}{2} + \frac{1/2k}{1 + k\rho \left(1 - \delta^2 \frac{(H - L)^2}{2} + \sigma_e^2\right)} - R_0.
\]

Differentiating \( E(Y_2 - W_2 \mid Y_1 < M) \) with respect to \( \delta \) and letting it be negative, we obtain:
\[
\frac{H - L}{2} > \frac{\rho \delta \left( \frac{H - L}{2} \right)^2}{\left( 1 + k \rho \right) \left( \frac{H - L}{2} \right)^2 + \sigma^2}.
\] (A.13)

That is, when this matching dominance condition is satisfied, the expected profit is maximized at \( \delta = 0 \). Therefore, when the firm’s existing performance is weak, it is optimal for the firm to hire an outsider to replace the incumbent manager. The pay contract in this case is:

\[
\alpha_2 = R_0 - \beta_2 \left( \frac{H + L}{2} - \frac{1}{2k} \right) - \frac{\beta^2_2}{k}.
\] (A.14)

**Appendix E. Proof of Proposition 5**

The firm’s expected two-period profit is:

\[
E(\Pi_{1+2}) = E\left[(Y_1-W_1) + (Y_2-W_2)|Y_0^1\right] \\
= E(Y_1-W_1|Y_0^1) + \text{Prob}(m_1=H|Y_0)E(Y_2-W_2|m_1=H) + \left[1 - \text{Prob}(m_1=H|Y_0)\right]E(Y_2-W_2|m_1=L) \\
= -\alpha_1 + (1 - \beta_1)[\mu_t(Y_0) + e_t] + E(Y_2-W_2|m_1=L) + \text{Prob}(m_1=H|Y_0)\Delta \Pi_{2}^{H-L}
\]

where, assuming that condition (15) in is satisfied,

\[
E(Y_2-W_2|m_1=L) = \frac{H + L}{2} + \frac{1/2k}{1 + k \rho \left( \frac{H - L}{2} \right)^2 + \sigma^2} - R_0,
\]

\[
E(Y_2-W_2|m_1=H) = H + \frac{1/2k}{1 + k \rho \sigma^2_e} - R_0,
\]
\[
\Delta \Pi^H = \Pi^H - \Pi = \frac{H - L}{2} + \frac{\rho \left( \frac{H - L}{2} \right)^2}{2(1 + k \sigma^2)} \left\{ 1 + k \rho \left[ \left( \frac{H - L}{2} \right)^2 + \sigma^2 \right] \right\}.
\]

Use the second-period solution \( E(U_2 | m_1) = R_0 \) to simplify the manager’s expected utility:

\[
E(U_{1+2}) = \alpha_1 + \beta_1 \bar{m}(Y_0) + \beta_1 e_1 - \frac{1}{2} k e_1^2 - \frac{1}{2} \beta_1 \rho \left[ \sigma^2_{m_1}(Y_0) + \sigma^2_{e} \right] + (1 - \varphi) R_0 \text{Prob}(m_1 = H | Y_0) + \varphi R_0.
\]

Noting that the second-period decision does not depend on the first period one, we can use the second-period solution and write the Lagrange function for the first-period problem as:

\[
\Gamma = -\alpha_1 + (1 - \beta_1) [\bar{m}(Y_0) + e_1] + E(Y_2 - W_2 | m_1 = L) + \text{Prob}(H | Y_0) \Delta \Pi^L + \lambda_1 (\beta_1 - k e_1)
\]

\[
+ \lambda_2 \left\{ \alpha_1 + \beta_1 \bar{m}(Y_0) + \beta_1 e_1 - \frac{1}{2} k e_1^2 - \frac{1}{2} \beta_1 \rho \left[ \sigma^2_{m_1}(Y_0) + \sigma^2_{e} \right] + (1 - \varphi) R_0 \text{Prob}(m_1 = H | Y_0) + \varphi R_0 - 2R_0 \right\}
\]

The first-order derivatives are:

\[
\frac{\partial \Gamma}{\partial \alpha_1} = -1 + \lambda_2
\]

\[
\frac{\partial \Gamma}{\partial \beta_1} = -\bar{m}(Y_0) - e_1 + \lambda_2 \left\{ \bar{m}(Y_0) + e_1 - \beta_1 \rho \left[ \sigma^2_{m_1}(Y_0) + \sigma^2_{e} \right] \right\}
\]

\[
\frac{\partial \Gamma}{\partial e_1} = 1 - \beta_1 - \lambda_1 k + \lambda_2 \left\{ \beta_1 - k e_1 \right\}
\]

\[
\frac{\partial \Gamma}{\partial \lambda_1} = \beta_1 - k e_1
\]

\[
\frac{\partial \Gamma}{\partial \lambda_2} = \alpha_1 + \beta_1 \bar{m}(Y_0) + \beta_1 e_1 - \frac{1}{2} k e_1^2 - \frac{1}{2} \beta_1 \rho \left[ \sigma^2_{m_1}(Y_0) + \sigma^2_{e} \right] + (1 - \varphi) R_0 \text{Prob}(m_1 = H | Y_0) + \varphi R_0 - 2R_0.
\]
Solving the first-order conditions gives:

\[
\beta_1 = \frac{1}{1 + k\rho \left( 1 - \delta^2 \left( \frac{H - L}{2} \right)^2 + \sigma_e^2 \right)},
\]

(A.15)

\[
\alpha_1 = R_0 - \beta_1 \left( \bar{m}_1(Y_0) + \frac{\beta_1}{k} \frac{1}{2} \right) + (1 - \varphi) R_0 \left[ 1 - \text{Prob}(m_1 = H|Y_0) \right],
\]

(A.16)

\[
E(\Pi_{1+2}) = \bar{m}_1(Y_0) + \frac{\beta_1}{2k} - (1 - \varphi) R_0 \left[ 1 - \text{Prob}(m_1 = H|Y_0) \right] + E(\Pi_2|m_1 = L) + \text{Prob}(m_1 = H|Y_0) \Delta \Pi_{2}^{H-L} - R_0
\]

Case 1. \( Y_0 > M \) (when the pre-appointment performance is strong).

With \( \text{Prob}(m = H|Y_0) = \frac{1 + \delta}{2} \) and \( \bar{m}_1(Y_0) = \frac{H + L}{2} + \frac{\delta(H - L)}{2} \), we obtain:

\[
E(\Pi_{1+2}) = \frac{H + L}{2} + \frac{\delta(H - L)}{2} + \frac{1/2k}{1 + k\rho \left( 1 - \delta^2 \left( \frac{H - L}{2} \right)^2 + \sigma_e^2 \right)} - \frac{(1 - \delta)(1 - \varphi) R_0}{2}
\]

\[
+ E(\Pi_2|m_1 = L) + \frac{(1 + \delta) \Delta \Pi_{2}^{H-L}}{2} - R_0
\]

With all terms with \( \delta \) being increasing in \( \delta \), the equilibrium requires \( \delta \) be maximized; in other words, the insider is appointed as the new CEO. His pay-performance sensitivity and expected total pay are

\[
\beta_1 = \frac{1}{1 + k\rho \left( 1 - \delta^2 \left( \frac{H - L}{2} \right)^2 + \sigma_e^2 \right)}
\]

and

\[
E(W_1) = R_0 + \frac{\beta_1}{2k} + \frac{(1 - \delta)(1 - \varphi) R_0}{2},
\]

(A.17)

respectively, where \( 0 < \delta < 1 \).
Case 2: $Y_0 < M$ (when the pre-appointment performance is weak).

With $\text{Prob}(m = H|Y_0) = \frac{1-\delta}{2}$ and $\bar{m}_i(Y_0) = \frac{H + L}{2} - \frac{\delta(H - L)}{2}$, we obtain:

$$E(\Pi_{1+2}) = \frac{H + L}{2} - \frac{\delta(H - L)}{2} + \frac{1/2k}{1 + kp\left[1 - \delta^2\left(\frac{H - L}{2}\right)^2 + \sigma_e^2\right]} - \frac{(1 + \delta)(1 - \varphi)R_0}{2},$$

$$+ E(\Pi_2|m_1 = L) + \frac{(1 - \delta)\Delta \Pi_2^{H-L}}{2} - R_0.$$

Hence,

$$\frac{\partial E(\Pi_{1+2})}{\partial \delta} = -\frac{(H - L) + \Delta \Pi_2^{H-L} + (1 - \varphi)R_0}{2} + \frac{\rho \delta\left(\frac{H - L}{2}\right)^2}{\left[1 + kp\left[1 - \delta^2\left(\frac{H - L}{2}\right)^2 + \sigma_e^2\right]\right]^2}. \quad (A.18)$$

The derivative is negative when the effect of matching (the first term) dominates the incentive effect (the second term), which is guaranteed by the matching dominance condition (14).

Therefore, the expected profit is maximized at $\delta = 0$; that is, the outsider is appointed as the new CEO. His pay-performance sensitivity and expected total pay are:

$$\beta_1 = \frac{1}{1 + kp\left[\left(\frac{H - L}{2}\right)^2 + \sigma_e^2\right]} \quad \text{and} \quad E(W_1) = R_0 + \frac{\beta_1}{2k} + \frac{(1 - \varphi)R_0}{2}, \quad (A.19)$$

respectively.

For the quality of matching, an outsider’s likelihood of having a good match with the firm is always $\frac{1}{2}$, and an insider’s likelihood is $\frac{1 + \delta}{2}$ when the matching dominance condition is met.
so that he is only appointed when the pre-appointment performance is strong.

Finally, we consider the more general case: the matching dominance condition does not always hold so it is possible for the firm to appoint an inside CEO in the state of poor pre-appointment performance. To generalize our results by taking into account this possibility, we consider the extreme case when insiders are always appointed. Given an equal chance of good and poor performance, half of the inside managers have a likelihood of \( \frac{1+\delta}{2} \) to have a good match and the other half \( \frac{1-\delta}{2} \). From \( E(W_i) = \alpha_i + \beta_i (\bar{m}_i + e_i) \), (A.15) and (A.16), we have

\[
E(W_i(Y_0 < M)) = R_0 + \frac{(1+\delta)(1-\varphi)R_0}{2} + \frac{\beta_1}{2k} \quad \text{where} \quad 0 < \delta < 1. \tag{A.20}
\]

Taking average of the likelihood and \( E(W_i) \) over the two states of performance gives the solution for the extreme case when insiders are always appointed. This solution determines the lower bound of the likelihood and the upper bound of the expected pay to the insider. Therefore, the generalized solution is:

\[
\frac{1}{2} < \text{Prob}(\text{Good})_{\text{insider}} < \frac{1+\delta}{2}, \tag{A.21}
\]

\[
R_0 + \frac{(1-\delta)(1-\varphi)R_0}{2} + \frac{\beta_1}{2k} < E(W_i)_{\text{insider}} < R_0 + \frac{(1-\varphi)R_0}{2} + \frac{\beta_1}{2k}. \tag{A.22}
\]

\[ \blacksquare \]

**Appendix F. Proof of Proposition 6**

From Proposition 5, when the matching dominance condition (14) holds, the firm’s expected first-period profit in the two performance cases are respectively:
\[
E(\Pi_1|Y_0 > M) = -R_0 + \frac{H + L}{2} + \frac{\delta(H - L)}{2} + \frac{\beta_1(\delta > 0)}{2k} - \frac{(1 - \delta)(1 - \varphi) R_0}{2}, \quad (A.23)
\]

\[
E(\Pi_1|Y_0 < M) = -R_0 + \frac{H + L}{2} + \frac{\beta_1(\delta > 0)}{2k} - \frac{(1 - \varphi) R_0}{2}. \quad (A.24)
\]

Therefore, we have:

\[
E(\Pi_1)_{\text{inside succession}} - E(\Pi_1)_{\text{outside succession}} = \frac{\delta(H - L)}{2} + \frac{\Delta \beta_1}{2k} + \frac{\delta(1 - \varphi) R_0}{2}, \quad (A.25)
\]

\[
E(\Delta \Pi_1)_{\text{outside succession}} - E(\Delta \Pi_1)_{\text{inside succession}} = \Delta \Pi_0 = \left[ \frac{\delta(H - L)}{2} + \frac{\Delta \beta_1}{2k} + \frac{\delta(1 - \varphi) R_0}{2} \right], \quad (A.26)
\]

where \( E(\Pi_1)_{\text{inside succession}} \equiv E(\Pi_1|Y_0 > M) \), \( E(\Pi_1)_{\text{outside succession}} \equiv E(\Pi_1|Y_0 < M) \),

\[
E(\Delta \Pi_1)_{\text{inside succession}} = E(\Pi_1|Y_0 > M) - \Pi_0(Y_0 > M), \quad E(\Delta \Pi_1)_{\text{outside succession}} = E(\Pi_1|Y_0 < M) - \Pi_0(Y_0 < M).
\]

\( \Delta \Pi_0 = \Pi_0(Y_0 > M) - \Pi_0(Y_0 < M) \), and \( \Delta \beta_1 = \beta_1(\delta > 0) - \beta_1(\delta = 0) \), and where \( 0 < \delta < 1 \).

We now extend the above results to the more general case by allowing inside succession in the state of poor performance (which can occur when the matching dominance condition is violated). The expected first-period profit with inside succession in the state of poor pre-appointment performance is:

\[
E(\Pi_1) = -R_0 + \frac{H + L}{2} + \frac{\delta(H - L)}{2} + \frac{\beta_1(\delta)}{2k} = \frac{(1 + \delta)(1 - \varphi) R_0}{2} \quad \text{where} \quad 0 < \delta < 1. \quad (A.27)
\]

Taking average of (A.23) and (A.27) gives the expected profit in the extreme case when insiders are always hired (in which half of the insiders will be associated with \( Y_0 > M \) and the other half with \( Y_0 < M \)):

\[
E(\Pi_1) = -R_0 + \frac{H + L}{2} + \frac{\beta_1(\delta)}{2k} = \frac{(1 - \varphi) R_0}{2} \quad \text{where} \quad 0 < \delta < 1. \quad (A.28)
\]
Because this presents a lower bound of the expected profit with inside succession, the above results, Eqs. (A.25) and (A.26), become:

\[
\frac{\Delta \beta_i}{2k} < E(\Pi_i)_{\text{inside succession}} - E(\Pi_i)_{\text{outside succession}} < \frac{\delta (H - L)}{2} + \frac{\Delta \beta_i}{2k} + \frac{\delta (1 - \phi)R_0}{2}, \tag{A.29}
\]

\[
\Delta \Pi_0 - \left[ \frac{\delta (H - L)}{2} + \frac{\Delta \beta_i}{2k} + \frac{\delta (1 - \phi)R_0}{2} \right] < E(\Delta \Pi_i)_{\text{outside succession}} - E(\Delta \Pi_i)_{\text{inside succession}} < \Delta \Pi_0 - \frac{\Delta \beta_i}{2k},
\tag{A.30}
\]

\]

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