A Theory on CEO Replacement by the Corporate Board

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Abstract

This paper provides a theory on how corporate board determines two important decisions regarding CEO replacement: the amount of monitoring level, and the choice of a successor to a CEO. I argue that there is a potential reason why boards are reluctant to have CEO turnover. The board consists of a CEO, outside directors, and inside directors. I examine that although the two types of directors have different incentives about becoming the next CEO, when all the incumbent board members jointly make these decisions, they agree to minimize the amount which will be paid to the future newcomer to the board, for the smaller the expected pay to the newcomer, the higher is the pay the incumbent board members receive in the future. The theory developed in this paper can explain why a less talented inside director is often promoted to the post of CEO even when there is a better candidate outside the board. Moreover, it can explain why the board tends to produce weak monitoring and hardly fires CEO.

Keywords: Corporate Governance; CEO Succession Policy; Board Monitoring; Outside Directors; Inside Directors

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1 Introduction

The board of directors is responsible for monitoring management, both legitimacy and adequacy of CEOs conduct, and replacing them if necessary. These are not exhaustive but two widely appreciated responsibilities of the boards and have been considered as the crux of corporate governance. However, many boards often fail these duties unwillingly or deliberately and invite unfavorable results.

This paper explores how corporate boards make their decisions about CEO replacement. CEO replacement requires two important decisions: a decision to fire the incumbent CEO which is often treated as synonymous to a decision about the monitoring level (the interpretation of *monitoring level* is defined later in section 4.1), and the choice of a successor to a CEO.[1] The board consists of three players: a CEO, inside directors, and outside directors. In my model, inside directors are all equally CEO candidates, but outside directors have the incentive to appoint the talented candidate to the post of CEO but cannot become CEO themselves.[2]

I find that when the incumbent board members jointly determine these two decisions, they consider about splitting the share the board receives from the expected corporate profit only among the incumbent members who participate in decision makings. However, CEO replacement requires a dismissal

[1] Monitoring is done to replace *a bad match CEO* with a new CEO, as in Hermalin and Weisbach [1998], and hence the term *monitoring* is used to mean *learning CEO's talent* or *evaluating CEO decisions.* Similar to Hermalin and Weisbach [1998], Raheja [2005], and Warther [1998], the CEO in this paper does not make efforts after being monitored.

[2] The term *outside directors* in this paper is defined as those non-management directors who are not expected to become CEO of the company where they are serving as outsiders. In Raheja [2005], outside directors are modeled as those who do not become CEOs. The directors in Hermalin and Weisbach [1998] are not expected to become CEO either. In logic, an outside director may become CEO if he quits to serve as an outsider of the relevant company. However, outsiders usually have their executive roles in other company, or have other professions as lawyers or professors, and in many cases serve as outsiders on multiple boards, and therefore, defining *outsiders* as non-CEO candidates, is not a deviation from the existing literature nor practice. It may as well be defined as *professional directors*, a concept proposed by Gilson and Kraakman [1991].

of the incumbent CEO and an appointment of a new CEO and hence they cannot avoid a newcomer to the board. I show that from the perspective of the incumbent board members, having a newcomer to the board in the future and letting the newcomer receive a pay or a benefit in place of one of themselves induce a certain expected loss to them at the point of decision makings. (I specify the expected loss later in this section.) Thus, the decisions related to CEO replacement are made to minimize such loss, and sometimes render a board weak monitoring device. I discuss that the theory developed in this paper can explain for weak monitoring of the CEOs and can also explain why one of the inside directors is often chosen to become a successor CEO when there is an outside candidate who is more talented.[3]

Weak monitoring is often attributed to several causes; such as director's personal allegiance to the CEO, the CEO being the chairman of the board, directors' lack of knowledge or information, and sense of comradeship for the CEO. Some of these are addressed by the laws or the rules.[4][5] The expected loss the board members incur from having a member change is different from these causes, and have not been paid much attention as a cause of weak board monitorings. On the other hand, there are a lot of discussions about factors that affect decisions to appoint either an insider or an outsider as a successor.[6] Bower [2007] states approximately sixty percent of the firms in

[3]This theory can explain a reason other than a family tie when a successor is chosen from one of the inside directors. For example, Nordstrom having family members on the board and passing the baton to them may not simply due to a desire to have one of the founder's kins on the top seat.

[4]For example, the NYSE and NASDAQ rules to require nominating committees of listed companies to be composed entirely of independent directors is intended to reduce director's personal allegiance to the CEO, where the SOX Acts provide a definition of what constitutes independence. The SEC's requirement of at least one financial expert on the audit committee is to supplement financial knowledge to the board.

[5]Charkham [2005] covers the recent changes made on corporate governance in five leading economies and discusses these in detail. Interested readers are also referred to Institute of Directors [2005].

[6]In this paper, a new CEO is appointed to the board after a forced retirement of the predecessor CEO, but the succession theory developed in this paper can be applied for both voluntary and forced CEO turnover.

which he conducted research have no specific policies about how to decide their successor CEOs. This may sound as if forty percent of the companies have fixed rules about where to hire a new CEO from, or to whom to give the baton, but sixty percent of the firms do not. And there has not been an argument that expected loss may explain the decision makings of such companies. Even though efforts have been devoted to formulate theoretical models about how boards make their decisions, there has not been a literature that discuss the concept of expected loss board members incur by having a CEO turnover.[7] (The related studies are discussed in section two.)

In the main model of this paper, there are one CEO, n_1 outside directors, and n_2 inside directors, where $n_1 + n_2 = n$, and hence total of $n + 1$ incumbent board members. All n_1 outside directors and n_2 inside directors act as one player respectively, and the CEO has a lot of influence on board decision makings, so the decisions regarding monitoring levels and where to bring the successor CEO from are determined by all three players in Nash bargaining.[8] Both types of directors are responsible for monitoring the CEO and if necessary, fire him. This is because the board receives a certain share from the corporate profit which is dependent on CEO's ability whose true value is not known to any player. All the directors equally receive a payment from the expected payoff at the end of the game. If the CEO is believed to have a bad ability as a result of monitoring, the board needs a new CEO who is expected to have a good ability and hence bring a higher profit to the firm. The successor is either promoted internally or recruited from outside the board, depending on the policy determined earlier. (I show later in section four that the same result is obtained even if the remaining directors renegotiate about the succession policy after they dismiss the incumbent CEO.[9]) The basic structure (especially the role and the payoff of the CEO)

[7] In Sato [2007], I argue the expected loss which are specific to the U.S. and Japanese corporate governance systems. In this paper, I develop a general model of expected loss which incumbent corporate board members incur from having CEO replacement.

[8] See Wilson [1968] for treating players of same utility function as one group.

[9] The directors are not making commitment to the succession policy determined together

follows Hermalin and Weisbach [1998].

In this setting, I specify the two types of expected loss (which is hereinafter referred to as 'loss') incumbent board members incur and how they affect board decisions. The type of 'loss' varies by the succession policy. Specifically, if the board decides to recruit from outside, a new CEO is the newcomer and the benefit this new CEO will receive in place of the incumbent CEO is a 'loss' to the incumbent members, whereas if it decides to promote an insider, one of the incumbent directors succeeds the post, but to keep the board size at $n + 1$, a new director (a newcomer) is hired, and the pay he will receive in the future is a 'loss' to the incumbent members. Since 'loss' is disutility to incumbent members, they choose the succession policy with less 'loss.' However, the succession policy is determined by comparing the two gaps; a gap between the amount of losses and a gap between the expected talents of CEO candidates. At the same time, the monitoring level is determined at the level that maximizes the Nash product of the incumbent board members which reflects the 'loss' that is specific to the succession policy.

With respect to the size of the board and its composition, I argue that the larger is the size of the board, the stronger the tendency to promote an inside director to the post of CEO. It is also shown that board monitorings become weak when the number of directors increases. I also argue that having two types of directors increases the alternatives of succession policy. Specifically, if the board is composed solely of outside directors, there is no choice but to recruit a successor from outside the incumbent board, but if the board has at least one inside director or solely composed of inside directors, it has a choice to promote an insider or recruit from outside the board. However, I discuss that when the board has at least one inside director (other than the CEO), although it opens a channel to promote inside directors, there is a risk of promoting a less talented insider when outside candidates are more talented than any inside candidates, unless the difference between their talents are

with the initial CEO.

extremely large. Since the optimum monitoring level is determined unique to the succession policy, the monitoring level is also relevant to the board composition. In Raheja [2005], she argues that board monitoring is effective when the board is composed of both outside directors and inside directors when there is asymmetric information between them. In my model, I show that even without information asymmetry, the board composed of both types of directors can produce effective monitoring and also show how it differs from board composed solely of outside directors.

The remainder of the paper is organized as follows. The next section of the paper discusses relevant literatures. Section three provides a brief orientation of the concept 'loss' using a simple model. Section four develops a main model and discusses how 'loss' affect the board's monitoring intensity and decisions on CEO succession policy. Section five concludes.

2 Literature Review

There are several literatures that theoretically discuss the cause of board lax monitoring.[10] Some of them specify the cause and further discuss it in relation to board composition. However, to the extent of my knowledge, there has not been a literature that argues 'loss' as a cause of weak board monitoring.[11] This paper provides a theoretical model on how a certain 'loss' affects board monitoring and how it differs depending on board characteristics, or in other words, a succession policy. It also examines how decisions regarding CEO successions are made, where there has not been much effort devoted to provide a theoretical formulation of CEO succession policy in the incumbent literature.

Hermalin and Weisbach [1998] provide a model in which the board mem-

[10] See the survey provided by Gillan [2006] for both theoretical and empirical studies. Also refer to Tirole [2006].

[11] In Sato [2007], I compare two corporate governance systems using the concept developed in this paper.

ber is endogenously determined in Nash bargaining between the board and the CEO. They argue that when CEO is involved in appointing a new director, someone who is less independent from the CEO is appointed and weakens board monitorings of the CEO. They measure this with notation $\overline{k}$: the board's lack of independence, where it changes from $\overline{k}_0$ to $\overline{k}_1$ ($\overline{k}_0 < \overline{k}_1$) as the board members changes. This $\overline{k}$ can be interpreted as a measure of comradeship or allegiance to the CEO, and they argue that the higher is $\overline{k}$ (or stronger the comradeship or allegiance to the CEO), the less they monitor the CEO. Similar to this cause, but a little different is a fear of being ousted from the board. That is, the directors do not always show their disagreement to the CEO for a fear of being ousted from the board when the CEO has a power to remove the directors from the board. This framework is developed by Warther [1998] where he shows a director cannot express his disagreement to the CEO when the other director is standing in the CEO's side.

With respect to the cause such as a lack of knowledge or information, Raheja [2005] develops a model where inside directors and outside directors face asymmetric information about a project implemented by the CEO.[12] The insiders are successor CEO candidates themselves and have the expertise knowledge in management and know the quality of the project proposed by the CEO, whereas the outsiders cannot tell the quality of the proposed project unless insiders share their superior information to them. When the information is shared, the outsiders decide to vote for or against the proposed project, but to vote against it requires verification that their decision is correct and hence monitoring is performed by outsiders. It is assumed that monitoring (verifying) is so costly that the outsiders do not monitor absent the insiders' information. This implies that in order for boards to function as monitoring device, the board must comprise both inside and outside directors. The study of Raheja [2005] may seem somewhat similar to my

[12]In Raheja [2005], the insiders are well informed of management than outsiders as argued by Fama and Jensen [1983].

paper, but I emphasize some major differences between our papers. That is, for one, the cause of board lax monitoring is clearly different. For two, the responsibilities of directors are different. For three, the way the succession policy is determined is quite different. That is, in her paper, when outsiders verify the information, the next CEO is voted from one of those insiders who had revealed the information. However, the CEO succession policy itself is not completely determined endogenously; specifically, the insiders have the choice of whether or not to reveal the information, but where to hire the successor from is given as a rule when it comes to the stage of appointment. In my model, the CEO successor itself is endogenously determined in the game through maximizing the utilities of all incumbent members. Despite the differences in our approach, Raheja [2005] and this paper are thus far the only papers that have attempted to endogenously choose the successor CEO. Adams and Ferreira [2007] and Gutierrez [2001] also provide theories along the line of lack of information, but different from Raheja [2005] is that it is the CEO who has the information and discuss the board composition that can efficiently derive information from the CEO.

3 Simple Model of 'Loss'

This section of the paper is devoted to describe the intuitive message of the main model provided in section four. In section four, I discuss the mechanism in which all the incumbent board members jointly determine the succession policy of whether to hire a successor CEO from outside the incumbent board or promote one of the inside directors to the post of CEO, and the monitoring level. I show that the decisions about these two matters are affected by the type and the amount of 'loss.' However, discussing the mechanism in which these two matters are endogenously determined requires an elaborate model as provided in section four, and hence it is my intention to first specify the two 'losses' in this section by using a simple model where monitoring levels

(in this section, it is either 0 or 1) are endogenously determined by the board, but the CEO succession policy is left exogenous for simplicity.

Definition : *'Loss' is defined as an expected pay given to a newcomer in place of one of the incumbent members, where it would be given to the incumbent member if there were no member changes.*

The type of 'loss' differs by board characteristics. In order to understand the two losses and how they differ by board characteristics, I identify two forms of corporate governance systems: outside-recruiting system and internal-promotion system. In both systems, the board consists of one CEO and n directors. Under outside-recruiting system, if the incumbent CEO is fired, a new CEO is always hired from outside the incumbent board, and the rest of the board members remain unchanged. Under internal-promotion system, if the incumbent CEO is fired, one of the incumbent directors is promoted to be the new CEO, and to maintain the board size, a new director is hired. Therefore, the newcomer and the 'loss' are the newly hired CEO and any benefit he may receive for outside-recruiting system, and for internal-promotion system, they are the newly hired director and a pay he may receive.

I explain this mechanism in two-period game between the initial CEO and n directors who act as one player, the board directors. In the first stage, the directors post an offer that the incumbent CEO must either accept or reject. The directors offer (p, w), where $p \in \{0, 1\} : 0$ means no monitoring, 1 means the directors do monitor, and w is the wage offered to the CEO. To be more precise, the directors offer the incumbent CEO $(p, w) = (1, w_1)$ or $(p, w) = (0, w_0)$. In the second stage, the CEO accepts or rejects the offer. Then, the profit of the firm is realized and players receive their payoffs. The directors in this model commit to the monitoring level determined in the first stage, but this is a simplification of the main model in section four.

The directors' objective (all n directors considered as one player) is to

maximize their utility: a share the board receives from the profit of the firm less the monitoring cost and the wage of the incumbent CEO, where the profit of the firm is dependent on the ability of the CEO.[13] The ability of the CEO is either high (H) or low (L) determined by nature and no one on the board (including the CEO himself) knows the true ability. On the other hand, the incumbent CEO's objective is to receive both the wage and the private benefit. Wage is surely paid to the incumbent CEO, but the private benefit exogenously determined is given to the CEO who is serving at the end of the game, and thus if the incumbent CEO is fired prior to the last stage he cannot obtain it.[14] The reservation utility of the CEO is assumed to be r.

The abilities of both the incumbent CEO and any new CEO are believed to be $\frac{1}{2}$ for being H and L. The priors the directors believe about the CEO's ability remain $\frac{1}{2}$ when the incumbent CEO serves to the end of the game without being monitored, and I denote the amount the directors receive from the expected corporate profit in this case as π_{N}. It is also the same when the incumbent CEO is fired and a new CEO is hired. If the directors monitor, with probability q, they observe a good signal y_H, and from Bayse' rule, their belief about CEO's ability being H, increases. With probability $(1-q)$, they observe a bad signal y_L, and updates him to be likely to have the ability L. The board receives π_{H} from the expected corporate profit conditional on y_H, and receives π_{L} when conditional on y_L. In short, $\pi_{H} > \pi_{N} > \pi_{L}$ is assumed.[15]

[13]The board updates the initial CEO's talent by monitoring. Then, if it believes the CEO is likely to be a bad match it replaces the CEO. Therefore, the purpose of the monitoring is to fire a bad match CEO and hire a new CEO who is expected to increase the corporate profit.

[14]Following Hermalin and Weisbach [1998], the private benefit b is given exogenous to the model, and only given to the CEO at the last stage of the game. Hence, it can be regarded as a good reputation or a prestige that enable this CEO to work another term or for another company with a certain bargaining power.

[15]The board fires the initial CEO who is believed to have the ability of L, and replaces him with a new CEO, and hence φ_L is not realized.

In the above setting, the expected payoffs of the players are expressed as follows. I begin with the case in which the directors offer $(p, w) = (0, w_0)$. In this case, there is no monitoring, and hence the incumbent CEO is sure to serve to the end of the game without his ability being updated in either outside-recruiting system or internal-promotion system. In other words, all the incumbent players survive the game, implying no 'loss' among the players. Thus the expected payoffs of the players are the same in both systems; the directors' expected payoff is expressed as

$$\pi_{_N} - w_0, \tag{1}$$

and the incumbent CEO's expected payoff is expressed as

$$b + w_0. \tag{2}$$

On the other hand, the players' expected payoffs for the case in which the directors offer $(p, w) = (1, w_1)$ differ between the two systems. This is because under outside-recruiting system, observing y_L is synonymous to saying that the incumbent CEO is fired and a new CEO is externally hired, whereas under internal-promotion system it is synonymous to saying that the incumbent CEO is fired and a new CEO is internally promoted. Therefore, the directors' expected payoff in outside-recruiting system is expressed as

$$q\pi_{_H} + (1-q)\pi_{_N} - w_1^O - c, \tag{3}$$

and the incumbent CEO's expected payoff is expressed as

$$qb + w_1^O. \tag{4}$$

The first and the second terms of (3) represent the expected profit to the directors. (The directors observe y_H with probability q, and with probability $(1-q)$, they observe y_L and fire the CEO and a new CEO is hired.) The third term is the wage the directors pay to the incumbent CEO which is offered to him at the first stage. The last term is the cost of monitoring

which is assumed to be a fairly small amount.[16] As for (4), the CEO receives w_1^O whether or not he serves to the last stage of the game, but receives the private benefit b only when he is retained with probability q, and thus it is expressed as such.

The directors' expected payoff under internal-promotion system is expressed as

$$q\pi_{_H} + (1-q)\left[b + (n-1)\frac{\pi_{_N}}{n}\right] - w_1^I - c, \tag{5}$$

and the incumbent CEO's expected payoff is expressed as

$$qb + w_1^I. \tag{6}$$

The CEO's expected payoff (6), is as (4). The difference between outside-recruiting system and internal promotion system appears in the second term of the directors' utilities. With probability $(1-q)$, the directors observe y_L and hence replace the incumbent CEO with a new CEO who was originally one of the board members. Recall that a new director is hired in this case to keep the board size at $n+1$. Thus, with probability $(1-q)$, one of the original board members surely obtains b, and each of the remaining $(n-1)$ directors receive $\frac{\pi_{_N}}{n}$.

Given these expected payoffs, the directors make the optimal choice in the first stage in offering $(0, w_0)$ or $(1, w_1^O)$, provided that the CEO will accept the offer in the second stage.

Under outside-recruiting system, if the directors post $(0, w_0)$, the wage is determined as to satisfy $b + w_0 = r$, but if they post $(1, w_1^O)$, the wage is determined to satisfy $qb + w_1^O = r$.[17] Thus, the directors' optimal choice is

[16] If $b > \frac{\pi_{_N}}{n}$ holds, the directors under both systems may conduct monitoring when the cost of monitoring is small enough to satisfy $q(\pi_{_H} - \pi_{_N}) - (1-q)b > c$, but if the cost is $q(\pi_{_H} - \pi_{_N}) - (1-q)\frac{\pi_{_N}}{n} > c > q(\pi_{_H} - \pi_{_N}) - (1-q)b$, then only directors under internal promotion system monitor. If $c > q(\pi_{_H} - \pi_{_N}) - (1-q)\frac{\pi_{_N}}{n}$, then the cost of monitoring is too large that the directors do not monitor in either systems. The similar argument holds for the case in which $\frac{\pi_{_N}}{n} > b$ holds.

[17] It is assumed that $b > r$. When the board offers $(0, w_0)$, the wage w_0 is determined as to satisfy $w_0 + b = r$. Since the CEO is sure to serve to the end of the game in case $(0, w_0)$

made between $(0, w_0) = (0, r - b)$ and $(1, w_1^O) = (1, r - qb)$. Plugging $w_0 = r - b$ into (1) yields

$$\pi_{_N} + b - r. \tag{7}$$

Plugging $w_1^O = r - qb$ into (3) yields

$$q\pi_{_H} + (1 - q)\pi_{_N} + qb - r - c. \tag{8}$$

Therefore, the directors decide whether to offer monitor or not to monitor by comparing (7) and (8). When b is sufficiently small, (8) $>$ (7) holds and as a result, the directors post $(1, w_1^O)$. When b is large, (8) $<$ (7) holds and as a result, the directors post $(0, w_0)$. Recall that b is the private benefit which is given only to the CEO serving at the last stage, and will be regarded as 'loss' by the incumbent members if the incumbent CEO does not receive this. Thus, if the loss of b is large, the directors hesitate to monitor and replace the incumbent CEO.

Under internal-promotion system, the wage level is determined to satisfy $b + w_0 = r$ when the directors post $(0, w_0)$, while it is determined to satisfy $qb + w_1^I = r$ when they post $(1, w_1^I)$. Thus, the directors make the optimal choice between $(0, w_0) = (0, r - b)$ and $(1, w_1^I) = (1, r - qb)$. Plugging $w_0 = r - b$ into (1) yields

$$\pi_{_N} + b - r. \tag{9}$$

Plugging $w_1^I = r - qb$ into (5) yields

$$q\pi_{_H} + (1 - q)\left[b + (n - 1)\frac{\pi_{_N}}{n}\right] + qb - c - r. \tag{10}$$

The directors' decision to post an offer to monitor or not is determined by comparing (9) and (10). When $\frac{\pi_N}{n}$ is sufficiently small, (10) $>$ (9) holds and as a result, the directors post $(1, w_1^I)$. When $\frac{\pi_N}{n}$ is sufficiently large, (10) $<$ (9) holds and as a result, the directors post $(0, w_0)$. In this system, a pay to the

is offered, the CEO knows he will eventually receive $r > 0$. This is the same for internal promotion system.

new director $\frac{\pi_N}{n}$, is the 'loss,' and again if the amount of 'loss' is large the directors choose not to monitor to avoid the expected loss.

The results and the implication of the simple model

The incumbent board incurs a 'loss' when a newcomer to the corporate board receives a pay in place of one of themselves.[18] Under outside-recruiting system, the benefit b given to the new CEO is a 'loss,' whereas it is the pay of $\frac{\pi_N}{n}$ to the new director under internal-promotion system. Comparing (8) and (10), it is straightforward to show that when $b > \frac{\pi_N}{n}$, the directors under internal-promotion system is more likely to monitor, but when $b < \frac{\pi_N}{n}$, the directors under outside-recruiting system is more likely to monitor. This is because the monitoring which is intended to fire the incumbent CEO induces a 'loss' to the incumbent board and because of this, the monitoring intensity is not solely determined by a trade-off between the positive effect of increase in the expected profit and the negative effect of monitoring cost. Thus, if the amount of 'loss' is large, the directors hesitate to (in this simple model, it is 'do not') monitor to reduce the risk of 'loss.' Notice that the board has to consider which type of 'loss': b and $\frac{\pi_N}{n}$, they will incur when they can choose where to bring the next CEO from. In the following section, not only the intensity to which the board monitors the CEO, but also a CEO successor is endogenously determined, and how 'loss' affects the decisions regarding these two issues are examined.

[18] The incumbent members do not incur 'loss' when they all remain on the board from the time of decision making to the time they receive their payoffs. Therefore, if all the incumbent members had bargaining power, they could benefit directly or indirectly from one of themselves obtaining either b or $\frac{\pi_N}{n}$. However, in the simple model, the initial CEO does not have bargaining power and hence his expected payoff is not more than his reservation utility. Because of this, the 'loss' does not really affect the initial CEO in this section. However, in the main model in section four, the initial CEO does have bargaining power and hence the 'loss' affects the initial CEO as well as the other directors.

4 Main Model: Monitoring Levels and Succession Policies

4.1 Basic Structure

The previous section has illustrated that CEO replacement induces a certain 'loss' to the incumbent board members and that it deprives them of the incentive to fire (monitor) the incumbent CEO to avoid such 'loss.' I have also shown that the type of 'loss' varies by the succession policy, which was given exogenous to the board. In this section, the incumbent board members jointly determine the succession policy as well as the monitoring level. I show the effect of 'loss' on these decisions and discuss how they differ from the optimum decisions that can be made by board of directors.

The board in this section is composed of a CEO, n_1 outside directors, and n_2 inside directors, where the number of directors is always maintained at $n_1 + n_2 = n$. All the outside directors and the inside directors act as one player respectively. I assume that the outside directors have no incentive to succeed the post of CEO.(As discussed in footnote two.) Hence, if the incumbent CEO gets fired, the board has a choice to recruit a successor CEO from outside the incumbent board members or promote one of the incumbent inside directors. This implies that the two separate systems described in the previous section are incorporated as one system. The monitoring level is continuous, and also the incumbent CEO jointly determines all the decisions through Nash bargaining, for CEOs usually have a lot of power in practice.

The basic structure of the interaction between the directors and the CEO is followed from Hermalin and Weisbach [1998]. (Their paper is described in section two.) In their model, CEO turnover induces 'loss,' but they do not argue about this concept nor discuss the effect of it on board decision makings, and hence I would like to provide a general model of how 'loss' affects the decisions determined by the board by extending their model. Also, the new feature of this paper is to incorporate the process in which the board

determines the next CEO, which was given exogenous to their model, and have not been examined by other researchers in the theoretical context.

In order to focus the analysis on these aspects, the model in this section has two distinctive different settings from Hermalin and Weisbach [1998]. One is as noted above, directors are distinguished into outsiders and insiders by their incentives about becoming the CEO.[19] [20] The other is omitting a stage in which the board determines a new director to be appointed, for doing so does not affect the substantial result of this paper.[21] [22] This allows stages to proceed as follows:

First stage: The board meeting takes place and all the incumbent members determine the amount of monitoring level denoted p, the wage of the incumbent CEO denoted w, and the the succession policy of whether to hire

[19]Hermalin and Weisbach [1998] do not specify whether the directors in their model are outsiders or insiders, but since they do not expect the directors to become CEOs, they would be classified as *outsiders* in this context.

[20]In Hermalin and Weisbach [1998], a board director is endogenously changed, and as a result, the measure of lack of independency of the board changes in their model (from $\overline{k}_0$ to $\overline{k}_1$, as discussed in section two of this paper), but the incentives (and hence the shape of objective functions) are the same for both newly hired directors and initial directors.

[21]In Hermalin and Weisbach [1998], all the incumbent board members determine a new director to be appointed to the board through Nash bargaining. Determining a new director in their model is synonymous to determining the measure of independency of the board. In other words, all initial board members endogenously determine a new director to the board, and depending on how independent he is from the incumbent CEO, the board measure of independence as a whole changes. Then, after the Nash bargaining, this new board determines the amount to which it monitors the incumbent CEO. However, the board measure of lack of independence and the monitoring level have one-to-one correspondence, and hence it can be considered that it is the initial board that practically determines the monitoring level. Therefore, I intentionally leave out the stage in which the incumbent board members determine their new board composition for simplicity and focus on the stage in which they endogenously determine a CEO successor, for this has not been done by other researchers thus far.

[22]I emphasize that the same results are derived in my model when a director is endogenously appointed as in Hermalin and Weisbach [1998]. That is, for example, a stage can be introduced after the Nash bargaining stage and let the board determine a new director so that the board before and after the Nash bargaining can be considered as two different players. See Sato [2007] for example. In this sense, it may as well be said the model provided in this section is the general model of Hermalin and Weisbach [1998].

a successor CEO from outside the incumbent board or promote one of the inside directors in Nash bargaining.[23] The monitoring level p, is interpreted as the list of work the board must determine as a unit to build a corporate governance system that enables all the directors (not only the members of the audit committee) to prevent the fraudulent conduct of executives. Thus, it can be regarded that the larger is p, the higher is the probability in obtaining an additional information about the CEO's ability. The incumbent CEO's prior about having a good ability is assumed to be more than $\frac{1}{2}$, where any other CEO candidates' priors about their abilities are assumed to be precisely $\frac{1}{2}$.[24] The wage is paid to the incumbent CEO right after it is determined.

Second stage: The directors commit to the monitoring level p determined in the first stage and monitor the incumbent CEO. This is because the whole board is responsible for building a system that will not let executives to involve in fraudulent conduct and the amount of work the board must do determined in the previous stage is not something each director determines alone. Based on p, the directors update the priors about the incumbent CEO's ability based on the additional information: an information to believe the CEO has high ability is denoted as y_H and observed with probability pq, and denoted as y_L for bad ability which is observed with probability $p(1-q)$. With probability $(1-p)$, the directors fail to obtain any information.

Third stage: The directors decide whether to replace or fire the incumbent CEO. They retain the incumbent CEO when y_H is observed, but also with probability $(1-p)$, there is no choice but to retain him. They fire the incumbent CEO when y_L is observed, and hire a new CEO from outside or inside the board based on the decision made in the first stage. (All the

[23] Recall that all the inside and the outside directors act as one player respectively. Thus, the board decision is considered to be determined by three players: the CEO, insiders, and outsiders. See Roth [1979] for Nash bargaining games held among more than two players.

[24] In Hermalin and Weisbach [1998], the initial CEO's talent is updated before the negotiation to give the CEO some bargaining power, but this process can be shortened by assuming the prior about his talent being higher than any new CEO candidates for being a good match. See the Appedix about the priors and the posteriors.

remaining directors may renegotiate the succession policy after the incumbent CEO has been fired, but even if they do so, the same conclusion as determined in the first stage is derived.[25])

Fourth stage: Payoffs are realized. The profit of the firm is dependent on the ability of the CEO and all the directors at this stage equally obtain a certain amount from it: if the incumbent CEO serves to the end without any monitoring, the expected profit of the directors is denoted π_I; if the incumbent CEO serves to the end with his ability being updated, it is denoted π_H; if the new CEO is hired in the third stage, and if he is recruited from outside it is denoted $\pi_{\widehat{N}}$, whereas it is denoted π_N when promoted from inside the incumbent board. The relations among expected board profits are induced by Bayse' update as described in the Appendix, and they are $\pi_H > \pi_I > \pi_L$, $\pi_H > \pi_{\widehat{N}} > \pi_L$, and $\pi_H > \pi_N > \pi_L$ where π_L denotes the expected payoff if the board kept the incumbent CEO who is updated to have a bad ability (where this is not realized in the equilibrium for such CEO would be fired.) The difference in $\pi_{\widehat{N}}$ and π_N depends on whether they are hired from outside the incumbent board or promoted from the board. I do not specify the magnitude relation between $\pi_{\widehat{N}}$ and π_N, since there are both merits and demerits for both candidates.[26] Each director equally receives $\frac{1}{n}$ from π_i, $i \in \left\{H, I, \widehat{N}, N\right\}$. As for the incumbent CEO, if he is retained to this last stage, he receives the private benefit of b, which can be interpreted

[25]Even if the remaining outside directors and inside directors renegotiate about the succession policy after they dismiss the initial CEO in stage three, they still choose the same policy as determined in the first stage. Therefore, it may seem as if the directors commit to the succession policy determined in the first stage, but it is not a commitment. It is determined in the first stage to simplify the analysis. The proof is in the Appendix.

[26]For example, outside CEO candidates may be some management experts in the same industry and might be talented, but may not fit the culture of the company. On the other hand, insider CEO candidates may know well about his company, but may not be able to make a necessary changes in management. Bower [2007] argues that the insider with the outsiders' perspective (which he refers to as *inside outsiders*) would be the best successor. Since it is beyond the scope of this paper to argue about *inside outsiders*, I assume the priors about the abilities of both candidate are the same, but the outcome may be different. The detail is in the Appendix.

as bonus or reputation. However, if the incumbent CEO has been fired prior to this stage, he receives no b, and a new CEO (who has no active role in this game) receives b in place of him.

4.2 The Players' Objective

The incumbent CEO's objective is the same as the simple model discussed in section three, except for that now he has bargaining power in the negotiation. The incumbent CEO's expected payoff is expressed as

$$[pq + (1-p)]\, b + w, \tag{11}$$

for he receives the wage w for sure, but the benefit b is only given when he is retained to the fourth stage. In other words, if the incumbent CEO is fired prior to the fourth stage, a new CEO receives b in place of him.

The expected payoffs of all outside directors serving on the board is expressed as either of the following two. If the board is to hire a CEO from outside of incumbent board members, it is expressed as

$$n_1 p \left[q \frac{\pi_{_H}}{n} + (1-q) \frac{\pi_{\widehat{N}}}{n} \right] + n_1 (1-p) \frac{\pi_{_I}}{n} - n_1 \cdot d(p) - w_1, \tag{12}$$

whereas if the board is to promote one of the inside directors to the post of CEO, it is expressed as

$$n_1 p \left[q \frac{\pi_{_H}}{n} + (1-q) \frac{\pi_{_N}}{n} \right] + n_1 (1-p) \frac{\pi_{_I}}{n} - n_1 \cdot d(p) - w_1. \tag{13}$$

The first term of (12), $n_1 p \left[q \frac{\pi_{_H}}{n} + (1-q) \frac{\varphi_{\widehat{N}}}{n} \right]$, is the expected payoff to the outside directors when the directors succeed in monitoring; specifically, n_1 is the number of outside directors serving on the board and p is the probability that the directors succeed in monitoring and q is the probability of obtaining a good signal and $(1-q)$ is the probability of obtaining a bad signal. Recall from Subsection 4.1 that board expected payoff is denoted by π_i, where $i \in \{H, \widehat{N}, N, I\}$ depending on CEO's ability, and it is assumed that

each director receives equal amount from it. The second term, $n_1 (1-p) \frac{\pi_I}{n}$, is the payoff to the outside directors when the monitoring fails and hence the incumbent CEO is retained. The third term $n_1 \cdot d(p)$, is the cost of monitoring for all the outside directors. Each director incurs monitoring cost of $d(p)$ which is a strictly increasing, strictly convex, twice continuously differentiable function.[27] I assume interior solutions: $d'(p) \to 0$, as $p \to 0$, and $d'(p) \to \infty$, as $p \to 1$ where $p \in [0,1]$. The fourth term w_1, is the amount of wage paid to the incumbent CEO which will be subtracted from the total amount of expected salary of all the outside directors. The incumbent CEO is paid w from the board of directors, and for simplicity I assume the portion of w_1 is paid out from the outside directors and w_2 is paid out from the inside directors, where $w_1 + w_2 = w$. The only difference between (12) and (13) are $\pi_{\widehat{N}}$ and π_{N}. Therefore, if $\pi_{\widehat{N}} > \pi_{N}$ holds, (12) $>$ (13), while the relation reverses to (12) $<$ (13) when $\pi_{\widehat{N}} < \pi_{N}$.

On the other hand, the expected payoff of all inside directors on the board is expressed as either of the following two. If the board is to hire a CEO from outside incumbent board members, it is expressed as

$$n_2 p \left[q \frac{\pi_H}{n} + (1-q) \frac{\pi_{\widehat{N}}}{n} \right] + n_2 (1-p) \frac{\pi_I}{n} - n_2 \cdot d(p) - w_2, \qquad (14)$$

whereas if the board is to promote one of the insiders to the post of successor CEO, it is expressed as

$$n_2 pq \frac{\pi_H}{n} + p(1-q) \left[(n_2 - 1) \frac{\pi_N}{n} + b \right] + n_2 (1-p) \frac{\pi_I}{n} - n_2 \cdot d(p) - w_2. \quad (15)$$

The expected payoff (14) is as (12): the objective functions are similar for both insiders and outsiders when the board is to hire a successor CEO from outside the incumbent board. This is because, neither types of directors can become the next CEO. On the other hand, if the board is to hire a CEO from inside, there is a clear difference between the expected payoffs of the insiders

[27] For simplicity, I assume both inside directors and outside directors incur the same amount of monitoring cost, for even if they were modeled as different, it would not affect the substantial results.

(expressed as (15)) and the outside directors (expressed as (13)), for each inside director has a chance of being promoted to the successor CEO. This is reflected in the second term of (15): $p(1-q)\left[(n_2-1)\frac{\pi_N}{n}+b\right]$; that is when the board succeeds in updating incumbent CEO with probability p, and fired him with probability $(1-q)$, one of the inside directors is promoted to a new CEO and the remaining directors stay on the board as inside directors. The other terms are as (12).

4.3 Analysis on Board Decision Makings

It is shown from the previous subsection that the wage is a transferrable utility among all the players. Therefore, each player in this model has the incentive to maximize their joint expected payoff when making decisions, for by doing so expands the feasible set. The problem is that when decisions are made by the incumbent board members, they only consider about the sum of their expected payoffs, but do not consider about those of new members who will join them in the future. Because of this fact, the decisions made by the board is affected by 'loss.'

4.3.1 Benchmark

I start with the optimum case with no 'loss.' That is, the incumbent board members consider not only the joint expected payoff of themselves, but also consider those of future newcomers to the board. This leads to:

Benchmark: Optimum Succession Policy and Monitoring Level

The optimum succession policy is to hire a CEO candidate who is expected to bring a higher expected profit to the board:

$$max\left\{\pi_{\widehat{N}},\, \pi_{N}\right\}. \tag{16}$$

The optimum monitoring level is determined to maximize the joint expected payoffs of all the board members, including the incumbent members and

those who may be appointed to the board after the CEO replacement. The joint expected payoff of such case is expressed as:

$$pq\pi_{H} + p(1-q)\max\{\pi_{\widehat{N}}, \pi_{N}\} + (1-p)\pi_{I} - n \cdot d(p) + b, \tag{17}$$

where the first two terms represent the expected payoff of the board of directors when it monitors the CEO, where the third term is the payoff when it does not monitor. The third term is the cost of monitoring, and the fourth is the benefit the CEO receives at the last stage. Taking the first-order condition with respect to p induces the optimum level of monitoring:

$$d'(p) = \frac{1}{n}[q\pi_{H} + (1-q)\max\{\pi_{\widehat{N}}, \pi_{N}\} - \pi_{I}]. \tag{18}$$

There are two intuitions from (18). First, if the number of directors increases, the level of monitoring decreases, for the cost of monitoring increases. Second, when the incumbent board members consider the expected payoffs of future newcomers to the board, no 'loss' (b or $\frac{\pi_{N}}{n}$) affects the board decisions.

4.3.2 The Choice of a Successor CEO and Monitoring Levels

In what follows, I discuss how monitoring levels and succession policies are determined when the incumbent board members are only interested in maximizing their own utilities, or in short, the joint expected payoff of members who are currently on the board.

Recall that there are two succession policies to choose from, where the type of 'loss' incumbent board members incur is determined specific to the policy the board adopts. Moreover, the amount of monitoring level is determined unique to the succession policy. Since Nash bargaining frontier is linear in forty-five degrees, the board determines to adopt a succession policy which induces higher joint expected payoff. [28] See Figure One. To be more specific, the monitoring level is determined at the level that shifts the

[28] Free disposal is assumed. Since the frontier is linear, the feasible set of Nash bargaining is convex.

bargaining frontier as outward as possible, where the ceiling of the frontier differs by the succession policy. The larger is the capacity of the feasible set, the better off all the players are, so the board has the incentives to adopt a policy with a higher ceiling.[29] However, one policy is not always better than the other policy, for the joint expected payoffs for each succession policy reflects the 'loss' that are specific to the succession policy, and the amount of 'loss' may vary.

The joint expected payoffs of the incumbent board members when the new CEO is to be hired from outside the incumbent board is expressed as

$$pq\pi_{_H} + p(1-q)\pi_{\widehat{N}} + (1-p)\pi_I - n \cdot d(p) + [pq + (1-p)]\, b, \qquad (19)$$

which is the addition of (11), (12), and (14). On the other hand, the joint expected payoffs of the incumbent board members when one of the inside directors is promoted to be the new CEO is expressed as

$$pq\pi_{_H} + p(1-q)\left(\frac{n-1}{n}\pi_{_N} + b\right)\pi_{_N} + (1-p)\pi_I - n \cdot d(p) + [pq + (1-p)]\, b, \quad (20)$$

which is the addition of (11), (13), and (15).

In comparing the above two expressions, (19) $<$ (20) holds, when $b > \pi_{\widehat{N}} - \pi_{_N} + \frac{1}{n}\pi_{_N}$, and (19) $>$ (20) holds, when $b < \pi_{\widehat{N}} - \pi_{_N} + \frac{1}{n}\pi_{_N}$. In other words, the sufficient condition to promote inside directors to be the CEO is expressed as:

$$b > \pi_{\widehat{N}} - \pi_{_N} + \frac{\pi_{_N}}{n}, \qquad (21)$$

and the sufficient condition to hire a CEO from outside the board is:

$$b < \pi_{\widehat{N}} - \pi_{_N} + \frac{\pi_{_N}}{n}. \qquad (22)$$

Recall from the simple model in section three that the loss to the newcomer is either b or $\frac{\pi_{_N}}{n}$. If the the new CEOs talents were the same for those hired

[29] Since one or the other feasible set always encompasses the other, the feasible set with the larger capacity (higher ceiling) always makes the players better off.

from outside and inside, (that is, $\pi_{\widehat{N}} = \pi_{N}$), (21) and (22) are reduced to $b > \frac{\pi_N}{n}$ and $b < \frac{\pi_N}{n}$, respectively.

Given the above argument, the board decision to promote inside director or recruit from outside is determined by comparing the gap between the losses and the gap between the talents of the successor candidates. This leads to the following Proposition.

Proposition 1 *The board decides to promote one of the inside directors as a successor CEO when* (21) *holds, and to recruit from outside the incumbent board when* (22) *holds.*

Proof When the private benefit of the CEO is sufficiently high as to satisfy (21), (or $b > \frac{1}{n}\pi_{N}$, when $\pi_{\widehat{N}} = \pi_{N}$), (19) $<$ (20) holds for any p, and as a result, the incumbent CEO and the directors agree to promote one of the inside directors to the post of CEO. However, when the private benefit of the CEO is sufficiently small as to satisfy (22), (or $b < \frac{\pi_N}{n}$, when $\pi_{\widehat{N}} = \pi_{N}$), (19) $>$ (20) holds for any p, and as a result, the they agree to hire a new CEO from outside the incumbent board.

If the incentives of the inside directors were considered independently, (15) $>$ (14) holds when $b > \frac{n_2}{n}\pi_{\widehat{N}} - \frac{n_2-1}{n}\pi_{N}$, and they would want to promote one of themselves to the post of CEO, but if $b < \frac{n_2}{n}\pi_{\widehat{N}} - \frac{n_2-1}{n}\pi_{N}$, the opposite is true. On the other hand, if the incentives of the outside directors were considered independently, then it is obvious that they would prefer candidates with higher expected talents. That is, if $\pi_{\widehat{N}} > \pi_{N}$, then, (12) $>$ (13), and outside directors' would want to recruit a new CEO from outside the board, but if $\pi_{\widehat{N}} < \pi_{N}$ holds, the relation is reversed and they would promote one of the inside directors. However, if both inside and outside directors serve on the board and make decisions together with the CEO, the incentive of the board as a whole is to promote one of the insiders when (21) holds, and recruit from outside when (22) holds.[30] Notice that the wage has the effect

[30]When (21) holds, the outside directors' expected payoff is expressed as (13) and that

of side payment among the directors.[31]

The interesting case is that when the board promotes one of the inside directors to the post even when there is an outside candidate who is expected to bring a higher profit to the firm. ($\pi_{\widehat{N}} > \pi_{N}$ with not too wide gap). The typical case of such decision makings can take place in a company that has started as a family business.[32] For example, consider a case in which all the inside directors are family members, and the entrepreneur is the CEO, who could be the only one who is talented in management. In such case, hiring a new CEO from the other company (maybe other company but the same industry) might be a good choice when the incumbent CEO retires or is fired. However, as is often observed in practice, CEOs' relatives may succeed the post.

Corollary 1 The board may promote an insider to the post of CEO even when outside candidates are expected to be more talented than any of the inside candidate.

Above Corollary holds unless $\pi_{\widehat{N}}$ is extremely higher than π_{N} so as to alter the inequality of (21).

Next, I discuss the amount of monitoring levels determined unique to the succession policy.[33]

Proposition 2 *The amount of monitoring levels are determined unique to the succession policy and they are expressed as follows.*

1. If the board determines to promote one of the inside incumbent direc-

of inside directors is (15). When (22) holds, outside directors' utility function is expressed as (12) and that of inside directors is expressed as (14).

[31] See the mathematics in the Appendix. Economically, the monitoring level and the wage are determined at the same time in the bargaining, but, mathematically, it can be considered that the monitoring level is determined first, and then, the wage is determined given the monitoring level. The wage w, is transferred among the players and affects the players' utilities as side payment.

[32] Charkham [2005] points out that managers attitude may not change even after companies that started as family businesses have grown to publicly quoted companies.

[33] Nash product, threat points of the players, and proof are in the Appendix.

tors, it is:

$$d'(p) = \frac{1}{n}\left[q\pi_{H} - \pi_{I} + (1-q)\,\pi_{N} - (1-q)\,\frac{\pi_{N}}{n}\right]. \tag{23}$$

2. *If the board determines to recruit from outside the incumbent board members, it is:*

$$d'(p) = \frac{1}{n}\left[q\pi_{H} - \pi_{I} + (1-q)\,\pi_{\widehat{N}} - (1-q)\,b\right]. \tag{24}$$

These monitoring levels are determined at the level that shifts the bargaining frontier as outwards as possible, given the succession policy. The 'loss' incumbent board incurs by having CEO replacement is reflected in the last term of both (23) and (24). That is, with probability $(1-q)$, the incumbent CEO is fired, and a newcomer is hired and takes away a certain share of payment from the incumbent board members: $\frac{\pi_N}{n}$ or b. Recall that when one of the inside directors is promoted to be the new CEO, then the board hires a new director to maintain the number of directors at n. Thus the payment of $\frac{\pi_N}{n}$ is given to this new director, and this is considered as a 'loss' from the perspective of the incumbent board members, whereas if the board appoints a candidate outside the incumbent board, the new CEO is the newcomer and the benefit b he receives in place of the incumbent CEO is the 'loss.' Therefore, (23) and (24) are always smaller than (18).

Above Proposition leads to the following corollary:

Corollary 2 The size of the board affects the board decisions.

1. The larger is the size of the board, the more likely the board adopts an internal promotion policy.

2. The larger is the size of the board, the less the board functions as an oversight device. This holds for both (23) and (24).

Proof. 1. If the number of directors increases, (21) is more likely to hold than (22), and hence the board decision about a successor policy is likely to become internal promotion.

2. The increase in n increases the cost of monitoring for the board, but at the same time, the amount of 'loss' each director incurs per capita decreases. The effect of the increase in the monitoring cost is larger, since $d'' \frac{dp}{dn} = -n^{-2} [q\pi_H - \pi_I + (1-q)\pi_N] < 0$. ■

Since the monitoring is done as a group, and not by individual, the increase in the number of directors decreases the monitoring cost of the board.

Lastly, with respect to board composition, if the board is composed solely of outside directors and the CEO, the board has no choice but to hire a successor from outside the incumbent board, and the monitoring level is unique at (24). However, if the board is composed of both types of directors, the board has a choice to promote one of the members to the post of CEO or recruit a new CEO from outside. Therefore, monitoring levels may become (24) or (23). In other words, if the board has at least one inside director, the alternatives for succession policy increases and hence the monitoring levels.

4.3.3 The Structure to Avoid 'Loss'

In this subsection, I argue some structures that allow incumbent board members to avoid themselves from incurring a 'loss.' If there is no 'loss,' or in other words, no newcomer on the board, the monitoring level becomes more intense. This can be done for internal promotion policy. One way to ensure this is to keep the predecessor CEO on the board as a plain director rather than hiring a newcomer to keep the board size at $n+1$, which establishes:

Proposition 3 *The monitoring level with no 'loss' is expressed as:*

$$d'(p) = \frac{1}{n} [q\pi_{_H} - \pi_I + (1-q)\,\pi_{_N}]\,. \tag{25}$$

Note that (25) equals the optimum level of monitoring (18), when $\pi_{_N} > \pi_{\widehat{N}}$ holds, and hence always larger than (23). In this paper, CEO replacement is forced, but since the reason for the removal does not necessarily need to be interpreted as a punishment of doing illegal conducts, it is not strange to keep the predecessor CEO on the board as a plain director. A predecessor

CEO might have been a bad match as a manager who leads the company, but he may remain on the board as one of the directors that participate in principle decision makings or monitoring.

The other way to avoid 'loss' is not to hire any newcomer at all, even though the board cannot do this eternally. If the board promotes insider to the post of CEO, the newcomer is the new director who is hired to maintain the board size. However, if the board size does not have to be maintained at $n + 1$, then there would be no 'loss.'

5 Conclusion

In this paper, I develop a model that allows us to explore the factor that affects the board decision regarding both succession policy and monitoring intensities. In the model, all the incumbent members including the incumbent CEO, outside directors, and inside directors jointly determine the two decisions in Nash bargaining, where the succession policy is complied by the directors even after the incumbent CEO has been fired. Although the two types of directors have different incentives about becoming the next CEO, I discuss that when all the incumbent board members jointly make the board decisions, there is a tendency to avoid having a newcomer to the board so that they can keep the expected profit of the board to themselves and share it only among themselves. This induces the board decision to be less optimum from the optimal board decisions that could be made.

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Appendix

Proof of Proposition 2(1): (23)

$$\begin{aligned} V_I \equiv & \left\{ n_1 p \left[q \frac{\pi_H}{n} + (1-q) \frac{\pi_N}{n} \right] + n_1 (1-p) \frac{\pi_I}{n} - n_1 \cdot d_1(p) - w_1 - \theta_1 \right\}^{\frac{n_1}{n}} \\ & \times \left\{ n_2 pq \frac{\pi_H}{n} + p(1-q) \left[(n_2 - 1) \frac{\pi_N}{n} + b \right] + n_2 (1-p) \frac{\pi_I}{n} - n_2 \cdot d_2(p) - w_2 - \theta_2 \right\}^{\frac{n_2}{n}} \\ & \times \{ [pq + (1-p)] b + w_1 + w_2 - \theta_3 \} \end{aligned}$$

I denote θ_1, θ_2, and θ_3 as the threat points of each players, where $(\theta_1, \theta_2, \theta_3)$ is assumed to be an interior point of the feasible set. Denote the first bracket as A, the second as B, and the third as C. Then, the first-order condition maximizing V_I with respect to p yields

$$\frac{n_1}{n} \frac{\partial A}{\partial p} A^{\frac{-n_2}{n}} B^{\frac{n_2}{n}} C + \frac{n_2}{n} \frac{\partial B}{\partial p} B^{\frac{-n_1}{n}} A^{\frac{n_1}{n}} C + A^{\frac{n_1}{n}} B^{\frac{n_2}{n}} \frac{\partial C}{\partial p} = 0. \tag{26}$$

Multiply both sides of (26) with AB, and derive

$$\frac{n_1}{n} \frac{\partial A}{\partial p} A^{\frac{n_1}{n}} B^{\frac{n_2}{n}} BC + \frac{n_2}{n} \frac{\partial B}{\partial p} B^{\frac{n_2}{n}} A^{\frac{n_1}{n}} AC + ABA^{\frac{n_1}{n}} B^{\frac{n_2}{n}} \frac{\partial C}{\partial p} = 0. \tag{27}$$

Dividing both sides of (27) with $A^{\frac{n_1}{n}} B^{\frac{n_2}{n}}$ yields

$$\frac{n_1}{n} \frac{\partial A}{\partial p} BC + \frac{n_2}{n} \frac{\partial B}{\partial p} AC + AB \frac{\partial C}{\partial p} = 0. \tag{28}$$

Next, derive the first-order condition maximizing V_I with respect to w_1 and w_2. The first-order condition with respect to w_1 yields

$$-\frac{n_1}{n}A^{-\frac{n_2}{n}}B^{\frac{n_2}{n}}C + A^{\frac{n_1}{n}}B^{\frac{n_2}{n}} = 0 \tag{29}$$

Multiply both sides of (29) with A, and also dividing it by $B^{\frac{n_2}{n}}$ yields $-\frac{n_1}{n}A^{\frac{n_1}{n}}C + AA^{\frac{n_1}{n}} = 0$. Organize this and obtain

$$n_1 C = nA. \tag{30}$$

Likewise, the first-order condition maximizing V_I with respect to w_2 yields,

$$n_2 C = nB. \tag{31}$$

From (28), (30), and (31), $d'(p)$, w_1, and w_2 are obtained. First plugging (30) and (31) into (28) yields $\frac{\partial A}{\partial p} + \frac{\partial B}{\partial p} + \frac{\partial C}{\partial p} = 0$. Organize this and $d'(p)$ is obtained as follows:

$$d'(p) = \frac{1}{n}\left[q\pi_{_H} - \pi_I + (1-q)\,\pi_{_N} - (1-q)\,\frac{\pi_{_N}}{n}\right],$$

which is the level of monitoring as shown in (23).

The wages, w_1 and w_2 are determined as:

$$\begin{aligned} w_1 &= -\frac{1}{2n^2}\begin{pmatrix} n^2\theta_1 - \pi_I nn_1 + bnn_1 - p\pi_{_N}n_1 - nn_1\theta_2 + nn_2\theta_1 \\ -nn_1\theta_3 + d(p)n^2n_1 + \pi_I npn_1 + qp\pi_{_N}n_1 - np\pi_{_N}n_1 - \pi_{_H}qnpn_1 + qnp\pi_{_N}n_1 \end{pmatrix} \\ w_2 &= -\frac{1}{2n^2}\begin{pmatrix} n^2\theta_2 + np\pi_{_N} - \pi_I nn_2 + bnn_2 - bn^2p + p\pi_{_N}n_1 + nn_1\theta_2 \\ -nn_2\theta_1 - nn_2\theta_3 + d(p)n^2n_2 - qnp\pi_{_N} \\ +\pi_I npn_2 - bnpn_1 - bnpn_2 + qbn^2p - qp\pi_{_N}n_1 - np\pi_{_N}n_2 \\ -\pi_{_H}qnpn_2 + qbnpn_1 + qbnpn_2 + qnp\pi_{_N}n_2 \end{pmatrix} \end{aligned}$$

q.e.d.

Proof of Proposition 2(2): (24)

$$
\begin{aligned}
V_O \equiv & \left\{ \frac{n_1}{n} p \left[q\pi_{H} + (1-q)\,\pi_{\widehat{N}} \right] + \frac{n_1}{n}(1-p)\,\pi_I - n_1 \cdot d(p) - w_1 - \theta_1 \right\}^{\frac{n_1}{n}} \\
& \times \left\{ \frac{n_2}{n} p \left[q\pi_{H} + (1-q)\,\pi_{\widehat{N}} \right] + \frac{n_2}{n}(1-p)\,\pi_I - n_2 \cdot d(p) - w_2 - \theta_2 \right\}^{\frac{n_2}{n}} \\
& \times \left\{ [pq + (1-p)]\, b + w_1 + w_2 \right\}
\end{aligned}
$$

I denote θ_1, θ_2, and θ_3 as the threat points of each players, where $(\theta_1, \theta_2, \theta_3)$ is assumed to be an interior point of the feasible set. Denote the first bracket as A, the second as B, and the third as C. Then, the first-order condition maximizing V_O with respect to p is

$$
\frac{n_1}{n}\frac{\partial A}{\partial p} A^{\frac{-n_2}{n}} B^{\frac{n_2}{n}} C + \frac{n_2}{n}\frac{\partial B}{\partial p} B^{\frac{-n_1}{n}} A^{\frac{n_1}{n}} C + A^{\frac{n_1}{n}} B^{\frac{n_2}{n}} \frac{\partial C}{\partial p} = 0. \tag{32}
$$

Multiply both sides of (32) with AB, and derive

$$
\frac{n_1}{n}\frac{\partial A}{\partial p} A^{\frac{n_1}{n}} B^{\frac{n_2}{n}} BC + \frac{n_2}{n}\frac{\partial B}{\partial p} B^{\frac{n_2}{n}} A^{\frac{n_1}{n}} AC + AB A^{\frac{n_1}{n}} B^{\frac{n_2}{n}} \frac{\partial C}{\partial p} = 0. \tag{33}
$$

Dividing both sides of (33) with $A^{\frac{n_1}{n}} B^{\frac{n_2}{n}}$ yields

$$
\frac{n_1}{n}\frac{\partial A}{\partial p} BC + \frac{n_2}{n}\frac{\partial B}{\partial p} AC + AB\frac{\partial C}{\partial p} = 0. \tag{34}
$$

Next, derive the first-order condition maximizing V_O with respect to w_1 and w_2. The first-order condition with respect to w_1 yields

$$
-\frac{n_1}{n} A^{-\frac{n_2}{n}} B^{\frac{n_2}{n}} C + A^{\frac{n_1}{n}} B^{\frac{n_2}{n}} = 0 \tag{35}
$$

Multiply both sides of (35) with A, and also dividing it with $B^{\frac{n_2}{n}}$ yields $-\frac{n_1}{n} A^{\frac{n_1}{n}} C + A A^{\frac{n_1}{n}} = 0$. Organize this and obtain

$$
n_1 C = nA. \tag{36}
$$

Likewise, the first-order condition maximizing V_O with respect to w_2 yields,

$$
n_2 C = nB. \tag{37}
$$

From (34), (36), and (37), $d'(p)$, w_1, and w_2 are obtained. First plugging (36) and (37) into (34) yields $\frac{\partial A}{\partial p} + \frac{\partial B}{\partial p} + \frac{\partial C}{\partial p} = 0$. Organize this and $d'(p)$ is obtained as:

$$d'(p) = \frac{1}{n}\left[q\pi_{_H} - \pi_I + (1-q)\,\pi_{\widehat{N}} - (1-q)\,b\right],$$

which is the level of monitoring as shown in (*24*).

The wages, w_1 and w_2 are determined as:

$$\begin{aligned} w_1 &= -\frac{1}{2n}\begin{pmatrix} -\pi_I n_1 + bn_1 + n\theta_1 - n_1\theta_2 + n_2\theta_1 - n_1\theta_3 \\ -\pi_{\widehat{N}} pn_1 + \pi_I pn_1 - bpn_1 + d(p)nn_1 - \pi_{_H} qpn_1 + \pi_{\widehat{N}} qpn_1 + qbpn_1 \end{pmatrix} \\ w_2 &= -\frac{1}{2n}\begin{pmatrix} -\pi_I n_2 + bn_2 + n\theta_2 + n_1\theta_2 - n_2\theta_1 - n_2\theta_3 \\ -\pi_{\widehat{N}} pn_2 + \pi_I pn_2 - bpn_2 + d(p)nn_2 - \pi_{_H} qpn_2 + \pi_{\widehat{N}} qpn_2 + qbpn_2 \end{pmatrix} \end{aligned}$$

q.e.d.

The proof of renegotiation about the succession policy

Below I show that even if the existing outside directors and inside directors renegotiated about the succession policy and w_1 and w_2 without the initial CEO, they would all be the same as what have been determined in the first stage.

If they were to renegotiate about the succession policy, it would take place between the third and the fourth stage. At this stage, the wage w is determined from the first stage and since this is already paid in the first stage, the board must commit to the total amount determined in the first stage. (Thus I denote it as $\overline{w}$ instead of w.) However, if they wish, they can renegotiate about the share they pay out of $\overline{w}$. That is, they can renegotiate the share of the total wage as ω_1 and $\omega_2 = \overline{w} - \omega_1$, and the difference between w_1 and ω_1 (or w_2 and ω_2) would be transferred between inside directors and outside directors.

I show below that $w_1 = \omega_1$ ($w_2 = \omega_2$), and also the same succession policy is determined as in the first stage, for any plausible bargaining game they

play, and hence provide a justification for formulating a model in which these matters are determined only once, and at the start of the game.

If the remaining outside and inside directors were to renegotiate about the succession policy and the share of the wage, the payoff to the outside directors would be expressed as:

$$n_1 \frac{\pi_{\widehat{N}}}{n} - \omega_1 \tag{38}$$

if the board hires a new CEO from outside, whereas it would be expressed as:

$$n_1 \frac{\pi_{N}}{n} - \omega_1 \tag{39}$$

if the board promotes one of the inside directors. In both cases, the reservation utility is expressed as $(\theta_1 - w_1)$. This is because the amount w_1 is already determined in the first stage and θ_1 is the threat point of the outside directors in the Nash bargaining in the first stage. I assume that if a bargaining breaks down, the remaining directors receive equal amount from the profit of the board. Specifically, the outside directors receive $\theta_1 - w_1$, where θ_1 is assumed to equal $n_1 \frac{\pi_{\widehat{N}}}{n}$ for (38), and $n_1 \frac{\pi_N}{n}$ for (39).

On the other hand, the utility of the inside directors would be expressed as:

$$n_2 \frac{\pi_{\widehat{N}}}{n} - (\overline{w} - \omega_1) \tag{40}$$

if a new CEO is hired from outside the incumbent board, where as it is expressed as

$$(n_2 - 1)\frac{\pi_{N}}{n} + b - (\overline{w} - \omega_1) \tag{41}$$

if the board promotes one of the inside directors to the post of CEO. In both cases, the reservation utility is expressed as $(\theta_2 - w_2)$, as that of the outside directors. Similar to θ_1, θ_2 is assumed to equal $n_2 \frac{\pi_{\widehat{N}}}{n}$ for (40), and $(n_2 - 1)\frac{\pi_N}{n}$ for (41).

Given these payoffs, recall next the sufficient conditions for hiring a CEO from outside the board and promoting one of the inside directors respectively.

That is, if (21) holds, one of the inside directors is appointed to be the CEO, but if (22) holds, the new CEO is recruited from outside.

As discussed in Section 4.3.1, the utilities are all linear in w, and thus which succession policy to adopt is determined by comparing the sum of utilities: the sum of the utilities when they decide to promote one of the inside directors is expressed as:

$$\frac{n_1}{n}\pi_{_N} + (n_2 - 1)\frac{\pi_{_N}}{n} + b - \overline{w}, \tag{42}$$

whereas it would be expressed as follows if they decide to hire from outside the incumbent board:

$$\frac{n_1}{n}\varphi_{\widehat{N}} + \frac{n_2}{n}\varphi_{\widehat{N}} - \overline{w}. \tag{43}$$

Then, it is obvious that (42) $>$ (43), when (21) holds, and (42) $<$ (43), when (22) holds. Therefore, the succession policy the board has decided in the first stage would not change even if the remaining directors renegotiated after the dismissal of the initial CEO.

Furthermore, $w_1 = \omega_1$ and $w_2 = \omega_2$ even if the directors renegotiated about the share of the wage. Suppose the inside directors have all bargaining power in the renegotiation. In this case, the inside directors post a take-it-or-leave-it offer of $\omega_1 = w_1$ to the outside directors. This is because the amount w_1 is the amount that has already been determined in the first stage as the share the outside directors must pay and this is the maximum level they would pay. In this case, the inside directors receive $\omega_2 = \overline{w} - \omega_1 = \overline{w} - w_1 = w_2$. The same logic applies for the case in which the outside directors post a take-it-or-leave-it offer. Therefore, $\omega_1 = w_1$ and $\omega_2 = w_2$.

I also note that when the bargaining powers are split between both types of directors, they enter into Nash bargaining. Nash bargaining is defined only when threat points are in the interior of the feasible set. However, in this renegotiation case, all threat points are on the Pareto efficient frontier, but it is quite natural that these threat points will be realized as bargaining solutions. Therefore, the same solutions are derived for the same conditions as in 4.3.2.

q.e.d.

The assumptions for deriving the profit of the board in section 4.1.

I denote the ability of the CEO as $a_i, i \in \{H, L\}$,where $a_H > a_L$. I denote the prior distribution of the ability of the incumbent CEO as γ^i, $i \in \{H, L\}$, where $\gamma^H > \gamma^L$,and $\gamma^H + \gamma^L = 1$. On the other hand, the prior distribution of the ability of any new CEO candidate is $\frac{1}{2}$ for both being H and L. The profit of the firm is denoted X_j, $j \in \{H, L\}$, where $X_H > X_L$. Then the conditional probability of outcome dependent on the ability of the CEO, $a_i, i \in \{H, L\}$ is expressed as $P_j^i \equiv \Pr\{X_j | a_i\}$. I assume that a_H stands for high ability and a_L stands for low ability. For example, P_L^H is the probability that the CEO produces X_L conditional on his high ability a_H. See Table A.

Table A

	a^H	a^L
X_H	P_H^H	P_H^L
X_L	P_L^H	P_L^L

I assume $P_H^H > P_H^L$, and hence, $P_L^L > P_L^H$ holds. Given these assumptions, the CEO is expected to bring the profit of $\overline{X}^H \equiv P_H^H X_H + P_L^H X_L$ when the CEO's ability is high, and $\overline{X}^L \equiv P_H^L X_H + P_L^L X_L$ when the CEO's ability is low, to the company. In either case, the board receives a share of ρ from this amount. That is, the board expected profit is expressed as $\rho\overline{X}^H \equiv A > B \equiv \rho\overline{X}^L$. Thus, the expected profit to the board when the incumbent CEO serves to the end is expressed as

$$\pi_I \equiv \rho\left[\gamma^H\left(P_H^H X_H + P_L^H X_L\right) + \gamma^L\left(P_H^L X_H + P_L^L X_L\right)\right] \equiv \gamma^H A + \gamma^L B$$

On the other hand, if a new CEO (internally promoted) is appointed and serves to the end, the board's expected profit is expressed as

$$\pi_N \equiv \rho\left[\frac{1}{2}\left(P_H^H X_H + P_L^H X_L\right) + \frac{1}{2}\left(P_H^L X_H + P_L^L X_L\right)\right] \equiv \frac{1}{2}(A + B).$$

Below, I show the expected profit of the directors when the board monitors and updates CEO's ability. See Table B.

Table B

	a^H	a^L
y_H	R_H^H	R_H^L
y_L	R_L^H	R_L^L

I denote the signal the board observes as $y \in \{y_H, y_L\}$, and the conditional probability of payoff dependent on the distribution of the ability of the CEO is expressed as $R_j^i = \Pr\{y_j | a_i\}$. Notice that this does not appear in the previous sections, for it is used to derive the posterior ability of the CEO by the Bayse' rule. When the board monitors and observes y_H, then it believes that the CEO is likely to have high ability with probability of $\frac{\gamma^H R_H^H}{\gamma^H R_H^H + \gamma^L R_H^L}$, which can be denoted μ_H^H. It is assumed that $\mu_H^H > \gamma^H > \frac{1}{2}$ ($\mu_H^L = 1 - \mu_H^H < \frac{1}{2}$) to imply that the monitoring raises the expected outcome of the firm if the incumbent CEO is believed to be likely to be H. Likewise, $\mu_L^H \equiv \frac{\gamma^H R_L^H}{\gamma^H R_L^H + \gamma^L R_L^L}$, and this is assumed to be $\mu_L^H < \frac{1}{2}$ ($\mu_L^L > \frac{1}{2}$). Given these assumptions, the board's expected profit would be expressed as:

$$\pi_H \equiv \left[\mu_H^H \rho \left(P_H^H X_H + P_L^H X_L\right) + \mu_H^L \rho \left(P_H^L X_H + P_L^L X_L\right)\right] \equiv \mu_H^H A + \mu_H^L B,$$

if the board observes y_H with probability q, where it is expressed as:

$$\pi_L \equiv \left[\mu_L^H \rho \left(P_H^H X_H + P_L^H X_L\right) + \mu_L^L \rho \left(P_H^L X_H + P_L^L X_L\right)\right] \equiv \mu_L^H A + \mu_L^L B,$$

if the board observes y_L with probability $(1 - q)$.

From the above arguments, $\pi_{_H} > \pi_I > \pi_{_L}$ and $\pi_{_H} > \pi_{_N} > \pi_{_L}$ are derived.

Lastly, I denote as $\pi_{\widehat{N}}$, the expected profit of the board when a new CEO is recruited from outside the board. This is expressed as

$$\pi_{\widehat{N}} \equiv \rho \left[\frac{1}{2}\left(P_H^H \widehat{X}_H + P_L^H \widehat{X}_L\right) + \frac{1}{2}\left(P_H^L \widehat{X}_H + P_L^L \widehat{X}_L\right)\right] \equiv \frac{1}{2}(\widehat{A} + \widehat{B}),$$

where the outcome $\widehat{X}_H$ and $\widehat{X}_L$ are different from X_H and X_L for the same priors for a newly hired CEO. I assume $\pi_{_H} > \pi_{\widehat{N}} > \pi_{_L}$.

q.e.d.