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Board Governance and Managerial Short-term Incentives

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Abstract: This paper examines the relationship between board independence degree and managerial short-term incentives in investment decisions using a game-theoretical framework which is based on the model of Narayanan (1985). Because the model here connects corporate governance by a board and investment decisions by a manager, we can see clearly how the board affects the manager's investment decisions using its wage policy for the manager. According to the results here, although corporate governance by the board can alleviate managerial short-term incentives in investment decisions, it can not solve these kinds of biases completely. Therefore, to accomplish our final target of eliminating managerial short-term incentives in investment decisions, the only way we can do is to make the information between board and manager completely symmetric. In the comparative statics analysis here, we also know that board independence degree may also change as firms' characteristics change when manager has a certain short-term incentive. Therefore, sometimes a board with lower independence degree would also be appropriate.

Key words: Board of directors; corporate governance; Investment decisions

1. INTRODUCTION

Because of the separation of ownership and control, modern corporations are run by professional managers. But, since Berle and Means (1932), the separation of ownership and control has been criticized for managers' more discretion. In general, managers' interests do not coincide with stockholders' interests and the agency problem between managers and stockholders happens.

Fama and Jensen (1983) suggest that market for takeover as an external control mechanism and board as an internal control mechanism can help solve agency problems. Hostile takeovers are a powerful governance mechanism because they offer the possibility of bypassing the management to take permanent control of the company, but also disruptive and costly at the same time. Thus, the corporate governance by the board is gathering public attention dramatically.

Because of the complex relationship in boards, theoretical analyses about the corporate governance by board are rare. As I know, no paper examines the relationship between board independence degree

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and managerial short-term incentives in investment decisions. Therefore, this paper ventures into this subject. Narayanan (1985) observes that managers concerned with their labor-market reputations may have incentives to take actions that boost measures of short-term performance at the expense of long-run shareholder value. Based on Narayanan (1985), this paper puts corporate governance factor (board independence degree) and examine the relationship between board independence degree and managerial short-term incentives in investment decisions. Hermalin and Weisbach (1998) is the first paper in which board independence degree is put into the model and the relationship between the negotiation power of CEO and board independence degree is analyzed. Hermalin and Weisbach (1998) concludes that CEO with stronger negotiation power will lower the board independence degree (in return, the board will weaken the monitor level on its CEO) and this trend would disappear until the incumbent CEO quits his job.

Based on several results from other empirical researches, this paper focuses on the relationship between board independence degree and managers' wage policy. To let managers' interests coincide with stockholders' interests, wage policy for managers is one of the most important instruments. According to the empirical results, managers' wage is more connected to their firm's performance as the board independence degree goes up. The model here does not consider direct private benefits (e.g. perquisite consumption from his investment decision), just indirect private benefits (the fraction of reputation effect in his wage). Under this assumption, we will see that manager still have incentives for short-term results in investment decisions which hurt stockholders' interests when the information between board and manager is asymmetric, even if he can not get any direct private benefits. Manager's incentives would be stronger as board independence degree becomes lower. The ultimate solution is to eliminate the asymmetric information between board and manager.

Then, we have some comparative statics analyses to investigate the relationship between board independence degree and firm's characteristics. Finally, we have some further analysis.

This paper proceeds as follows. Section 2 reviews the related literatures. Section 3 presents the setup of the model. In Section 4, we analyze the model. In Section 5, we have some comparative statics analysis. Based on the model, Section 6 gives us some further analysis, and Section 7 concludes.

2. LITERATURE REVIEW

Although the corporate governance by board got much attention from practitioners, academic research about the corporate governance by board can only date back to Weisbach (1988). It is different from other fields of Economics that theoretical researches get behind empirical researches in corporate governance by board. Theoretical researches become active after 90's. For example, Hirshleifer and Thakor (1994) analyzes the interaction between takeover and board and Maug (1997) investigates roles of board, takeover, and creditor in restructuring a firm.

The independence degree of board is being emphasized and outside directors are seen as an important mechanism for controlling CEO. But, Hermalin and Weisbach (1991) and Bhagat and Black (2001)'s results contradict with this common sense. They conclude that board's composition (independence degree) does not necessarily have a positive relationship with the firm's performance. Especially, Bhagat and Black (2001) finds that firms' performance is being worse as boards' independence degree goes up.

To explain these empirical results, theoretical researches are extended. Hermalin and Weisbach (1998) analyzes the negotiation process between CEO and board about CEO's wage and the selection of new directors and find that CEO can change board’s independence degree through the negotiation process when CEO has negotiation power. Recent theoretical researches emphasize both inside directors' information advantage and outside directors' independence advantage in their model. Adams and Ferreira (2007) puts strategic information communication between CEO and board into the model and concludes that sometimes a friendly board which has a lower independence degree is better for stockholders' interests when board acts both as a monitor and as an adviser. Raheja (2005) endogenously derives the optimal board size and composition by maximizing the board effectiveness in monitoring and concludes that the optimal board composition is affected by firms' characteristics such as verification

difficulty and amount of free cash flow. Harris and Raviv (2008) finds that optimal control system of board (by outside directors or by inside directors) is affected by the value of information held by both parties and agency costs. Thus, Harris and Raviv (2008) points out that boards which are controlled by inside directors may be optimal for stockholders sometimes.

Because Narayanan (1985) does not consider the factor of corporate governance, this paper puts board independence degree into Narayanan (1985)'s model and examine the relationship between board independence degree and managerial short-term incentives in investment decisions. According to the results here, although corporate governance by the board can lower managerial short-term incentives in investment decisions, it can not solve these kinds of biases completely. Therefore, to accomplish our final target of eliminating managerial short-term incentives in investment decisions, the only way we can do is to make the information between board and manager completely symmetric. This result is consistent with Adams and Ferreira (2007). In the comparative statics analysis here, we also know that board independence degree may change as firms' characteristics change when manager has a certain short-term incentive. Therefore, if inside directors are important as other papers believe, sometimes a board with lower independence degree would also be appropriate.

3. MODEL SETTING

Consider an all-equity firm run by a professional manager. The firm is assumed to live finitely while the manager lives for a finite number of periods, T. The output of the firm depends on the manager's ability, *n*, and a random error term, *e*. The output in period t is given by the following equation.

$$y_t = n + e_t \qquad (1)$$

where e_t is assumed to be distributed independently and normally with mean 0 and precision, *r*. The realizations of e_t are not observable. The only observable number is the output y_t. It follows from (1) that $y_1, y_2, ..., y_t, ...$ is a random sample from a normal distribution with mean, *n*, and precision, *r*.

The firm has a board of directors to monitor the manager and to set the compensation level for the manager. But, the board receives wage 0 and does not affect the output of the firm directly. In other words, to affect the output indirectly, the board has to change its monitor level and the manager's compensation level. The board's independence degree is assumed to be *v*. Because the outside directors are more independent from the manager, the independence level *v* can be understood as the ratio of the outside directors in the board.

We assume that the shareholders (represented by the board) and the manager are risk-neutral. Therefore, the utility for intertemporal consumption $c^t \equiv (c_1, c_2, ..., c_t, ...c_T)$ of both the manager and the stockholders is given by

$$u(c^T) = \sum_{t=1}^{T} \rho^t c_t, \rho \le 1. \qquad (2)$$

Without any loss of generality, we can assume that $\rho = 1$.

The manager's ability *n* is fixed through his career. We follow Harris and Holmstrom (1982) by assumption that the manager, like the board, knows only the distribution of his ability *n*. We justify this assumption by noting that the uncertainty about a manager's ability in a particular job is uncertain about the match between him and the firm, which is similarly unknown to both the manager and the board. The board and the manager update their belief about the manager's ability at the period *t+1* according to the output at the period *t*. The prior beliefs about the manager's ability *n* are assumed to be normal with mean m_0 and precision h_0. The information about this prior beliefs can be manager's academic background or the output produced by manager in previous jobs.

Prior beliefs are updated on the basis of all the previous outputs produced by the manager. The

posterior distribution of *n* at time *t* is normal with mean, m_t, and precision, h_t, given by (see DeGroot (1970)'s 167 page)

$$m_t = [h_0 m_0 + r(y_1 + y_2 + ... + y_t)] / (h_0 + tr) \quad (3)$$

$$h_t = h_0 + tr \quad (4)$$

Equation (3) and equation (4) can also be written as the following form.

$$m_{t+1} = (h_t m_t + r y_{t+1}) / (h_t + r) \quad (5)$$

$$h_{t+1} = h_t + r. \quad (6)$$

The wage policy for the manager set by the board is assumed as follows.

$$w_t = (1-b)m_t + by_t \quad (7)$$

b is the ratio of the wages which are related to firm's performance. *(1-b)* is the ratio of the wages which are related to manager's ability. *b* is a monotone increasing function of board's independence degree *v*. In other words, $\partial b / \partial v > 0$. Therefore, we can take *b* as the proxy for board's independence degree *v* in the following analysis. Because the ratio of the wages which are related to firm's performance can not be 1, we know that $0 \le b < 1$. From equation (7), we can see that manager's compensation become more sensitive to realized output y_t (not his expected output m_t) as the independence degree becomes higher. This assumption captures the fact that manager's pay-performance sensitivity (the relation between manager's pay and firm performance) will rise when the corporate governance become stronger. Newman and Mozes (1999), Core, Holthausen, and Larcker (1999), and Murphy (1999) have found empirical results for this fact.

The manager is hired at the beginning of period 1. He is paid at the beginning of each period based on the history up to that period and before that period's output is observed. For example, he is paid his first wage, w_1, at the beginning of the second period based on the history up to that period, $\{m_0, y_1\}$. After the second period output, y_2, is observed, he is offered his second wage, w_2 at the beginning of the third period, based on the history $\{m_0, y_1, y_2\}$, and so on.

The manager acts to maximize his total wages $\sum_{t=1}^{T-1} w_t$. Obviously, the manager has incentives to maximize the output of the firm. When the manager maximize the output of the firm, he does not only raise by_t in his current period wage, but also raise $(1-b)m_s, s = (t+1, t+2, ..., T)$ in his subsequent period wages. In such a situation, the manager has incentives to maximize future's cash flows and the manager's interests coincide the stockholders' interests. But, when the manager has to choose a project between an inferior project with a short-term higher return and a superior with a long-term higher return, the situation becomes somewhat different.

4. BOARD INDEPENDENCE DEGREE AND MANAGERIAL SHORT-TERM INCENTIVES IN INVESTMENT DECISIONS

In this section, we show that the manager has a penchant for short-term results when the asymmetric information exits between the manager and the board. Although the corporate governance by board with higher pay-performance sensitivity can be a solution to this problem, it can not eliminate this problem completely. In order to model the manager's penchant for short-term results, we add a decision factor which is made by the manager into the firm's output equation of the previous section. Thus, the firm's output is defined as a function of the ability, the random factor and a decision that the manager makes. The output is specified as follows.

$$y_t = n + e_t + D_t(z), t = 1,2,...,T-1. \quad (8)$$

z ($z \in Z$) represents an element of his decision set Z and $D_t(Z)$ ($Z \to R^1$) represents the cash flow originated from the managerial decision. The decision, z , is made at the beginning of period 1.

To let the analysis more clear, we consider the simplest decision set here. Let $Z = \{A, B\}$, i.e., the manager has a choice between decision *A* or *B*. Let

$$D_t(A) = k, t = 1$$

$$= 0, t > 1$$

$$D_t(B) = 0, t = 1$$

$$= 1, t = 2$$

$$= 0, t > 2. \quad (9)$$

In other words, decision *A* results in *k* additional dollars in period 1, while *B* results in 1 additional dollar in period 2. After period 2, both decisions produce identical (zero) cash flows. We let the discount factor equals 1 here. Thus, when $k < 1$, decision *A* produces higher cash flows in period 1 but, from the long-term view, is inferior. Our purpose is to investigate whether conditions exist wherein the manager has incentives to take decision *A* and whether the corporate governance by board can be a solution to this problem.

4.1 The symmetric information case

In this subsection, we will first consider the managerial decision under symmetric information which means that all the information is available to both the manager and the board. In particular, the board can observe precisely the manager's decision which is *A* or *B*. The board will give the manager the wage set based on the board's observed decision which will actually be chosen by the manager.

If the manager's decision is *A*, the board will give the manager the wage set based on the evaluation of manager's performance by the following set of equations.

$$w_1^A = (1-b)\frac{h_0 m_0 + (y_1^A - k)r}{h_0 + r} + by_1^A$$

$$w_2^A = (1-b)\frac{h_0 m_0 + (y_1^A + y_2^A - k)r}{h_0 + 2r} + by_2^A$$

$$w_t^A = (1-b)\frac{h_0 m_0 + (\sum_{s=1}^{t} y_s^A - k)r}{h_0 + tr} + by_t^A, t = 3,4,...T-1 \quad (10)$$

If the manager's decision is B, the board will give the manager the following wage set.

$$w_1^B = (1-b)\frac{h_0 m_0 + (y_1^B)r}{h_0 + r} + by_1^B$$

$$w_2^B = (1-b)\frac{h_0 m_0 + (y_1^B + y_2^B - 1)r}{h_0 + 2r} + by_2^B$$

$$w_t^B = (1-b)\frac{h_0 m_0 + (\sum_{s=1}^{t} y_s^B - 1)r}{h_0 + tr} + by_t^B, t = 3,4,...T-1. \quad (11)$$

From equation (8) and equation (9), we can know y^A and y^B as follows.

$$y_1^A - k = n + e_1$$

$$y_t^A = n + e_t, t = 2,3,...T-1. \quad (12)$$

$$y_t^B = n + e_t, t = 1,3,...T-1$$

$$y_2^B - 1 = n + e_2. \quad (13)$$

From equation (12) and equation (13), it is obvious that

$$y_1^A - k = y_1^B$$

$$y_2^A = y_2^B - 1$$

$$y_t^A = y_t^B, t = 3,4,...T-1. \quad (14)$$

The manager will choose the decision which will maximize his wage set. The difference of total wages between decision *A* and decision *B* is

$$\sum_{s=1}^{t} w_t^A - \sum_{s=1}^{t} w_t^B = b(k-1), t = 3,4,...T-1. \quad (15)$$

The manager will prefer decision *A* When *k>1*, decision B when *k<1*. Because the board (represents stockholders) will prefer the decision which generates the highest net present value, the board also prefers decision *A* when *k>1*, decision *B* when *k<1*. Thus, the manager's decision coincides with the board's. This coincidence is being stronger as *b* becomes bigger. In other words, this coincidence between the manager and the board becomes stronger as pay-performance sensitivity becomes stronger. Therefore, the manager does not have any incentive for short-term results which will hurt stockholders' interests in this case.

4.2 The asymmetric information case

In this subsection, we consider the situation where the information is asymmetric between the board and the manager. In other words, the board can not know which decision the manager took. As a result, the evaluation of the manager's ability will depend on the board's guess of the manager's decision. This is a game-theoretic situation. It is a two-person variable-sum game in which the players move simultaneously, i.e., ignorant of each other's move. The decision variable for the manager is the decision *A* or *B*, and the decision variable for the board is the basis on which to assess the manager's performance. The board can base the wage policy for the manager on the assumption that the manager's decision is *A* or *B*. The equilibrium concept we use here is the special case of the Nash equilibrium, the dominant strategy equilibrium.

Let S_m and S_b be the set of strategies for the manager and the board, respectively. $S_m = \{A, B\}$, where the letters inside the braces represent the manager's decision; $S_b = \{A, B\}$, where the letters inside the braces represent the decision, on the basis of which the board will evaluate the manager. Let $W(s_m, s_b)$ denote the manager's total expected wages and $V(s_m, s_b)$ denote the board's total expected profits if the manager's strategy is s_m and the board's strategy is s_b, where $s_m \in S_m$ and $s_b \in S_b$. Then, s_m is a strictly dominant strategy for the manager if $W(s_m, s_b) > W(S_m - s_m, s_b)$, for $s_b = A, B$; similarly, s_b is a strictly dominant strategy for the stockholders if $V(s_m, s_b) > V(s_m, S_b - s_b)$, for $s_m = A, B$, where $(S_i - s_i) \cup s_i = S_i$, $i = m, b$. $\{s_m, s_b\}$ is a strictly dominant strategy equilibrium if s_m and s_b are strictly dominant strategies for the manager and the board, respectively. Clearly, the strategies of the participants depend on the value of *k*. We shall show that, depending on the value of *k*, either {*A*, *A*} or {*B*, *B*} is the dominant strategy equilibrium.

From the following analysis, we can see that the manager's decision depends only on the value of *k* and not on the board's basis of valuation, i.e., given *k*, the manager has a dominant strategy. First, let us assume that the board's strategy is *A*, i.e., they evaluate the manager on the basis of decision *A*. If the manager chooses decision *A*, his wage set would be as follows.

$$w_1^A = (1-b)\frac{h_0 m_0 + (y_1^A - k)r}{h_0 + r} + by_1^A$$

$$w_2^A = (1-b)\frac{h_0 m_0 + (y_1^A + y_2^A - k)r}{h_0 + 2r} + by_2^A$$

$$w_t^A = (1-b)\frac{h_0 m_0 + (\sum_{s=1}^{t} y_s^A - k)r}{h_0 + tr} + by_t^A, t = 3, 4, ...T-1. \quad (16)$$

If the manager's decision is B, the board will give the manager the following wage set.

$$w_1^B = (1-b)\frac{h_0 m_0 + (y_1^B - k)r}{h_0 + r} + by_1^B$$

$$w_2^B = (1-b)\frac{h_0 m_0 + (y_1^B + y_2^B - k)r}{h_0 + 2r} + by_2^B$$

$$w_t^B = (1-b)\frac{h_0 m_0 + (\sum_{s=1}^{t} y_s^B - k)r}{h_0 + tr} + by_t^B, t = 3, 4, ...T-1. \quad (17)$$

According to equation (14), we can calculate the difference between these two wage set.

$$\sum_{s=1}^{t} w_t^A - \sum_{s=1}^{t} w_t^B = \frac{(1-b)kr}{h_0 + r} + \sum_{s=2}^{t} \frac{(1-b)(k-1)r}{h_0 + sr} + bk - b, t = 2, 3, ...T-1. \quad (18)$$

Now, let us assume that the board uses strategy *B*. If the manager chooses decision *A*, his wage set would be as follows.

$$w_1^A = (1-b)\frac{h_0 m_0 + (y_1^A)r}{h_0 + r} + by_1^A$$

$$w_2^A = (1-b)\frac{h_0 m_0 + (y_1^A + y_2^A - 1)r}{h_0 + 2r} + by_2^A$$

$$w_t^A = (1-b)\frac{h_0 m_0 + (\sum_{s=1}^{t} y_s^A - 1)r}{h_0 + tr} + by_t^A, t = 3, 4, ...T-1. \quad (19)$$

If the manager's decision is *B*, the board will give the manager the following wage set.

$$w_1^B = (1-b)\frac{h_0 m_0 + (y_1^B)r}{h_0 + r} + by_1^B$$

$$w_2^B = (1-b)\frac{h_0 m_0 + (y_1^B + y_2^B - 1)r}{h_0 + 2r} + by_2^B$$

$$w_t^B = (1-b)\frac{h_0 m_0 + (\sum_{s=1}^{t} y_s^B - 1)r}{h_0 + tr} + by_t^B, t = 3, 4, ...T-1. \quad (20)$$

According to equation (14), we can calculate the difference between these two wage set and we can

find that the result is the same as equation (18). Therefore, irrespective of the board's strategies, the difference between manager's wage sets under his both decisions are the same. In other words, the difference between the manager's total expected wages under decision *A* and *B* depend only on *k* and not on the board's strategies.

In this situation, we can show that the manager sometimes will choose *A* even under the condition of *k<1*. In these cases, the manager chooses the short-term results which hurt the stockholders' interests. From the above analysis, we can have the parameter θ_k as follows.

$$\theta_k = W(A, s_b) - W(B, s_b) = \frac{(1-b)kr}{h_0 + r} + \sum_{t=2}^{T-1} \frac{(1-b)(k-1)r}{h_0 + tr} + bk - b. \quad (21)$$

$s_s \in \{A, B\}$. The manager's dominant strategy is *A* if $\theta_k > 0$ and *B* if $\theta_k < 0$. If the board's basis of evaluation turns out to be correct, i.e., if $s_b = s_m$, the manager's total expected wage will be the same as in the symmetric case. Let W_0 be the manager's total expected wage in the symmetric case. Then,

$$W(A, A) = W(B, B) = W_0. \quad (22)$$

From equation (21) and equation (22), we know that $W(A,B) = W_0 + \theta_k$ and $W(B,A) = W_0 - \theta_k$. In other words,

$\theta_k = W(A,A) - W(B,A) = W(A,B) - W(B,B)$ Because stockholders' (who are represented by the board) interests plus manager's interests are the sum of the cash flow, the following equation holds.

$$V(A,A) + W(A,A) = \sum_{t=1}^{T-1} y_t + k = V(A,B) + W(A,B)$$

$$V(B,B) + W(B,B) = \sum_{t=1}^{T-1} y_t + k = V(B,A) + W(B,A) \quad (23)$$

Therefore, the difference of board's interests is

$$V(A,A) - V(A,B) = W(A,B) - W(A,A) = \theta_k$$

$$V(B,A) - V(B,B) = W(B,B) - W(B,A) = \theta_k \quad (24)$$

Obviously, the board also has his dominant strategy. The board will have *A* as his dominant strategy when $\theta_k > 0$ and *B* when $\theta_k < 0$. Therefore, if $\theta_k > 0$, the dominant strategy equilibrium is $\{A, A\}$. If $\theta_k < 0$, the dominant strategy equilibrium is $\{B, B\}$.

Let k^* be the value of k for which the manager is indifferent between decisions *A* and *B*. To find *k**, we set $\theta_k = 0$ and obtain

$$k^* = \frac{b(h_0 + r) + (1-b)(h_0 + r)r\sum_{t=2}^{T-1} \frac{1}{h_0 + tr}}{(1-b)r + b(h_0 + r) + (1-b)(h_0 + r)r\sum_{t=2}^{T-1} \frac{1}{h_0 + tr}}. \quad (25)$$

For all $k \geq k^*$, the manager's choice would be decision *A* and for $k < k^*$ it would be decision *B*. Because it is obvious that *k*<1*, we encounter situations wherein the manager has incentives for short-term results at the expense of the long-term interests of the stockholders. The reason that *k** is less than 1 lies in the fact that an extra dollar in the first period is worth more to the manager than an extra dollar in the second period. This is because the manager's wage in any period is based on the total output till that period. Therefore, a project with an extra dollar in the first period results in higher wage in the first period than a project with an extra dollar in the second period; however, in all subsequent periods, the wages under both projects are the same. Since an extra dollar in the first period is worth more to the manager than an extra dollar in the second period, he requires less than a dollar in the first period to compensate for the extra dollar in the second period. Because the manager is concerned about the past

performance he made, this result could be explained as "the reputation effect".

When $k \geq 1$, the manager's decision is not in conflict with the interests of the stockholders because the manager's decision *A* results in the highest net present value. Similarly, for *k*< *k**, the manager's decision *B* does not conflict with the stockholder's interests, as in this case decision *B* maximizes stockholders' wealth. But for $1 > k \geq k^*$, the manager's decision *A* is not in the best interests of the stockholders, who would like the manager to take decision *B* which maximizes their wealth. Therefore, when the difference between the net present values of the two decisions is not very high, asymmetric information does result in decisions that are detrimental to the stockholders' interests. In such situations ($1 > k \geq k^*$), the manager sacrifices the long-term interests of the stockholders for short-term gains.

Therefore, outside the range [*k**,*1*), the equilibrium decision is optimal. The smaller this range is (*k** is bigger), the less are the chances of finding a *k* that falls in this range.

From equation (25), we notice that *k** is a function of *b* (*b* is made as a proxy for the board's independence degree *v*). Differentiate *k** with *b* and we can obtain the following result.

$$\frac{\partial k^*}{\partial b} = \frac{[(h_0 + r) - (h_0 + r)\sum_{t=2}^{T-1} \frac{1}{h_t + r}][(1-b)r + b(h_0 + r) + (1-b)(h_0 + r)r\sum_{t=2}^{T-1} \frac{1}{h_t + r}]}{[(1-b)r + b(h_0 + r) + (1-b)(h_0 + r)r\sum_{t=2}^{T-1} \frac{1}{h_t + r}]^2} > 0 \quad (26)$$

Therefore, *k** increases as *b* increases. From this relationship between *k** and *b*, we can conclude that increasing the independence degree of the board would be a solution to managerial incentives for short-term results. More independent the board is, higher the pay-performance sensitivity of the manager wages is. Because the ratio of the pay based on the performance in this period become bigger, the importance of the former performance the manager made would become relatively small. Thus, the reputation effect diminished. As the board independence degree increases, the board would evaluate the manager basing more on what the manager did, not what the manager can do. We can call this effect as "the pay-performance sensitivity effect".

In equation (24), we can see that *k** will be equal to 1 when *b=1*. But, based on the former assumption, we know that *b* can not be 1. Because *k** is a monotone increasing function of *b*, *k** would always be smaller than 1 even if *b* is extremely close to 1. Therefore, although an independent board can make the range [*k**,*1*) smaller so that the manager's incentives for short-term results become smaller, it can not eliminate the manager's incentives completely as long as the reputation effect exists.

Therefore, to accomplish our final target of eliminating manager's incentives for short-term results, the only way we can do is to make the information between the board and manager completely symmetric.

5. COMAPRATIVE STATICS ANALYSIS

In the previous section, we saw that the manager makes decisions which are suboptimal for some values of *k* when the information is asymmetric. The board can alleviate this problem, but can not eliminate this problem completely. We also have seen that outside the range [*k**,*1*), the equilibrium decision is optimal. Hence, the smaller this range, the less are the chances of finding a *k* that falls in this range. In this section, we do some comparative statics analysis to examine the relationship between firm's characteristics and board independence when manager has a certain short-term incentive.

We examine the relationship between firm's characteristics and board independence by assuming two firms have the same *k** but different firm's characteristics. Because inside directors have more specified knowledge and inside information, they are also indispensable for the firm. As a result, inside directors are also necessary to firms and boards' independence degree always can not be extended too much. But, from the analysis below, we can see that under the same extent of managerial incentives for short-term results, the firms with different characteristics will have different board independence which are optimal to these firms.

First, we examine the relationship between firm's risk and board independence. According to the

assumption in section 3, the parameter 1/r could be a proxy for firm's risk. When *r* falls, the deviation of firm's outputs 1/r becomes large.

$$\frac{\partial k^*}{\partial r} = \frac{[(1-b)r^2\frac{\partial\delta}{\partial r} - bh_0](1-b)}{[(1-b)r + b(h_0+r) + (1-b)r\delta]^2} < 0, \text{ where } \quad \delta = (h_0+r)\sum_{t=2}^{T-1}\frac{1}{h_0+tr}, \frac{\partial\delta}{\partial r} < 0 \qquad (27)$$

From total differentiation, we have $dk^* = 0 = \frac{\partial k^*}{\partial r}dr + \frac{\partial k^*}{\partial b}db$. (28)

Thus, $\frac{db}{dr} > 0$. (29)

As *r* becomes smaller, 1/r is being larger and the firm's risk increases. Because *k** increases when 1/r increases, the manager in the firm with more risk would have smaller incentive for short-term results. When the firm's risk increases, the firm's performance and the estimation of manager' ability are more attributed to the random factor which is out of manager's control. The effect from manager's investment decision decreases. Therefore, the firm with more risk could have a smaller board independence which is optimal for the firm.

Second, we examine the relationship between h_0 and board independence. h_0 is the precision of the prior distribution of the manager's ability. Because the manager's previous education or experience could increase the precision of the prior distribution, we can take h_0 as a proxy for the manager's previous education, experience.

$$\frac{\partial k^*}{\partial h_0} = \frac{[b+(1-b)r\frac{\partial\delta}{\partial h_0}][(1-b)r]}{[(1-b)r + b(h_0+r) + (1-b)r\delta]^2} > 0 \qquad (30)$$

$$\frac{\partial^2 k^*}{\partial h_0^2} = \frac{(1-b)^2 r^2 \frac{\partial^2\delta}{\partial h_0^2}[(1-b)r + b(h_0+r) + (1-b)r\delta]^2}{[(1-b)r + b(h_0+r) + (1-b)r\delta]^4} \qquad (31)$$

$$-\frac{2(1-b)^2 r^2 \frac{\partial\delta}{\partial h_0}[b+(1-b)r\frac{\partial\delta}{\partial h_0}][(1-b)r + b(h_0+r) + (1-b)r\delta]}{[(1-b)r + b(h_0+r) + (1-b)r\delta]^4} < 0 \qquad (32)$$

Where $\frac{\partial\delta}{\partial h_0} > 0, \frac{\partial^2\delta}{\partial h_0^2} < 0$. From total differentiation, we have

$$dk^* = 0 = \frac{\partial k^*}{\partial h_0}dh_0 + \frac{\partial k^*}{\partial b}db \qquad (33)$$

Thus, $\frac{db}{dh_0} < 0$. (34)

When h_0 increases, the ability fraction of his wage (the reputation effect) decreases and the other fraction of his wage (the pay-performance effect) increases. Therefore, the firm's request for the board independence decreases and smaller board independence would be optimal. As the signs of $\frac{\partial k^*}{\partial h_0}$ and $\frac{\partial^2 k^*}{\partial h_0^2}$ show, h_0 can put *k** to extremely close to 1. When *b=1*, $\frac{\partial k^*}{\partial h_0}$ becomes 0 and *k** become 1. But, because it is impossible to have *b=1*, a very famous manager with a high h_0 would still has incentives for short-term results although we could have a board with a smaller independence.

Finally, we examine the relationship between manager's contract duration and board independence.

When manager's contract duration increases, his incentives for short-term gains would be surely changed. As a result, the board independence would also be different. We let

$$J(T) = b(h_0 + r) + (1-b)r\delta \qquad (35)$$

J(T) is an increasing concave function of T. Thus,

$$k^* = \frac{J(T)}{(1-b)r + J(T)} \qquad (36)$$

$$\frac{k^*}{J(T)} = \frac{(1-b)r}{[(1-b)r + J(T)]^2} > 0 \qquad (37)$$

From total differentiation, we have $dk^* = 0 = \frac{\partial k^*}{\partial J(T)} dJ(T) + \frac{\partial k^*}{\partial b} db$ (38) .

Thus, $\frac{\partial b}{\partial J(T)} < 0, \frac{\partial b}{\partial T} < 0$.

Because the manager takes actions which maximize his total wages, increased reputation effect from his short-term results would be relatively smaller when his contract duration increases. Therefore, a board with a smaller independence would be optimal.

6. FURTHER ANALYSIS

Based on the former analysis, we proceed with further analysis.

a. Symmetric information VS. Asymmetric information. Because manager's benefits (loss) are equivalent to board's loss (benefits), manager has no incentive to disclose information which he holds. Therefore, it is necessary to make managers' information disclosure compulsory. Boards' information collection and information processing are also important. Lipton and Lorsch (1992) point out that boards' inefficiencies always stem from the following problems. First, boards' insufficient time to discuss and unnecessary size (number of directors). In general, boards' gatherings are limited and directors can not have enough time to fulfill their responsibilities. When boards' size passes 10, it will become difficult for every director to describe his ideas and opinions in the limited time. Second, the complexity of information. Because boards should analyze and discuss complex information in a limited time, a correct decision making must be very difficult. Therefore, boards' gathering time should be assured and boards' size should be limited. Managers are also responsible for understandable information provision to boards.

b. Direct private benefits. The model here does not consider direct private benefits (e.g. perquisite consumption from his investment decision), just indirect private benefits (the fraction of reputation effect in his wage). But, the results are obvious when direct private benefits are put into the model. When the manager gets his private benefits from a short-term investment decision (an inferior project), he will act to maximize his private benefits plus his total wages. In this case, pay-performance effects also go down. Therefore, managers will have more incentives to make short-term investment decisions, even if stockholders' interests will be hurt. Of course, it is reasonable that the effects from direct private benefits would be smaller as pay-performance effects in his wages are stronger.

7. CONCLUSION

Based on the former analysis, boards can alleviate managerial short-term incentives in investment decisions; it can not solve these kinds of biases completely. The most radical solution is to eliminate the

asymmetric information problem between boards and managers. Because manager's benefits (loss) are equivalent to board's loss (benefits), manager has no incentive to disclose information which he holds. Therefore, it is necessary to make managers' information disclosure compulsory. In addition, boards' gathering time should be assured and boards' size should be limited. Managers are also responsible for understandable information provision to boards.

Because managerial short-term incentives in investment decisions change as firms' characteristics change when manager has a certain short-term incentive, sometimes a board with a lower independence degree would also be appropriate. Therefore, we can not emphasize boards' independence degree purely.

An inefficient corporate governance mechanism with a low independent board would decrease pay-performance effects in manager's wages and make firm's performance even worse. Therefore, reforms towards boards are very necessary and important. Recently, reforms towards boards are extended around the world and managers' wages are more related to their firms' performance through stock and stock options in managers' wage policies. But, we also always heard that managers pursue their own private benefits by manipulating accounting data and some important information. Therefore, a "really " independent board must relate manager's wage to firm's performance completely, not only by an ax ante contract, but also by an intermediary monitor and an ex post negotiation.

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