A Theory of Friendly Boards

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Abstract

This paper analyzes the consequences of the board's dual role as an advisor as well as a monitor of management. As a result of this dual role, the CEO faces a trade-off in disclosing information to the board. On the one hand, if he reveals his information, he gets better advice. On the other hand, a more informed board will monitor him more intensively. Since an independent board is a tougher monitor, the CEO may be reluctant to share information with it. Thus, our model shows that management-friendly boards can be optimal. Using the insights from the model, we analyze the differences between a sole board system, such as in the United States, and the dual board system, as in various countries in Europe. We highlight several policy implications of our analysis.

Keywords: Board of Directors, Advisor, Monitor, Sole Board, Management-Friendly, Dual Board

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> "Too much emphasis on monitoring tends to create a rift between non-executive and executive directors, whereas the more traditional job of forming strategy requires close collaboration. In both activities, though, independent directors face the same problem: they depend largely on the chief executive and the company's management for information." *The Economist (February 10, 2001, p. 68) describing a survey by PWC of British boards.*

Both the Business Roundtable and the American Law Institute (see e.g. Monks and Minnow (1996), p. 172) list advising management among the top five functions of the board of directors in the United States. The advisory role of the board exists not only in the sole board system in the United States but also in, for example, Europe, where boards in several countries are formally separated into a management and a supervisory board. However, while the monitoring role of the board has been studied extensively in a large, mostly empirical, literature,[1] the advisory role has received little attention. This paper examines one implication of combining the board's two roles in the sole board system, then turns to a discussion of the dual board system. We argue that a characteristic of the sole board system is that because the entire board is responsible for monitoring the manager, the manager may face a trade-off when the board also advises him.

The board has the ultimate legal authority over decision-making within the firm. According to the American Bar Association's Committee on Corporate Laws (1994, p. 4), this means, amongst others, that the board must review and approve fundamental operating, financial, and other corporate plans and strategies. To alleviate moral hazard problems which arise when managers' preferred projects are not those which maximize shareholder value, directors must be willing to withhold approval and insist on change. We call the board's active participation in decision-making its monitoring role.

In its advisory role, the board takes a more hands-off approach. As one director puts it in Lorsch and MacIver (1989, p. 64): "Directors are sounding boards for management. They contribute their opinions as to general policy, and their judgement whenever a problem comes up." Thus, the board draws upon the expertise of its members to counsel management on the firm's strategic direction. Since many board members have full-time jobs in other corporations, they rely on the CEO to provide them with the necessary information to evaluate, for example, whether the company should enter a new line of business. The more information the manager provides and the better the manager synthesizes the information, the better is the board's advice.

To analyze the implications of combining the board's two roles, this paper first presents a model of the interaction between a sole board and a manager in which moral hazard problems arise because the manager's preferred projects differ from those of shareholders. When monitoring by the board is successful, the board effectively controls project selection. In addition to not being able to implement his preferred projects in this case, the

[1] See the survey by Hermalin and Weisbach (2003).

CEO loses valuable control benefits. When the board does not control project selection, the board advises the manager. Advice here consists in information-sharing, where the quality of the board's advice is improved if the manager provides it with information about the firm's investment opportunities.

In our model, independent boards monitor more intensively. Given that the board monitors him, the manager faces a trade-off in sharing information. On the one hand, the board will give better advice if the manager shares his information. On the other hand, information revealed by the manager helps the board determine the range of options available to the firm. The more precise the board's information about these options, the greater the risk to the manager that the board will interfere in decision-making. As a result, we show that the CEO will not communicate firm specific information to a board which is too independent.

At first glance, the advisory and monitoring roles of a sole board complement each other, because the board uses any information the manager provides during the advisory process both to make better recommendations and to implement better decisions. However, consistent with the quote above, the two roles of the board may also conflict. We show that, in selecting their boards, shareholders may choose to play off one role against the other. Specifically, to encourage the manager to share information, shareholders may optimally elect a less independent or friendlier board which does not monitor the CEO too intensively.

Other theoretical papers have examined why boards may not monitor too intensively. Warther (1998) focuses on how the management's power to eject board members affects the behavior of the board. Hermalin and Weisbach (1998) also use the manager's power over the board selection process to develop a model of how board composition is determined as a function of the board's monitoring intensity. Both these papers describe how passive boards may arise. Almazan and Suarez (2003) argue that passive (or weak) boards may be optimal under certain conditions. The reason is that in their framework severance pay and weak boards are substitutes for costly incentive compensation. Our paper is similar to Almazan and Suarez (2003) in that we also describe why it might be optimal to have a passive (in our terminology: management-friendly) board, however the driving forces behind our idea are the potential conflicts between the different roles of the board.

After analyzing the sole board system, we reinterpret our model to discuss the implications of separating the board's advisory and monitoring functions in a dual board system. When the two roles are separated, the manager does not face a trade-off in the provision of information. The model shows, therefore, that under certain conditions shareholders prefer a dual board system to a sole board system. Thus, the model has implications for cross-country variation in governance systems. While the dual board structure allows for the cleanest separation of the board's two roles, it is also possible to separate the roles through the use of board committees. For example, one can view the

audit committee in the sole board systems of the United States and the United Kingdom as fulfilling some of the functions of a supervisory board. With this interpretation, our model may also shed some light on the policy debate concerning audit committees.

In the final part of the paper, we relax the assumption that the board's preferences are aligned with those of shareholders. In the United States, the board's preferences may diverge from those of shareholders, because nonshareholder constituency statutes allow directors to consider the effects of their decisions on nonshareholder stakeholders. Similarly, the preferences of management and the supervisory board may differ from each other in a dual board system because in some countries, such as Germany, workers are given explicit representation on the supervisory board. We show that when the board's preferences are more aligned with those of the manager, the quality of the advice the board provides is higher. This is an additional reason why shareholders may benefit from a CEO-friendly sole board. In the dual board system, shareholders prefer boards whose preferences are adapted to their role.

Our analysis has several policy implications that are particularly topical given the emphasis on governance reform in the United States and Europe in the wake of recent corporate scandals. Because boards have been criticized for being too friendly to managers (e.g. U.S. House (2002)), Congress, through the Sarbanes-Oxley Act of 2002, the NYSE and NASDAQ are requiring that independent directors play a more important role in firm governance. Others have asked whether a two-tier board structure might enhance board oversight in countries, such as Britain, which currently have a sole board structure (see the discussion by O'Hare in *The Financial Times*, (2003)).

In the context of our model, we find first that policies which enhance board independence may be detrimental for shareholders in a sole board system, but not in a dual board system. Second, while the sole board structure can achieve the first-best outcome for shareholders more often than the dual board structure, the latter is sometimes the second-best option from shareholders' standpoint. Thus, if possible, shareholders should be allowed to choose between board structures. Finally, our model illustrates that shareholders are always at least weakly better off if the board has an advisory role.

This paper is structured as follows: Section I presents the model of the trade-off to the manager of consulting a sole board in an advisory capacity and discusses the empirical content of the model. Section II discusses the model's extension to the dual board system and to boards whose preferences may not be aligned with those of shareholders. In section III, we make our final remarks and highlight the policy implications of our analysis. All proofs are in the appendix.

I. The Model

The theory in this paper builds upon four basic ideas. First, the CEO dislikes monitoring by the board because he values control. Second, advising by the board increases firm value without interfering with the CEO's choices, thus he likes advising. Third,

both monitoring and advising by the board are more effective when the board is better informed. Finally, in both roles, the board depends crucially on the CEO for firm-specific information.[2]

Similar to the monitoring technology used in previous papers (for example, Burkart, Gromb and Panunzi (1997)), in our model, the board monitors by interfering with the CEO's project choice. The CEO dislikes board interference because his interests are not always aligned with the board's and because he enjoys private benefits of controlling project choice. We assume that the CEO has private benefits of control in this context for two main reasons. First, as much of the corporate governance literature assumes (see e.g. the discussion in Dyck and Zingales (2004)), the CEO may attribute a psychic value to being in control. In this case, he dislikes board interference per se. He may also dislike board interference because it may weaken his authority, especially if it becomes public that he is not in control of project selection. This may cause him to lose the respect of his subordinates, making it more difficult for him to manage, and may also diminish his value in the market for CEOs.[3]

Board advising increases firm value because the board's expertise is complementary to the CEO's. Moreover, if the CEO provides the board with firm-specific information, the board's advice is better. We believe it is intuitive that the quality of advice is higher when the advisee reveals his private information to his advisor. But, to our knowledge, this link between information revelation and the quality of advice has not been modeled before. We view the modeling of such a relationship as an additional contribution of our paper.

Formally, we model the communication game between the CEO and the board as a standard strategic information transmission game in which the board may strategically distort its advice to influence the CEO's choice.[4] We choose this approach because, as long as boards' preferences are not fully aligned with CEOs', it is realistic to expect that the board will have a strategic motive to manipulate its advice. This approach also generates several implications that are unique to it. In particular, as CEOs' and boards' interests converge, the noise in communication decreases, leading to interesting comparative statics exercises which we explore in section II.[5]

[2]Raheja (2005) examines the optimal board structure when insiders other than the CEO are an additional source of information to the board.

[3]Consistent with the idea that the CEO may incur significant costs due to board interference, Joseph L. Bower argued in an article in *Corporate Board Member* (2002): "Overruling a CEO is very complex. If done formally as a vote-as opposed to effective argument that the CEO sees has persuaded a significant part of the board-it is tantamount to firing the CEO...But actual overruling is tough. They did it at Coke, and Douglas Daft remains, but he's been a much less powerful CEO after that."

[4]Classic references are Milgrom (1981) for sender-receiver games with verifiable information and Crawford and Sobel (1982) for cheap-talk games.

[5]Our main results do not depend on the existence of strategic communication. Even if the board always truthfully reveals its information, most of our results in section still hold. As noted by the referee, truth-telling can sometimes be sustained as an equilbrium outcome even in cheap-talk games

In practice, directors may have incentives to develop a reputation for being forthright. While such reputational concerns may weaken directors' incentives to communicate strategically, we believe they will not eliminate them, because in our baseline model directors manipulate their information in the interests of shareholders. As long as directors care more about their reputation for acting in the interest of shareholders than for being forthright, the strategic motive will exist. Directors' desire to be known as cooperative with the CEO may also weaken their incentives to manipulate information. This effect is likely to be more important for less independent boards, because insiders' careers are more dependent on the incumbent CEO. When boards are at least moderately independent, we expect the strategic motive to dominate. Consistent with this idea, we show in an extension to the baseline model in section II that less independent boards will distort messages to a lesser extent than more independent ones, even though reputational concerns are not present.

A. Setup

In this section, we describe the setup of our model of a sole board, whose timeline we provide in Figure 1.

A.1. Timing

Period 0 - Shareholders set up the firm

In period 0, the firm is established and the shareholders hire a CEO. They also elect a board whose degree of independence is given by $I \in [0, 1]$.[6] The board is responsible for both advising and monitoring the CEO.

Because inside directors' careers are dependent on the CEO, they have incentives to cooperate with the CEO. As a result, outsiders are generally considered to be more effective monitors than insiders. However, insiders may also play an important monitoring role because they have access to better information or have a better understanding of the business environment and of the actions taken by the CEO (see e.g. Ocasio (1994); Morck (2004); Boumosleh and Reeb (2005)). If insiders are more effective at monitoring than outsiders, then the first-best board would be packed with insiders. Because this is opposite to what most governance advocates would argue should be true, we assume that insiders' career concerns are sufficiently important so that less independent boards face higher costs of monitoring the CEO.

(e.g. Krishna and Morgan (2001); Battaglini (2002)). In addition, noisy communication can arise even without strategic considerations, as in models of information processing in organizations (Radner (1993); Vayanos (2003)), thus our model is in many aspects equivalent to one in which boards report truthfully, but messages are read with error.

[6] While in theory shareholders choose board structure because they elect directors, in practice, they may have little effective control. Nevertheless, different forces, such as activism by institutional investors or the market for corporate control, may lead a firm's board structure to approximate the optimal structure for shareholders. For simplicity, we assume that shareholders choose the optimal board structure.

Because board composition changes only infrequently, the initial choice of I works as a credible commitment to monitor the CEO with the intended intensity. When renegotiation between the CEO and the board is possible, choosing a "friendly board" is a way in which shareholders may commit to monitor the CEO with low intensity. However, in our model the actual monitoring intensity π will be endogenously chosen by the board. Thus, the choice of I will affect the board's decision to monitor, although it is not possible for shareholders to formally commit to a given monitoring intensity π.[7]

[Insert Figure 1 about here]

Period 1 - The CEO gathers information and communicates with the board

In period 1, the CEO and the board face a non-routine project-choice decision. We assume that this decision is non-routine because on routine issues the board is unlikely to have much of an advisory role. There is an infinite number of feasible projects, but the firm can undertake only one of them. We denote each project by a real number $y \in \Re$. At this stage, the CEO and the board may acquire some firm-specific information that is useful for the project decision. We assume that the CEO is generally in a better position to acquire this information. Formally, we assume that with probability $c \in (0,1)$ only the CEO acquires this information, while with probability $1-c$ both the board and the CEO are equally informed. Thus, c can be viewed as a measure of the degree of information asymmetry between the CEO and the board. Information is represented by a signal θ about the state of nature. When only the CEO is informed, he may choose to reveal his information to the board.[8]

We assume that the CEO's cost of acquiring information is zero to abstract from potential hold-up problems that may arise when ex post monitoring reduces the value of making ex ante investments in information acquisition, an effect emphasized in Burkart, Gromb and Panunzi (1997) in the context of monitoring by large shareholders. While introducing costs of becoming informed would not change the implications of our analysis substantially, we wish to highlight that monitoring is costly in our model because it has detrimental effects on the CEO's incentives to communicate openly with the board.

[7] In period 0, the shareholders may also decide how much equity-based compensation to award the CEO. To simplify the analysis, we assume that all possibilities of aligning interests by means of incentive pay have already been exhausted.

[8] Since the CEO is always informed, the board could induce the CEO to reveal his signal by offering him a contract in which it commits to punish the CEO in case he does not reveal. However, due to the limited time they spend in the firm, directors may not know what information they need, which makes it difficult for them to implement such contracts. One way to formalize this idea is to assume that there is a probability that both the board and the CEO are uninformed about θ, i.e. the arrival of the signal is stochastic. If the probability that the CEO does not obtain a signal is sufficiently high, it will not be optimal for the board to punish the CEO for not revealing information. For the sake of simplicity, we make this assumption only implicitly, i.e. we assume that contracts which induce revelation are not optimal.

Period 2 - The board gathers information and monitors the CEO

After listening to the CEO's report, the board invests one unit of its time to gather its own private signal ε about the profitability of the project. We assume that θ and ε are *complements*, i.e. both pieces of information are relevant for the project choice decision. The board also chooses its monitoring intensity π. Because the board generally prefers a different project than the one the CEO prefers, we consider monitoring to be successful if the board can impose its preferred project.

Period 3 - Control is allocated and the project is chosen

At the beginning of period 3, the board observes its private signal ε. With probability π, monitoring is successful and the board has effective control over the project decision. With probability $1-\pi$, the CEO retains his right to choose his preferred project. In this case, the board may send a message a to the CEO, which we call the board's advice. Because the board may have information that the CEO does not have, its advice is generally informative, even though the board may choose to strategically distort it to influence the CEO's choice. At the end of period three, the firm is liquidated.

A.2. Technology, Information, and Preferences

The project y must be chosen from a continuum of sets of projects indexed by a real number $\theta \in \Re$. Our main assumption is that if the board is informed about the relevant set of projects, denoted by the state variable θ, then the board obtains its private information ε. If the board remains uniformed about θ, then it cannot learn ε.

Formally, we assume that both the CEO and the board believe that the prior distribution of project sets θ is diffuse with zero mean:

$$\theta \sim U\left[-\infty, \infty\right]. \tag{1}$$

Both the CEO and the board believe that the prior distribution of ε is uniform on the unit interval:

$$\varepsilon \sim U\left[0, 1\right]. \tag{2}$$

Conditional on knowing the realization of the state variable θ, the CEO's posterior belief is that $\varepsilon(\theta)$ is uniformly distributed on the unit interval $[0,1]$. If $\theta \neq \theta'$, then $\varepsilon(\theta)$ is independent from $\varepsilon(\theta')$, i.e. $\varepsilon(\theta)$s are independently and identically distributed random variables. Conditional on knowing the realization of the state variable θ, the board learns the true realization of ε with probability one.

One way to motivate our distributional assumptions is to assume that directors have limited time to devote to the firm, thus the board only has time to investigate one set of projects θ. This assumption makes the information provided by the CEO concerning the relevant project set θ crucial for the quality of the information acquired by the board. When the board invests one unit of time investigating the project set θ, it learns the true

value of $\varepsilon(\theta)$ with probability one. If the board does not learn which project set θ is the relevant one to investigate, advising by the board becomes uninformative.

We assume shareholders's preferences can be represented by the following utility function:

$$U_s = -(y - \varepsilon)^2, \tag{3}$$

where y is the chosen project and ε is the random variable defined above. One way of interpreting (3) is to think of it as firm value, where the quadratic term represents the technological relationship between inputs (i.e. the chosen project y) and firm profits. For simplicity, we normalize the maximum profit to zero. It is evident from (3) that shareholders would like to choose project $y_s = \varepsilon$, which is the one that maximizes firm value ex post. The problem is that ε is unknown at the start of the game; full knowledge of ε is only possible when the CEO's and the board's expertise are combined.

Reflecting the assumption that the shareholders' and the CEO's interests may not be perfectly aligned, the CEO's preferences are represented by

$$U_c = -(y - \varepsilon + g)^2 + \chi b, \tag{4}$$

where $g > 0$ is a measure of the CEO's bias in project choice, $b > 0$ is a parameter measuring the CEO's private benefits of retaining control over project choice and χ is an indicator function such that

$$\chi = \begin{cases} 1, \text{ if the CEO retains control} \\ 0, \text{ otherwise} \end{cases}. \tag{5}$$

This utility function formalizes our assumptions that the CEO's preferred project, $y_c = \varepsilon - g$, is different from the shareholders' preferred project and that the CEO values the ability to control project choice. We assume $b > 0$, because the CEO may gain directly from maintaining his authority, because he values power per se, and indirectly, because his market value may depend on his reputation for being in control.

Finally, shareholders can hire a board with the following utility function:

$$U_b = -(y - \varepsilon)^2 - C(\pi; I), \tag{6}$$

where $C(\pi; I)$ is the board's cost of monitoring the CEO with intensity π, given the degree of board independence I. These monitoring costs arise, for example, because directors may be reluctant to implement projects which are not favored by the CEO. For example, because insiders' careers are tied to the CEO, we assume they will be unwilling to act counter to the CEO's wishes. We assume that $I \in [0, 1]$ is a choice variable from the shareholders' perspective. The crucial assumption is that more independent boards are more willing to monitor:

$$\frac{\partial^2 C}{\partial \pi \partial I} < 0. \tag{7}$$

The board's preferences differ from shareholders' only by its disutility in monitoring. This is natural, since shareholders in many countries, such as the United States and the United Kingdom, are dispersed and do not monitor the CEO directly.

To make the board's preferences more realistic, we could also assume that directors have preferences over projects which are neither coincident with the shareholders' preferences nor the CEO's. We analyze this case as an extension of the basic model in section II and we show that in this situation shareholders may have an additional incentive to choose a CEO-friendly board.

B. Analysis of the Model for a Fixed Degree of Board Independence I

This section analyzes the model when the degree of board independence I is fixed. In section C, we relax this assumption.

B.1. Solving the Game

We solve the game by working backwards. In period 3, if monitoring is successful, the board will have full control over project choice. The board minimizes the mean squared error of y from ε, thus it will choose

$$y_b = \begin{cases} \varepsilon, \text{ if the board knows } \varepsilon \text{ and } \theta \\ E(\varepsilon) = \frac{1}{2}, \text{ if the board does not know } \theta \end{cases}. \tag{8}$$

If monitoring is not successful, the CEO will retain control over project choice. Let $\Im$ be the CEO's information set when he retains control in period 3. His choice of project is

$$y_c = \arg\min_{y \in \Re} E\left[(y - \varepsilon + g)^2 \mid \Im\right]. \tag{9}$$

If the CEO does not get any information from the board, which happens when the board is uninformed or chooses to send an uninformative message to the CEO, the project which minimizes the mean squared error of y from $\varepsilon - g$ is $y_c = \frac{1}{2} - g$. Otherwise, the CEO's choice depends on how informative the message the board sends is.

B.2. Information and the Quality of Advice

This section describes the advice the board gives to the CEO and the CEO's optimal choice of project given the board's advice. If the board is uninformed and the CEO does not reveal his information, the board's advice is uninformative. Thus, we focus on the situation in which the board learns θ, either directly, or from the CEO.

We model the communication game between the board and the CEO assuming that the board has already invested one unit of time investigating the set of relevant projects θ and has learned ε. First, we introduce some notation. Let $a \in [0, 1]$ denote a message

(advice) the board sends to the CEO. Let $q(a \mid \varepsilon)$ denote the probability (density) function that the board sends the message a given that it has observed ε. This is an "advising rule," which is chosen by the board. A Perfect Bayesian Nash equilibrium for this game is defined as follows:

DEFINITION 1: *A Perfect Bayesian Nash Equilibrium for the advising game consists of a family of advising rules* $q(a \mid \varepsilon)$, *such that* $\int_0^1 q(a \mid \varepsilon)\, da = 1$ *for all* $\varepsilon \in [0,1]$, *and a project choice function for the CEO, denoted* $y(a)$, *such that:*

(a) *for each* $\varepsilon \in [0,1]$, *if* $q(a' \mid \varepsilon) > 0$ *then*

$$a' \in \arg\min_{a \in [0,1]} [y(a) - \varepsilon]^2;$$

(b) *for each* $a \in [0,1]$,

$$y(a) \in \arg\min_{a \in [0,1]} \int_0^1 (y - \varepsilon + g)^2 \, p(\varepsilon \mid a)\, d\varepsilon,$$

where $p(\varepsilon \mid a) \equiv \frac{q(a|\varepsilon)}{\int_0^1 q(a|t)dt}$.

The first part of this definition says that, given the rule $y(a)$, any message a' that the board sends when it observes ε must imply a choice of project $y(a')$ by the CEO that is no worse than any other $y(a'')$ from the board's standpoint. The second part imposes a similar requirement on the equilibrium project choice function; given the family of advising rules $q(a \mid \varepsilon)$, the project $y(a)$ must be a solution to the CEO's expected utility maximization problem when he observes the message a. The definition also requires all probabilities to be updated according to Bayes's rule.

Our first proposition characterizes the relevant equilibrium for the advising game.

PROPOSITION 1 (Advising Equilibria): *If* $g > 0$, *then there exists at least one equilibrium with the following properties: There is a positive integer* N *such that one can define a set of* $N+1$ *real numbers, with generic element denoted by* a_i, *such that* $0 = a_0 < a_1 < ... < a_{N-1} < a_N = 1$, *and*

(a) $y(a) = \frac{a_{i+1}+a_i}{2} - g$ *for all* $a \in (a_i, a_{i+1})$ *and*

(b) $q(a \mid \varepsilon)$ *is uniform, supported on* $[a_i, a_{i+1}]$, *if* $\varepsilon \in (a_i, a_{i+1})$.

This proposition, which follows from Theorem 1 in Crawford and Sobel (1982), states that there is a "partition" equilibrium in which the board intentionally distorts its advice by adding noise to it: the CEO only learns in which interval (a_i, a_{i+1}) the realization of ε lies. The CEO understands the board's strategy and, in equilibrium, chooses the average project in the interval (a_i, a_{i+1}) minus his bias g. It is important to note that there might

be many partition equilibria of this sort, and that there might be other types of equilibria. In their Theorem 1, Crawford and Sobel also show that any other equilibria will be payoff-equivalent to some partition equilibrium, implying that they will be economically identical. Furthermore, there always exists a *most informative equilibrium*, i.e. a partition equilibrium in which the number of intervals N is maximal. As is standard in the cheap-talk literature, we choose the most informative equilibrium as the focal one. Thus, in what follows we will be assuming that N is the maximal number of intervals that is supported in equilibrium.[9]

Let σ_{ε}^2 be the residual variance of ε the CEO expects to have, ex ante, after hearing the board's advice a in equilibrium. Crawford and Sobel (1982, part 4) show that

$$\sigma_{\varepsilon}^2 = \frac{1}{12N^2} + \frac{g^2\left(N^2-1\right)}{3}, \tag{10}$$

where N is the smallest integer greater or equal to $\widetilde{N}$ and

$$\widetilde{N} = -\frac{1}{2} + \frac{1}{2}\sqrt{1+\frac{2}{g}}. \tag{11}$$

The board's advice is more informative when the size of the partition intervals decreases, i.e. as N increases. Thus, the residual variance is maximized when $N=1$, and we denote it by $\sigma_M^2 = \frac{1}{12}$.

Intuitively, an informed board is better at advising the CEO than an uninformed one. Thus, everything else constant, shareholders must be (weakly) better-off when they expect the board to be informed. In order to formalize this idea, we compute shareholders' expected utility when the board advises as a function of the board's information.

Let i denote the information the board has concerning θ. If $i=\theta$, the board knows the CEO's signal; if $i=\emptyset$, it does not. Conditional on the game arriving at the advising stage, we denote shareholders' ex ante expected utilities in these two scenarios by $E_A U_s\left(i=\theta\right)$ and $E_A U_s\left(i=\emptyset\right)$, respectively. The following result is straightforward.

PROPOSITION 2 (Information Sharing Implies Better Advice): *In equilibrium, the following holds:*

$$E_A U_s\left(i=\theta\right) = -(\sigma_{\varepsilon}^2 + g^2) \geq E_A U_s\left(i=\emptyset\right) = -(\sigma_M^2 + g^2). \tag{12}$$

We define the *advisory benefits from information sharing* to be $E_A U_s\left(i=\theta\right) - E_A U_s\left(i=\emptyset\right) = \sigma_M^2 - \sigma_{\varepsilon}^2$, which is always non-negative, given that σ_M^2 is the maximal residual variance.

Although our analysis is well-defined for any value of the advisory benefits from information sharing, the model is uninteresting when $\sigma_M^2 - \sigma_{\varepsilon}^2 = 0$. In such cases, the board

[9] For a critique of this equilibrium selection procedure in cheap talk games, see Farrell and Rabin (1996).

does not really have a dual role, because only monitoring can add value. For advising and monitoring to interact, it is necessary that $\sigma_M^2 - \sigma_\varepsilon^2 > 0$, which is the assumption that we will make from now on.[10]

B.3. Information and Monitoring Intensity

In this section, we analyze the incentives for the board to monitor in period 2. A board which knows θ will choose the monitoring intensity which solves

$$\begin{aligned}\max_{\pi\in[0,1]} \pi E_\varepsilon\left[-\left(y_b-\varepsilon\right)^2 \mid i=\theta\right] + (1-\pi)\, E_A U_s\left(i=\theta\right) - C\left(\pi; I\right)\\ = \max_{\pi\in[0,1]} -(1-\pi)\left(\sigma_\varepsilon^2 + g^2\right) - C\left(\pi; I\right).\end{aligned} \tag{13}$$

We simplify the problem by assuming that the monitoring cost function is quadratic:

$$C\left(\pi; I\right) = \frac{\pi^2}{2I}, \tag{14}$$

for $I \in (0,1]$.

Thus, the optimal level of monitoring is uniquely determined by the first-order condition

$$\pi\left(i=\theta; I\right) = I\left(\sigma_\varepsilon^2 + g^2\right) \tag{15}$$

and is always less than one, given our previous assumption that $\sigma_\varepsilon^2 < \sigma_M^2 = \frac{1}{12}$.

If the board does not know θ, its maximization problem becomes

$$\begin{aligned}\max_{\pi\in[0,1]} \pi E_\varepsilon\left[-\left(y_b-\varepsilon\right)^2 \mid i=\emptyset\right] + (1-\pi)\, E_A U_s\left(i=\emptyset\right) - \frac{\pi^2}{2I}\\ = \max_{\pi\in[0,1]} -\pi\sigma_M^2 - (1-\pi)\left(\sigma_M^2 + g^2\right) - \frac{\pi^2}{2I},\end{aligned} \tag{16}$$

which implies that the optimal level of monitoring in this case is given by

$$\pi\left(i=\emptyset; I\right) = Ig^2. \tag{17}$$

The following two results follow directly from inspecting conditions (15) and (17).

PROPOSITION 3 (Determinants of the Board's Monitoring Intensity):

(a) $\pi\left(i=\theta; I\right)$ *and* $\pi\left(i=\emptyset; I\right)$ *are non-decreasing in the degree of board independence* I*;*

(b) *for a given* I, $\pi\left(i=\theta; I\right) \geq \pi\left(i=\emptyset; I\right)$.

[10] Since the residual variance decreases as N increases, the largest σ_ε^2 that is strictly less than σ_M^2 occurs for $N=2$. Given the expression for $\tilde{N}$, it follows that the assumption that $\sigma_M^2 > \sigma_\varepsilon^2$ is equivalent to $g \leq \sigma_M^2 = 1/12$.

The first result simply states that more independent boards will choose to monitor more intensively. This result is straightforward given that we have defined board independence as a variable which reduces the marginal cost of monitoring. The second result is more interesting. It states that better informed boards will choose to monitor more intensively, all else equal.

B.4. The Decision to Share Information

Now we address the information revelation problem, or the first-period decision problem for the CEO. To decide his strategy, the CEO compares his expected utilities from revealing and not revealing his information. When the board with degree of independence I learns his information, the expected utility for the CEO is given by

$$\begin{aligned} EU_c\left(i=\theta;I\right) &= \pi\left(i=\theta;I\right)E_\varepsilon\left[-\left(y_b-\varepsilon-g\right)^2 \mid i=\theta\right] \\ &\quad + \left[1-\pi\left(i=\theta;I\right)\right]\left\{E_\varepsilon\left[-\left(y(a)-\varepsilon-g\right)^2 \mid i=\theta\right]+b\right\} \\ &= -\pi\left(i=\theta;I\right)g^2-\left[1-\pi\left(i=\theta;I\right)\right]\left(\sigma_\varepsilon^2-b\right) \\ &= -\sigma_\varepsilon^2+b+\pi\left(i=\theta;I\right)\left(\sigma_\varepsilon^2-g^2-b\right). \end{aligned} \tag{18}$$

If the CEO chooses not to reveal his signal, his expected utility is given by

$$\begin{aligned} EU_c\left(i=\emptyset;I\right) &= -\pi\left(i=\emptyset;I\right)\left(\sigma_M^2+g^2\right)-\left[1-\pi\left(i=\emptyset;I\right)\right]\left(\sigma_M^2-b\right) \\ &= -\sigma_M^2+b+\pi\left(i=\emptyset;I\right)\left(-g^2-b\right). \end{aligned} \tag{19}$$

For a given degree of board independence I, the CEO will choose to reveal his information to the board if and only if:[11]

$$EU_c\left(i=\theta;I\right)-EU_c\left(i=\emptyset;I\right)=\sigma_M^2-\sigma_\varepsilon^2+p\left(I\right)\left(\sigma_\varepsilon^2-b\right)\geq 0, \tag{20}$$

where we have defined $p\left(I\right)\equiv\pi\left(i=\theta;I\right)-\pi\left(i=\emptyset;I\right)=I\sigma_\varepsilon^2$. This variable can be interpreted as the *increase in the intensity of monitoring due to information sharing*.

The condition in (20) reflects the trade-off the CEO faces. Intuitively, it can be decomposed into three distinct parts. The first one, $\sigma_M^2-\sigma_\varepsilon^2$, is a measure of the CEO's *advisory benefits from information sharing*. Without the board's advice, the variance of the payoff distribution from the CEO's standpoint is at its maximum, which is σ_M^2. When the CEO shares his information, board advising reduces this variance to σ_ε^2. Thus, $\sigma_M^2-\sigma_\varepsilon^2$ can be regarded as the CEO's gains from obtaining better advice after sharing information with the board.

The second term is $p\left(I\right)\sigma_\varepsilon^2$, which is a measure of the CEO's *monitoring benefits from information sharing*. Even though the CEO dislikes monitoring by the board, he still prefers a board which is more informed in making decisions to an uninformed board which

[11] We assume that when the CEO is indifferent between revealing or not revealing his signal to the board in equilibrium, he will choose to reveal.

interferes with his project choice. When monitoring is successful, an informed board will reduce the variance of the payoff distribution from σ_ε^2 to zero, while an uninformed board will have no effect on this variance. Thus, $p(I)\,\sigma_\varepsilon^2$ can be seen as the CEO's marginal expected gain from improved monitoring by the board after sharing his information.

Finally, the last term $-p(I)\,b$ is a measure of the CEO's *costs from information sharing*. Better informed boards will interfere with the CEO's choice more frequently. Thus, $-p(I)\,b$ can be interpreted as the CEO's expected loss in control benefits due to information sharing.

We now characterize the equilibrium when the degree of board independence I is fixed.

Define I' to be

$$I' = \begin{cases} \frac{\sigma_M^2 - \sigma_\varepsilon^2}{\sigma_\varepsilon^2 (b - \sigma_\varepsilon^2)}, \text{ if } b - \sigma_\varepsilon^2 > 0 \\ 1, \text{ if } b - \sigma_\varepsilon^2 \leq 0 \end{cases}. \tag{21}$$

We have the following result:

PROPOSITION 4 (Board Independence and Information Sharing): *The equilibrium is such that:*

(a) *if* $I \leq I'$, *the CEO always reveals* θ;

(b) *if* $I > I'$, *the CEO never reveals* θ.

According to this proposition, there exist equilibria in which managers will not share information with the board. Since firm value is higher when the CEO shares his information, this proposition explains why shareholders might prefer a board with which the CEO will communicate.

C. Endogenizing Board Independence

In the previous section, we argue that when the board's preference for monitoring is fixed, the CEO may not share his information with a board with a dual role in equilibrium, depending on whether $I > I'$ or not. Here we discuss the equilibria which arise when shareholders choose the degree of board independence which maximizes shareholder value.

Let $m(I)$ be an indicator variable concerning the message the CEO sends to the board when his private information is θ and board independence is I. With the convention that $m = 1$ if the CEO communicates openly with the board and $m = 0$ if it does not, it follows from proposition 4 that

$$m(I) = \begin{cases} 1, \text{ if } I \leq I' \\ 0, \text{ if } I > I'. \end{cases} \tag{22}$$

To characterize the optimal choice of I from the shareholders' standpoint, for simplicity we assume that shareholders do not internalize the board's cost of monitoring

$C(\pi; I)$.[12]

We can write the shareholders' problem as

$$\begin{aligned}\max_{I\in[0,1]} & -c\{m(I)\left[1-\pi(i=\theta;I)\right](\sigma_\varepsilon^2+g^2)\\ & +\left[1-m(I)\right]\left(\pi(i=\emptyset;I)\,\sigma_M^2+\left[1-\pi(i=\emptyset;I)\right]\left(\sigma_M^2+g^2\right)\right)\}\\ & -(1-c)\left\{\left[1-\pi(i=\theta;I)\right](\sigma_\varepsilon^2+g^2)\right\}. \end{aligned} \tag{23}$$

The solution to this problem is characterized in the next proposition.

PROPOSITION 5 (Optimal Choice of Board Independence): *The equilibrium is always unique (with respect to the choice of I) and it is of one of the following three types:*

(a) *the optimal degree of board independence, I^*, is equal to 1 and the CEO shares his information $m(1)=1$;*

(b) *the optimal degree of board independence, I^*, is equal to $I'<1$ and the CEO shares his information $m(I')=1$;*

(c) *the optimal degree of board independence, I^*, is equal to 1 and the CEO does not share his information $m(1)=0$.*

The first equilibrium arises whenever the CEO's revelation constraint is not binding when $I'\geq 1$. Because the CEO shares his information, monitoring by the board is more informed, thus the first-best solution is achieved. In the second equilibrium, the CEO's revelation constraint is binding, while in the third equilibrium the revelation constraint is not met. In these cases, shareholders compare their expected utilities from inducing or not inducing revelation. In the second equilibrium, the value of the CEO's information is so high that shareholders will optimally commit to choose a board whose independence is less than the first best level to induce the CEO to reveal it. In the third equilibrium, it is too costly to induce the CEO to reveal.

D. Comparative Statics

In this section, we briefly discuss the empirical content of our model. Because empirical proxies are most readily available for the manager's private benefits, we will discuss here only the most straightforward results linking cross sectional differences in the board's monitoring intensity π and independence I to the CEO's control benefits b.

[12] Nothing essential is lost with this assumption, it merely simplifies the algebra. The same qualitative results hold if shareholders compensate the board for their expected costs of monitoring ex ante. Shareholders cannot compensate the board ex post, because we assume π is non-verifiable effort exerted by the board.

The equilibrium described in proposition 5 allows for the possibility that shareholders may find it optimal not to induce revelation by the CEO (case (c)). It can be shown that this case can only occur if the information asymmetry between the board and the CEO, as measured by the probability c that only the CEO is informed about θ, is not too high. If c is too high, the board can do nothing but rely on the CEO's information. In such a case, shareholders perceive no trade-off between inducing or not inducing information revelation from the CEO.

The following lemma holds:

LEMMA 1: *There always exists $c' \in (0,1)$, such that if $c > c'$, there is no equilibrium in which the CEO does not share information with the board.*

Thus, we initially analyze the more interesting case in which the information asymmetry is not too extreme, $c \leq c'$. If this holds, all three cases in proposition 5 are possible, depending on the other parameters, of course.

First, we define the expected level of monitoring intensity to be

$$\Pr(i = \theta)\, \pi(i = \theta; I) + \Pr(i = \emptyset)\, \pi(i = \emptyset; I). \tag{24}$$

We denote the expected level of monitoring in cases (a), (b) and (c) of proposition 5 by π^f, π^r and π^n, respectively, where f refers to the first-best, r refers to induced revelation and n refers to no revelation. Proposition 5 implies that the expected level of monitoring intensity chosen by the board will be as follows. If the equilibrium is of type (a), then

$$\pi^f = \sigma_\varepsilon^2 + g^2, \tag{25}$$

which is the first-best level of expected monitoring. We note that π^f does not depend on b.

If the equilibrium is of type (b), then the monitoring intensity which makes the CEO just indifferent between revealing and not revealing his information is

$$\pi^r(b) = \frac{(\sigma_M^2 - \sigma_\varepsilon^2)(\sigma_\varepsilon^2 + g^2)}{\sigma_\varepsilon^2 (b - \sigma_\varepsilon^2)}. \tag{26}$$

Finally, since $\Pr(i = \theta) = 1 - c$, in the equilibrium of type (c), we have

$$\pi^n = (1-c)\left(\sigma_\varepsilon^2 + g^2\right) + cg^2 = (1-c)\,\sigma_\varepsilon^2 + g^2, \tag{27}$$

which also does not depend on b.

As the CEO's cost of losing control increases, he is less likely to reveal his information. Thus, as b increases it will become more costly to induce him to reveal. As a function of his private benefits, optimal monitoring varies non-monotonically as follows:

PROPOSITION 6 (Relation between Expected Monitoring in Equilibrium and Private Benefits): *Assume that $c \leq c'$. Then, there exist levels of private control benefits b^f and b^n where $0 < b^f < b^n$ such that:*

(a) *the expected monitoring intensity of the board is at the first-best level* π^f, *if private benefits are less than* b^f*;*

(b) *the expected monitoring intensity of the board is* $\pi^r(b)$, *if private benefits are between* b^f *and* b^n*;*

(c) *the expected monitoring intensity of the board is* π^n, *if private benefits are above* b^n.

The optimal monitoring intensity is a non-monotonic function of b. As we illustrate in Figure 2, when b is low, boards monitor with the first best intensity π^f. Beyond b^f, monitoring decreases continuously and then jumps up again to π^n.[13]

[Insert Figure 2 here]

In summary, the model implies a (roughly) "U"-shaped relation between board monitoring and private benefits, i.e. monitoring decreases then increases with private benefits. As we display in Figure 3, a similar relationship holds between board independence and the CEO's private benefits. When b is low, the board is fully independent. When $b^f < b < b^n$, board independence decreases linearly in b. For $b > b^n$, the board is fully independent again. Figures 2 and 3 highlight that even when the board is fully independent, the board may not monitor at the first-best level because monitoring is less effective when the board has too little information. While it would be difficult to test the model's implications concerning the extent to which managers share information with their boards, the implied cross-sectional relationships between both board monitoring and independence and CEO private benefits can, in principle, be examined empirically. Of course, care must be taken in interpreting the results in situations in which b is not exogenous, as we assume in our model.

[Insert Figure 3 here]

The role of the CEO's informational advantage c is to determine the point at which it is no longer optimal for shareholders to induce information revelation. As c increases, the threshold b^n in Figures 2 and 3 increases, implying that revelation is the optimal choice for a larger set of values of the CEO's private benefits of control. If $c > c'$, then it is always optimal to induce revelation, thus monitoring and board independence will be decreasing in b for all values of b larger than b^f. On the other hand, as c decreases, the threshold b^n decreases, which implies that friendlier boards are optimal for a smaller set of firms.

Following Enron, the role of internal control systems has become much more important. For example, a provision of Sarbanes-Oxley requires that CEOs and CFOs certify

[13] As illustrated in Figure 2, $\pi^r(b)$ is a convex function of b.

their financial statements. Such provisions are likely to reduce the information asymmetry between managers and directors, i.e. to reduce c. Ceteris paribus, such provisions are also likely to increase directors' willingness to intervene in decision-making, i.e. to increase π. With more hard information at their disposal, it will be harder for directors to rubberstamp the CEO's decisions, for example, because of increased liability concerns. While both of these changes are unlikely to eliminate the role of board friendliness, they will make board friendliness less relevant. Thus, we should expect to observe independent boards which monitor more intensively playing a more important role in the future. It is important to realize, however, that unless boards are given better access to information, simply increasing board independence is not sufficient to improve governance.

II. Extensions

A. Separating the Roles of Monitor and Advisor

In this section, we modify our model to discuss what happens when shareholders have an additional mechanism at their disposal: the assignment of the right to monitor the CEO to a board which does not have a dual role. In practice, many governance mechanisms exist that have a pure monitoring function, for example, takeovers. Also, managers often rely on advisors (such as consultants) who play no role in evaluating them. It is instructive, therefore, to think about situations in which it is optimal to separate the two roles rather than combine them in one institution such as the board.

This idea is particularly relevant for the choice of board structure. While boards in the United States combine the two roles to varying degrees, this is not necessarily true in other countries. In Table I, we classify all countries for which we could obtain information by their board structure types. As is evident from the table, the sole board is by no means the dominant board structure type. Thus, an analysis of board structure as the choice between a board that combines monitoring and advising (a *sole* or *unitary* board) and one that separates the two roles (a *dual* or *two-tier* board) may help us understand cross-country variations in governance.

[Insert Table I here]

Because members of the two boards in a dual board system generally do not overlap, the dual board structure allows for the cleanest separation of the board's two roles. Of course, there may be other ways of separating the board's roles, for example, through the use of board committees. In particular, the role of the audit committee in the sole board systems of the United States and the United Kingdom may be similar to that of supervisory boards. As such, our analysis may also help us understand when boards should delegate decision-making to committees.

Before discussing the trade-off shareholders face in deciding between a sole and a dual board system, we first reinterpret our model in order to characterize the equilibrium in

a dual board system. We assume that the management board has some expertise and is solely responsible for advising the CEO. The supervisory board has no specialized knowledge and has sole authority to monitor the CEO. In addition, we assume that the management board does not communicate information it obtains from the CEO to the supervisory board. If both boards communicated perfectly, there would be no real difference between the dual and the sole board.

With this separation of tasks, we obtain the following equilibrium in our model:

PROPOSITION 7 (Dual Board Equilibrium): *In a dual board system:*

(a) *the CEO always reveals his information to the management board;*

(b) *the CEO reveals his information to the supervisory board if and only if* $\sigma_\varepsilon^2 \geq b$*;*

(c) *the supervisory board monitors with intensity* π^f *with certainty if* $\sigma_\varepsilon^2 \geq b$*, and with expected intensity* $(1-c)\,\pi^f$ *if* $\sigma_\varepsilon^2 < b$*;*

(d) *the supervisory board is always fully independent,* $I_S^* = 1$*.*

If $\sigma_\varepsilon^2 \geq b$, the monitoring benefits from information sharing exceed the costs from information sharing, thus the CEO is fully aligned with the supervisory board with respect to information disclosure. In such a case, because the CEO always reveals his information, the first-best is attained in both the sole and dual board structures. This case is uninteresting, since there is no trade-off between the two board structures and board independence is actually favored by the CEO, whose interests are fully aligned with shareholders'.

Only when $\sigma_\varepsilon^2 < b$ does the CEO dislike monitoring by the board. In this case, since there is too little monitoring ($(1-c)\,\pi^f$) in the dual board system, the sole board system is the first-best for all $b \leq b^f$, and is strictly better than the dual board system for all $b \in \left(\sigma_\varepsilon^2, b^f\right]$. It is important to note that the reason why the sole board structure may be better than the dual board structure is because a sole board can take advantage of information obtained from the CEO to improve the quality of both monitoring and advising. However, if b is sufficiently large, there will exist a set of firms for which managerial private benefits are such that shareholders prefer to separate the two roles of the board into a dual board structure rather than choosing a more management-friendly sole board. If the value of the CEO's information is high enough that a sole board would choose to monitor with intensity $\pi^r(b)$ to induce the manager to reveal it, but $\pi^r(b) < (1-c)\,\pi^f$, shareholders prefer a dual board system. The following result holds:

PROPOSITION 8 (Choice of Dual versus Sole Board System): *There exists a level of CEO private benefits* b^D*, where* $b^f < b^D < b^n$ *(provided that* b^n *exists), such that shareholders prefer a sole board system for all* $b \leq b^D$ *and a dual board system for all* $b \geq b^D$*.*

When making their decision about board structure, this proposition shows that shareholders must decide whether using information obtained as part of the advisory process to monitor the CEO is sufficiently important given the trade-off the manager faces. When the gain to using the CEO's information is sufficiently high and the value the CEO attaches to control is not too high, shareholders may prefer a management-friendly sole board to a dual board system. However, as the CEO's private benefits increase, shareholders prefer a dual board system.

Clarke and Bostock (1997, p. 244) describe the German dual board system: "In many companies the flow of information from managers to supervisors is sparse." In their analysis, this is a source of criticism of the dual board structure. Contrary to their view, proposition 8 shows that there may be situations in which it is optimal to limit the flow of information between the manager and the monitor.

If one views the audit committee as a variant of the supervisory board, part (d) of proposition 7 suggests that audit committees should be fully independent. This is consistent with the requirements of the Sarbanes-Oxley Act. On the other hand, our results suggest that the provision of Sarbanes-Oxley, that companies disclose whether they have financial experts on the audit committee, may not be effective. DeFond, Hann and Hu (2004) examine the market reaction to the appointment of financial experts to the audit committee prior to Sarbanes-Oxley. They find that the market reacts positively only to the appointment of accounting financial experts, as opposed to non-accounting financial experts or non-experts. Thus, the market reacts positively only when new directors appear to strengthen the ability of the audit committee to carry out its role. Our results are consistent with theirs, because proposition 8 states that shareholders may be better off if the monitoring and the advisory roles of the board are completely separated. If some audit committee members are non-accounting financial experts whom managers consult in other capacities, the audit committee may take on an advisory nature.

B. Boards with Different Preferences Over Projects

So far, we have interpreted a management-friendly board as a board which puts little effort into monitoring the CEO, because it is not too independent. But we have assumed that even a management-friendly board will choose the value-maximizing project, if in control. This assumption may be unrealistic if boards' interests are not the same as shareholders', which may happen for several reasons. For example, in some cases CEOs are involved in the nomination of directors (see e.g. Shivdasani and Yermack (1999)). Thus, they may choose directors whose interests are more aligned with theirs than with shareholders. In addition, many states in the United States have enacted so-called non-shareholder constituency statutes, which allow directors to consider the effects of their decisions on nonshareholder stakeholders, such as employees, the local community and the environment. As a result, even though directors in the United States have a fiduciary duty to shareholders, they may still be legally entitled to consider interests other than

those of shareholders in decision-making.

In the context of the dual board system, the preferences of the management and the supervisory boards may differ from those of shareholders because workers often have explicit representation on the board.[14] For example, under the German system of codetermination, employees are allocated seats on the supervisory board. Because the supervisory and the management board have different roles, it is natural to assume that their objectives should differ. We formalize this intuition below by allowing boards to have interests that are neither coincident with shareholders' nor the CEO's.

We assume that the board has its own bias in project choice, $g_b \in [0, g]$. Notice that g_b can also be seen as a measure of board independence. If $g_b = 0$, the board would like to choose the shareholders' preferred project, thus in this sense it is fully independent from the CEO's interests. On the other hand, if $g_b = g$, the board will always choose the CEO's preferred project. Intuition suggests that for a given I, if one could freely choose g_b to maximize expected profits for shareholders, g_b would equal zero. After all, why would shareholders choose a board with a bias $g_b > 0$ in project choice? To analyze whether this is the case, we study the effects of changing g_b on three determinants of board effectiveness, which we call the *quality of board advising*, the *quality of board monitoring*, and the *intensity of board monitoring*. For the sake of simplicity, we consider the case in which I is fixed at a level at which the CEO's revelation constraint (20) is not binding, so the board always knows θ.

We define the quality of board advising to be $-\sigma_\varepsilon^2$, which is the residual variance of ε the CEO expects to have after hearing the board's advice in equilibrium. The next proposition describes the effect of g_b on the quality of advice.

PROPOSITION 9 (Board Friendliness and the Quality of Advice): *The residual variance σ_ε^2 is decreasing in $g_b \in [0, g]$.*

Because shareholders' ex ante expected utility is decreasing in σ_ε^2, shareholders may benefit from a CEO-friendly board due to an increase in the quality of the advice provided by the board. This is an additional reason for choosing a friendly board, a reason that was not present in the previous analysis, in which the board's preferences over projects conformed with shareholders'. This effect is a formal justification for the claim that "the more traditional job of forming strategy requires close collaboration" in the quote that starts this paper.

Although increasing the board's bias improves the performance of the board with respect to its advisory role, it may worsen the board's monitoring role. We define the quality of monitoring as minus the distance between the project the board picks when it is in control and shareholders' preferred project:$-|y_b - y_s|$. This value is equal to $-g_b$,

[14] Workers may also have representatives on the board in some European sole board systems, for example, in Sweden. This creates an additional wedge between the preferences of sole boards and those of shareholders.

implying that the quality of monitoring is decreasing in g_b. Clearly, shareholder value is increasing in the quality of monitoring.

Finally, as before, the intensity of monitoring is given by π. With probability π, the board gains control over project selection and chooses the project $y_b = \varepsilon - g_b$. With probability $1 - \pi$, the CEO retains decision rights over project selection. Knowing θ, the board chooses the monitoring intensity which solves

$$\max_{\pi \in [0,1]} -(1-\pi)\left[\sigma_\varepsilon^2 + (g - g_b)^2\right] - \frac{\pi^2}{2I}. \tag{28}$$

The optimal level of monitoring is uniquely determined by the first-order condition

$$\pi(g_b) = I\left[\sigma_\varepsilon^2 + (g - g_b)^2\right]. \tag{29}$$

Since σ_ε^2 is decreasing in g_b, the intensity of monitoring is decreasing in the board's bias g_b. Boards whose preferences over projects are biased away from those of shareholders will not monitor managers as intensively as unbiased ones.

We have shown that, although the quality of advising improves with a biased board, both the *intensity* and the *quality* of monitoring are compromised if the board is too friendly to the CEO, in the sense that its bias g_b is large. We summarize these results in the next proposition.

PROPOSITION 10 (Board Friendliness and Shareholder Value): *Suppose that the CEO reveals his information to a board with a bias g_b. Then, the following holds:*

(a) *increasing the board's bias, g_b, improves the board's advising role and, holding the quality and intensity of monitoring constant, increases shareholder value;*

(b) *increasing the board's bias, g_b, worsens the board's monitoring role and, holding the quality of advising constant, decreases shareholder value.*

The choice of an optimal g_b will trade-off these two conflicting forces. On the one hand, a large g_b improves advising because the board will communicate more openly with the CEO; on the other hand, a larger g_b reduces both the intensity and the quality of monitoring. Although solving for the optimal g_b in the shareholder's maximization problem involves no conceptual difficulties, explicitly solving for the optimal g_b is cumbersome because, although σ_ε^2 is a continuous function of g_b, it is not always differentiable.[15] Regardless, an explicit solution is not necessary for our purposes. It is sufficient to note that, due to the trade-off we describe above, for a given I the optimal g_b will not always be zero (nor equal to g). Intuitively, when π is not very sensitive to g_b, increasing the

[15] That a solution to the maximization problem exists follows immediately from the fact that $[0, g]$ is a compact set and σ_ε^2 is a continuous function of g_b, which we prove in the proof of proposition .

board's bias will have a small effect on the intensity of monitoring and a relatively larger effect on the quality of advising. In addition, some comparative statics are possible. For example, the optimal bias g_b^* should be inversely related to I, because an increase in I makes the marginal effect of g_b on π even more negative, making it more costly to increase g_b:[16]

$$\frac{\partial^2 \pi}{\partial g_b \partial I} = \frac{d\sigma_\varepsilon^2}{dg_b} - 2\left(g - g_b\right) < 0. \tag{30}$$

In other words, boards which face high costs of monitoring the CEO (low I) should have an optimal high bias g_b^*. This implies that when boards are pressured to be independent, it might be optimal to also limit CEOs' participation on the nominating committee to help ensure that directors' preferences are not too aligned with CEOs'. Of course, a complete analysis of the sole board system would allow for the simultaneous choice of I and g_b. Again, it is unnecessary to fully solve the problem to realize that to induce the CEO to reveal his information to the board, for many parameter constellations, board independence I must be less than 1, the board's project preferences must be aligned with those of the CEO, i.e. $g_b > 0$, or both. Thus, friendly boards arise optimally.

Our analysis in this section suggests that a unitary board with interests that are not fully aligned with shareholders' may be optimal due to the effect of board friendliness on the quality of the advice it provides to the CEO. Bertrand and Mullainathan (2003) provide evidence consistent with the idea that managers' interests are aligned with those of workers. If this is the case, our analysis suggests that nonshareholder constituency statutes may not be as detrimental to shareholder value as many argue, because they allow boards' preferences to be more aligned with those of managers.

Another interesting situation arises in the dual board system. In this case, boards' preferences with respect to projects will depend on their role. Intuition suggests that the supervisory board should be aligned with shareholders, while the management board should be aligned with the CEO. The next proposition shows that this intuition is indeed correct.

PROPOSITION 11 (Role-specific Preferences in the Dual Board System): *In the dual board system:*

(a) *the optimal supervisory board has preferences which are always fully aligned with those of shareholders, i.e.* $g_{sb} = 0$*;*

(b) *the optimal management board has preferences which are always fully aligned with those of the CEO, i.e.* $g_{mb} = g$*.*

The main implication of this result is that, when a dual boards' preferences over projects are optimally chosen, the distortion in the advice given by the management

[16] Assuming, for simplicity, that one is in a region in which $\frac{d\sigma_\varepsilon^2}{dg_b}$ is well-defined.

board is zero ($\sigma_\varepsilon^2 = 0$). Since advice provided by a sole board is generally distorted, this is another reason why the dual board structure dominates the sole board structure with respect to the advisory role of boards.

We believe part (a) of this proposition is particularly interesting in light of recent findings by Gorton and Schmid (2004). They find that companies with equal representation of employees and shareholders on supervisory boards in Germany trade at a 31% discount compared to companies with only one third labor representation. They argue that this may be because labor maximizes a different objective function than shareholders. Part (a) of proposition 11 is consistent with their findings, since we show that to maximize shareholder value, the supervisory board should be fully aligned with shareholders.

Because the interests of the management board and the CEO are perfectly aligned, we can replace σ_ε^2 by 0 for the management board in the dual board equilibrium. Since proposition 7 still holds exactly if σ_ε^2 is replaced by 0, we can see that even when boards' preferences are not fully aligned with those of shareholders, the main trade-off between the sole and dual board structures remains the same.

III. Final Remarks

The question of when advisors should have the authority to simultaneously evaluate their advisees or when monitors should have the authority to participate in decision-making is an interesting question, and one that has, to our knowledge, not been raised before. It is particularly relevant for the study of corporate boards, because we observe both the combination of the two roles of advising and monitoring management in the sole board system, and the separation of the two roles in the dual board system. Given the recent worldwide emphasis on governance reform, we believe our analysis of the interaction between the board's advisory and monitoring roles is especially topical because it has several relevant policy implications.

The first implication of our model is that emphasizing director independence may have adverse consequences in the sole board system. The reason is that managers are less inclined to share information with a sole board as its monitoring intensity increases. With less information, even an independent board cannot monitor effectively. This implies that recent regulation aimed at increasing board independence may decrease shareholder value, even though shareholders may benefit if increases in independence are accompanied by improved disclosure practices. In contrast, enhancing the independence of supervisory boards in a dual board system will not affect the incentives of managers to share information. Thus, increasing the independence of supervisory boards unambiguously increases shareholder value.

When boards have an advisory role, we show that shareholders may be better off if the board's preferences are aligned with those of managers. This suggests that nonshareholder constituency statutes may not be as detrimental to shareholder value as many argue, because they allow boards' preferences to be more aligned with those of managers. On the

other hand, our model questions whether workers' interests should be directly represented on the supervisory board in the system of codetermination as in Germany.

Since information generated during the advisory process enhances the monitoring process, as long as managerial control benefits are not too large, our model implies that the first-best outcome for shareholders is implemented by the sole board system. Otherwise, it is better to give shareholders the choice of board structure. In this case, firms that might otherwise be forced to choose a management-friendly sole board may prefer to move to a dual board structure in which monitoring is higher. If one views the audit committee as a variant of the supervisory board, our analysis suggests further that shareholders may benefit from measures which strengthen the audit committee's role as an independent monitor.

Because monitoring is more effective when a sole board also advises, it is important to also consider the board's advisory role when evaluating board effectiveness and composition. Investigating circumstances in which it is optimal to have a board which does not monitor too much has implications for the interaction between monitoring by boards and monitoring by other governance mechanisms. When a management-friendly board is optimal, one should expect other governance mechanisms to pick up the slack.

Appendix: Proofs

Proof of Proposition 1: The proof follows from Theorem 1 in Crawford and Sobel (1982). If one performs the following change of variables:

$$\widetilde{y} \equiv y + g, \tag{A1}$$

one can express utilities as

$$\widetilde{U}_b = -\left(\widetilde{y} - \varepsilon - g\right)^2 \tag{A2a}$$

$$\widetilde{U}_c = -\left(\widetilde{y} - \varepsilon\right)^2. \tag{A2b}$$

Now all the conditions of Theorem 1 in Crawford and Sobel (1982) are satisfied, implying that there is a positive integer N such that for every n with $1 \leq n \leq N$, there exists at least one equilibrium in which $q\left(a \mid \varepsilon\right)$ is uniform, supported on $[a_i, a_{i+1}]$ if $\varepsilon \in (a_i, a_{i+1})$, where the following conditions hold:

(a) $0 = a_0 < a_1 < ... < a_{n-1} < a_n = 1$;

(b) $\widetilde{y}\left(a\right) = \frac{a_{i+1}+a_i}{2}$ for all $a \in (a_i, a_{i+1})$;

(c) $\left(\frac{a_{i+1}+a_i}{2} - a_i - g\right)^2 - \left(\frac{a_i+a_{i-1}}{2} - a_i - g\right)^2 = 0$ for all $i = 1, ..., n-1$.

The proof is complete if one notices that

$$y\left(a\right) \equiv \widetilde{y}\left(a\right) - g = \frac{a_{i+1} + a_i}{2} - g. \tag{A3}$$

Q.E.D.

Proof of Proposition 2: If the CEO has control over project selection and the board is informed, i.e. $i = \theta$, then from proposition 1 it will send a message $a \in [a_i, a_{i+1}]$ if $\varepsilon \in (a_i, a_{i+1})$, implying that the CEO will choose $y_c = \frac{a_{i+1}+a_i}{2} - g$. Using the Law of Iterated Expectations and the fact that $E_\varepsilon\left\{\varepsilon \mid \varepsilon \in (a_i, a_{i+1})\right\} = \frac{a_{i+1}+a_i}{2}$, the shareholders' ex ante expected utility when the game arrives at the advising stage in equilibrium is given by

$$\begin{aligned}
E_A U_s\left(i = \theta\right) &= -E_\varepsilon\left[\left(y\left(a\right) - \varepsilon\right)^2 \mid i = \theta\right] \\
&= -E_\varepsilon\left\{E\left[\left(\frac{a_{i+1} + a_i}{2} - g - \varepsilon\right)^2 \mid \varepsilon \in (a_i, a_{i+1})\right]\right\} \\
&= -E_\varepsilon\left\{E\left[\left(\frac{a_{i+1} + a_i}{2} - \varepsilon\right)^2 - 2g\left(\frac{a_{i+1} + a_i}{2} - \varepsilon\right) + g^2 \mid \varepsilon \in (a_i, a_{i+1})\right]\right\} \\
&= -\left(\sigma_\varepsilon^2 + g^2\right).
\end{aligned} \tag{A4}$$

When the board is not informed, i.e. $i = \emptyset$, it will send an uninformative message to the CEO (i.e. $N = 1$), implying that the residual variance of ε is maximized, which leads to $E_A U_s (i = \emptyset) = -(\sigma_M^2 + g^2)$, which completes the proof. Q.E.D.

Proof of Proposition 4: Define the function

$$R(I) = \sigma_M^2 - \sigma_\varepsilon^2 + I\sigma_\varepsilon^2 \left(\sigma_\varepsilon^2 - b\right), \tag{A5}$$

which is the left-hand side of the revelation constraint in (20).

If $\sigma_\varepsilon^2 - b < 0$, then for all $I \in (0,1)$, $\frac{dR(I)}{dI} < 0$. Because $R(I') = 0$, and we have assumed that the CEO chooses to reveal when he is indifferent, it follows that he reveals if $I \leq I'$ and does not reveal if $I > I'$. If $I' > 1$, then the proposition holds trivially because $I < I'$ and the CEO always reveals.

If $\sigma_\varepsilon^2 - b \geq 0$, then by definition $I' = 1$. This implies that the CEO should always reveal his information if the proposition is valid. Since for all $I \in [0,1]$, $R(I) \geq 0$, it is indeed true that the CEO always reveals. Q.E.D.

Proof of Proposition 5: First, suppose that the CEO's revelation constraint is not binding. That is, shareholders can choose whichever I they want without affecting the CEO's incentives to communicate with the board. Since in this case $m(I) = 1$, from (23), the shareholders' problem is to

$$\max_{I \in [0,1]} -\left[1 - I\left(\sigma_\varepsilon^2 + g^2\right)\right]\left(\sigma_\varepsilon^2 + g^2\right). \tag{A6}$$

Because firm value is always strictly increasing in I in this case, the optimal I^* is equal to 1. But this will be an equilibrium only if $I^* = 1$ does not violate the CEO's revelation constraint, that is, we need that $I' \geq 1$. Thus, if the set of parameters is such that $I' \geq 1$, the optimal degree of board independence I^* is equal to 1 and the manager shares his information $m(1) = 1$. This is the equilibrium in item (a).

Now consider the case in which $I' < 1$. If shareholders choose to induce revelation in such a case, i.e. $m(I) = 1$, the revelation constraint must be binding, i.e. $I = I'$, implying that the monitoring intensity is given by

$$\pi(\theta; I') = I'\left(\sigma_\varepsilon^2 + g^2\right) = \frac{\left(\sigma_M^2 - \sigma_\varepsilon^2\right)\left(\sigma_\varepsilon^2 + g^2\right)}{\sigma_\varepsilon^2\left(b - \sigma_\varepsilon^2\right)}, \tag{A7}$$

and shareholders' expected utility is given by

$$EU_s(I = I') = -\left[1 - \frac{\left(\sigma_M^2 - \sigma_\varepsilon^2\right)\left(\sigma_\varepsilon^2 + g^2\right)}{\sigma_\varepsilon^2\left(b - \sigma_\varepsilon^2\right)}\right]\left(\sigma_\varepsilon^2 + g^2\right). \tag{A8}$$

On the other hand, if shareholders choose not to induce revelation, so $m(I) = 0$, the optimal I^* is again equal to 1. From (23), shareholders' expected utility is given by

$$EU_s(I = 1) = -c\left[\sigma_M^2 + \left(1 - g^2\right)g^2\right] - (1 - c)\left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right). \tag{A9}$$

Thus, if $I' < 1$, the optimal level of board independence is given by

$$I^* = \begin{cases} I' \text{ if } EU_s(I = I') \geq EU_s(I = 1) \\ 1 \text{ if } EU_s(I = I') < EU_s(I = 1) \end{cases}. \tag{A10}$$

These are equilibria (b) and (c) above. It is straightforward to check that, depending on the parameters, both cases are indeed possible (we show that this is so in the next lemma). Q.E.D.

Proof of Lemma 1: We need to establish the existence of at least one c', such that for all $c > c'$, $EU_s(I = I') \geq EU_s(I = 1)$. To do this we will define the function

$$\varphi(c) \equiv \lim_{b \to \infty} EU_s(I = I') - EU_s(I = 1). \tag{A11}$$

Because $EU_s(I = I') - EU_s(I = 1)$ is strictly decreasing in b, if $\varphi(c) \geq 0$, then $EU_s(I = I') - EU_s(I = 1)$ is positive for *any* $b > 0$. Thus, it suffices to show that there is a c' such that $\varphi(c) \geq 0$ if $c > c'$.

Now,

$$\varphi(c) = -\left(\sigma_\varepsilon^2 + g^2\right) + c\left[\sigma_M^2 + \left(1 - g^2\right)g^2\right] + (1 - c)\left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right). \tag{A12}$$

It can be easily checked that there is only one fixed point $c' \in (0, 1)$ such that $\varphi(c') = 0$. In order to see that, note that if $c = 0$

$$\varphi(0) = -\left(\sigma_\varepsilon^2 + g^2\right) + \left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right) = -\left(\sigma_\varepsilon^2 + g^2\right)^2 < 0. \tag{A13}$$

Now we note that because the assumption of informative advising $\sigma_M^2 > \sigma_\varepsilon^2$ implies that $N \geq 2$ and $g \leq \sigma_M^2 = 1/12$, from (10) the largest value for $\sigma_\varepsilon^2 + g^2$ is $\frac{1}{12 \cdot 4} + \left(\frac{1}{12}\right)^2 + \left(\frac{1}{12}\right)^2$, which is strictly less than $\frac{1}{12} = \sigma_M^2$. Thus, if $c = 1$, we have

$$\varphi(1) = -\left(\sigma_\varepsilon^2 + g^2\right) + \sigma_M^2 + \left(1 - g^2\right)g^2 > 0. \tag{A14}$$

Because $\varphi(c)$ is strictly increasing, then there is only one $c' \in (0, 1)$ such that $\varphi(c') = 0$. If $c > c'$, the condition $EU_s(I = I') < EU_s(I = 1)$ in the proof of proposition 5 can never occur, thus there is no constellation of parameters such that it is optimal for shareholders not to induce the CEO to reveal his information. Q.E.D.

Proof of Proposition 6: Let b^f be the level of private benefits such that

$$R(1) = \sigma_M^2 - \sigma_\varepsilon^2 + \sigma_\varepsilon^2\left(\sigma_\varepsilon^2 - b^f\right) = 0. \tag{A15}$$

For any $b < b^f$ we have that $R(1) > 0$, which implies that the equilibrium is the one in case (a) of proposition 5. In this case, the expected monitoring intensity is given by π^f, proving part (a).

Recall that

$$\lim_{b\to\infty} EU_s\left(I = I'; b\right) = -\left(\sigma_\varepsilon^2 + g^2\right). \tag{A16}$$

From lemma 1, the assumption that $c \leq c'$ implies that

$$\lim_{b\to\infty} EU_s\left(I = I'; b\right) < EU_s\left(I = 1\right). \tag{A17}$$

Now, we also have that

$$\begin{aligned} EU_s\left(I = I'; b^f\right) &= -\left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right) \\ &> -c\left[\sigma_M^2 + \left(1 - g^2\right)g^2\right] - (1-c)\left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right) \\ &= EU_s\left(I = 1\right), \end{aligned} \tag{A18}$$

because $\sigma_M^2 > \sigma_\varepsilon^2 + g^2$.

Thus, since $EU_s\left(I = I'; b\right)$ is continuous and monotonic in the interval $\left[b^f, \infty\right)$,there exists $b^n > b^f$ such that

$$EU_s\left(I = I'; b^n\right) = EU_s\left(I = 1\right). \tag{A19}$$

If $b \in \left(b^f, b^n\right]$, we have that $I^* = I' < 1$, implying that we are in an equilibrium of the second type described in proposition 5 above, thus the monitoring intensity is given by

$$\pi^r\left(b\right) = \frac{\left(\sigma_\varepsilon^2 + g^2\right)\left(\sigma_M^2 - \sigma_\varepsilon^2\right)}{\sigma_\varepsilon^2\left(b - \sigma_\varepsilon^2\right)}. \tag{A20}$$

Finally, if $b > b^n$, it is optimal for shareholders not to induce revelation, thus we are in an equilibrium of the third type described in proposition 5 above, implying that the expected monitoring intensity is π^n. Q.E.D.

Proof of Proposition 7: Because the management board does not monitor the CEO, the CEO's revelation constraint with respect to the management board is

$$\sigma_M^2 - \sigma_\varepsilon^2 \geq 0, \tag{A21}$$

which implies that the CEO always discloses his information to the management board.

The CEO's revelation constraint with respect to the supervisory board is

$$I\sigma_\varepsilon^2\left(\sigma_\varepsilon^2 - b\right) \geq 0, \tag{A22}$$

which holds if and only if $\sigma_\varepsilon^2 - b \geq 0$. If $\sigma_\varepsilon^2 \geq b$, the CEO will reveal his information to the supervisory board, independently of I. Thus, shareholders will optimally choose $I_S^* = 1$, implying that the supervisory board will monitor with the first-best intensity $\pi^f = \sigma_\varepsilon^2 + g^2$.

If $\sigma_\varepsilon^2 < b$, the CEO will never reveal his information to the supervisory board, independently of I. Thus, shareholders will again optimally choose $I_S^* = 1$. If the supervisory board is not informed, which happens with probability c, it will choose not to intervene

($\pi^* = 0$) because successful uninformed monitoring implies a payoff of $-\sigma_M^2$ which is less than the expected payoff when the CEO is in control $-\left(\sigma_\varepsilon^2 + g^2\right)$ (Recall that the management board always advises the CEO, so the variance is σ_ε^2 when the CEO is in control). When informed, the supervisory board will monitor with the first-best intensity $\pi^f = \sigma_\varepsilon^2 + g^2$. Thus, the expected monitoring intensity is $(1-c)\,\pi^f$ in this case. Q.E.D.

Proof of Proposition 8: If $b > \sigma_\varepsilon^2$, the expected value for shareholders under a dual board structure is given by

$$\begin{aligned} EU_s^D &= -c\left(\sigma_\varepsilon^2 + g^2\right) - (1-c)\left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right) \\ &= -\left[1 - (1-c)\left(\sigma_\varepsilon^2 + g^2\right)\right]\left(\sigma_\varepsilon^2 + g^2\right). \end{aligned} \tag{A23}$$

If $b \in \left(\sigma_\varepsilon^2, b^f\right]$, the sole board structure's payoff is

$$EU_s^S = -\left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right), \tag{A24}$$

which implies that the sole board dominates the dual board structure if $b \in \left(\sigma_\varepsilon^2, b^f\right]$.

If $b \in \left(b^f, b^n\right]$, the sole board structure's payoff is

$$EU_s^S\left(I = I'; b\right) = -\left[1 - \frac{\left(\sigma_\varepsilon^2 + g^2\right)\left(\sigma_M^2 - \sigma_\varepsilon^2\right)}{\sigma_\varepsilon^2\left(b - \sigma_\varepsilon^2\right)}\right]\left(\sigma_\varepsilon^2 + g^2\right). \tag{A25}$$

Thus, a dual board structure is preferred if and only if

$$1 - c \geq \frac{\sigma_M^2 - \sigma_\varepsilon^2}{\sigma_\varepsilon^2\left(b - \sigma_\varepsilon^2\right)}. \tag{A26}$$

At $b = b^f$, we have that

$$1 - c < \frac{\sigma_M^2 - \sigma_\varepsilon^2}{\sigma_\varepsilon^2\left(b_f - \sigma_\varepsilon^2\right)} = 1. \tag{A27}$$

This implies that the sole board structure is strictly better at b^f. Due to continuity and monotonicity of $\frac{\sigma_M^2 - \sigma_\varepsilon^2}{\sigma_\varepsilon^2(b - \sigma_\varepsilon^2)}$, there exists a unique $b^D > b^f$, such that

$$1 - c = \frac{\sigma_M^2 - \sigma_\varepsilon^2}{\sigma_\varepsilon^2\left(b^D - \sigma_\varepsilon^2\right)}. \tag{A28}$$

Now, we only need to show that $b^D < b^n$. Suppose not; then $1 - c < \frac{\sigma_M^2 - \sigma_\varepsilon^2}{\sigma_\varepsilon^2(b^n - \sigma_\varepsilon^2)}$, which implies that a sole board structure in which revelation is induced strictly dominates the dual board structure at b^n. But by the definition of b^n a sole board structure which does not induce revelation yields the same expected payoffs as a sole structure with no revelation, i.e.:

$$\begin{aligned} EU_s\left(I = I'; b^n\right) &= EU_s\left(I = 1\right) \\ &= -c\left[\sigma_M^2 + \left(1 - g^2\right)g^2\right] - (1-c)\left(1 - \sigma_\varepsilon^2 - g^2\right)\left(\sigma_\varepsilon^2 + g^2\right), \end{aligned} \tag{A29}$$

which is strictly lower than EU_s^D, because $\sigma_M^2+(1-g^2)\,g^2 > \sigma_\varepsilon^2+g^2+(1-g^2)\,g^2 > \sigma_\varepsilon^2+g^2$. But this contradicts the assumption that the sole board is better than the dual board at b^n, which implies that $b^D < b^n$ must hold. Q.E.D.

Proof of Proposition 9: Let σ_ε^2 be the residual variance of ε the CEO expects to have after hearing the board's advice a in equilibrium. It can be shown that

$$\sigma_\varepsilon^2 = \frac{1}{12N^2} + \frac{(g-g_b)^2\,(N^2-1)}{3}, \tag{A30}$$

where N is the smallest integer greater or equal to $\widetilde{N}$, where

$$\widetilde{N} = -\frac{1}{2} + \frac{1}{2}\sqrt{1+\frac{2}{g-g_b}}. \tag{A31}$$

(For calculations, see Crawford and Sobel,1982, part 4).

We want to show that σ_ε^2 is decreasing in g_b, for $g_b \in [0,g]$. First, note that $\widetilde{N}$ is increasing in g_b, implying that N is non-decreasing in g_b. Second, suppose that a marginal increase in g_b does not change N (i.e., we are in a situation in which $N > \widetilde{N} \geq 1$). Then it is straightforward to see from (A30) that σ_ε^2 decreases in g_b.

However, it is unclear whether σ_ε^2 is a continuous function of $g_b \in [0,g]$, because N jumps discontinuously when $\widetilde{N}$ reaches a new integer value. We will show, however, that σ_ε^2 is indeed a continuous function of $g_b \in [0,g]$. First, suppose that g_b' is such that any infinitesimal increase in g_b induces a change from N' to $N'+1$. Then it follows that

$$N' = -\frac{1}{2} + \frac{1}{2}\sqrt{1+\frac{2}{g-g_b'}}, \tag{A32}$$

which implies that

$$g - g_b' = \frac{1}{2N'\,(N'+1)}. \tag{A33}$$

The variance before the jump is given by

$$\sigma_\varepsilon^2\,(N') = \frac{1}{12N'^2} + \frac{(g-g_b')^2\,(N'^2-1)}{3} \tag{A34}$$

and after by

$$\sigma_\varepsilon^2\,(N'+1) = \frac{1}{12\,(N'+1)^2} + \frac{(g-g_b')^2\,(N'^2+2N')}{3}. \tag{A35}$$

Thus,

$$\sigma_\varepsilon^2\,(N') - \sigma_\varepsilon^2\,(N'+1) = \frac{1}{12}\left[\frac{1+2N'}{N'^2\,(N'+1)^2}\right] - \frac{(g-g_b')^2\,(1+2N')}{3}. \tag{A36}$$

We need to show that this difference is zero. From (A33), we get

$$\sigma_{\varepsilon}^{2}\left(N'\right)-\sigma_{\varepsilon}^{2}\left(N'+1\right)=\frac{1}{12}\left[\frac{1+2N'}{N'^{2}\left(N'+1\right)^{2}}\right]-\frac{\left(1+2N'\right)}{12N'^{2}\left(N'+1\right)^{2}}=0. \tag{A37}$$

Thus, we conclude that σ_{ε}^{2} is indeed a continuous function of $g_b \in [0, g]$. As a consequence, σ_{ε}^{2} is decreasing in $g_b \in [0, g]$. Q.E.D.

Proof of Proposition 11: The supervisory board never advises the CEO, thus if $g_{sb} > 0$ both the quality and the intensity of monitoring are below their optimal levels, while the quality of the advice is not affected by g_{sb}. Thus, $g_{sb}^{*} = 0$. The management board never monitors the CEO, thus any $g_{mb} < g$ will lead to some distortion in the advice provided by the board, i.e. $\sigma_{\varepsilon}^{2} > 0$, without affecting monitoring. So that advice is without any distortion, i.e. $\sigma_{\varepsilon}^{2} = 0$, we must have $g_{mb}^{*} = g$. Q.E.D.

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Figure 1: Timeline before the Firm is Liquidated at the End of Period 3

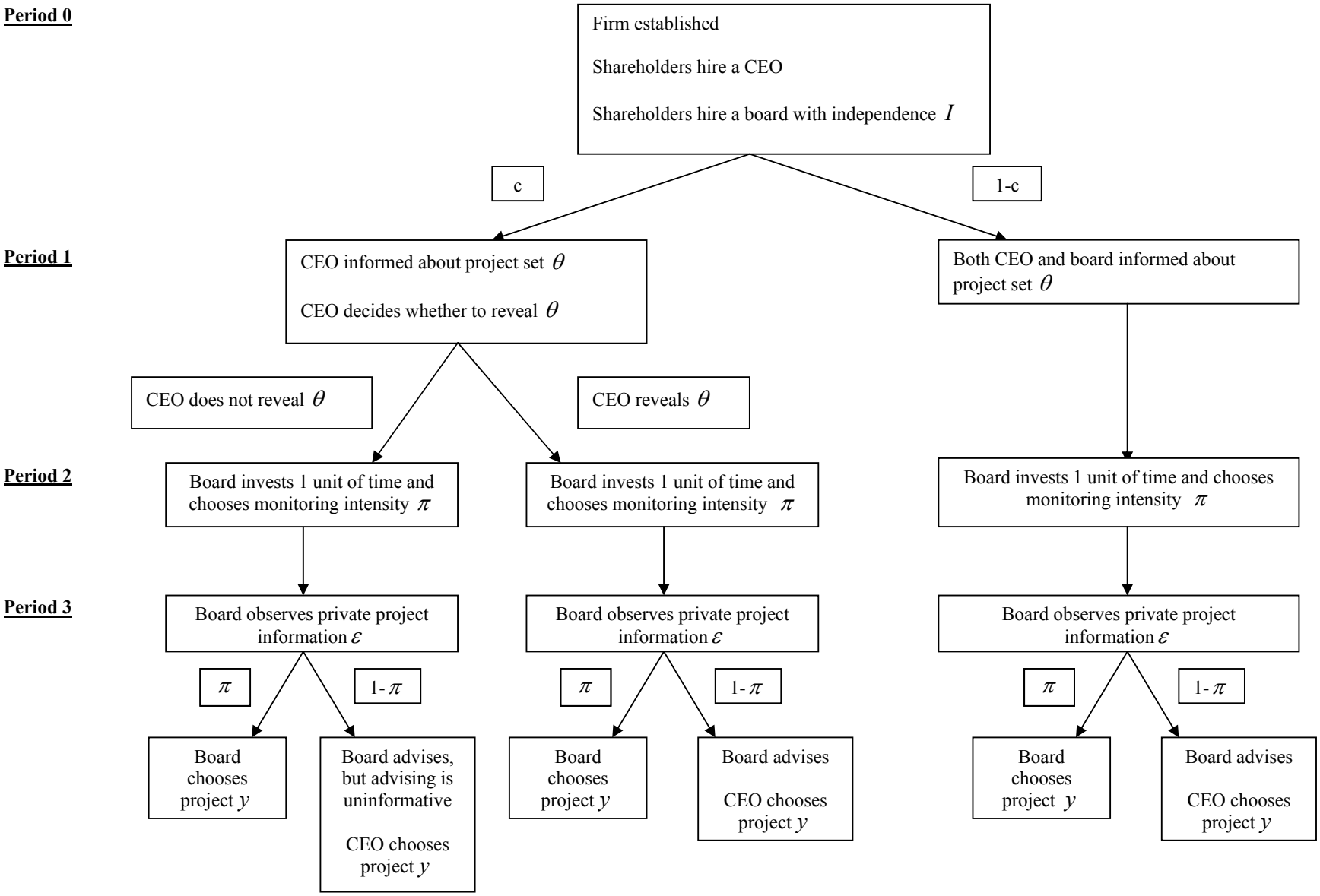

Figure 2: Expected Monitoring Intensity of the Board and Managerial Private Benefits

Figure 2 shows the relationship between the expected monitoring intensity of the board in equilibrium and managerial private benefits when the information asymmetry between the manager and the board is not too extreme. The figure is not drawn to scale. b_f is the level of private benefits below which the manager always shares his information and the expected monitoring intensity of the board is at the first-best level in equilibrium. b_n is the level of private benefits above which the manager does not share his information.

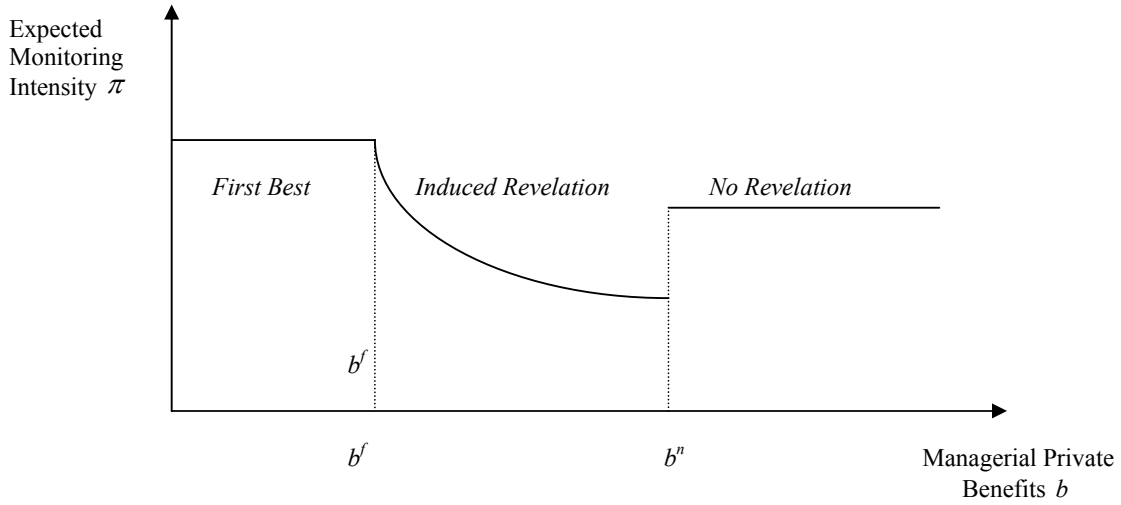

Figure 3: Optimal Board Independence and Managerial Private Benefits

Figure 3 shows the relationship between optimal board independence and managerial private benefits when the information asymmetry between the manager and the board is not too extreme. The figure is not drawn to scale. b_f is the level of private benefits below which the manager always shares his information and board independence is equal to 1. b_n is the level of private benefits above which the manager does not share his information.

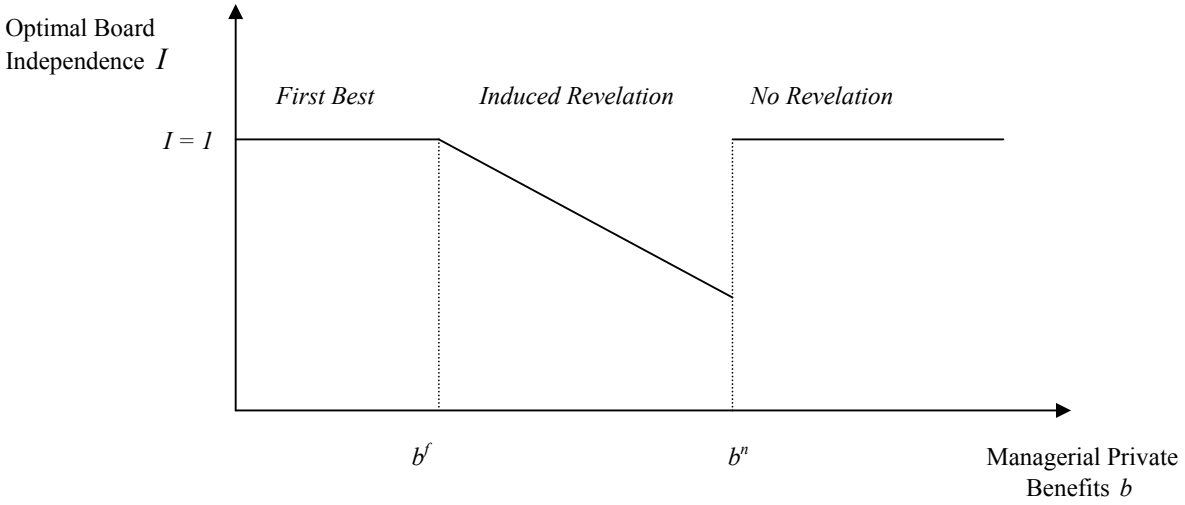

Table I
Cross-Country Variation in Board Structure

Table I classifies 40 countries according to whether they have a sole board system, a dual board system or a mixed system. A country is considered to have a mixed system if different firms can have different types of board structures within that country. For example, in France and Bulgaria, firms are allowed to choose between the sole and the dual board structure. In Switzerland, banks must have a dual board structure. Data sources are *Brefort, Tenev and Zhang (2002), the Institute of Directors (1994), Korn/Ferry International (1998), OECD (2001), World Bank and IMF (2001-2002)*. The dates of the data are from 2001-2003 in 25 cases, from 1998 in 12 cases, from 1997 in 1 case (Thailand) and from 1994 in 1 case (South Africa). In the case of Ukraine, we were unable to verify the date of the data.

Board Structure Type	Country
Sole Board System	Australia, Brazil, Canada, Egypt, India, Italy, Japan, Malaysia, Norway, Philippines, Singapore, South Africa, South Korea, Sweden, Thailand, Turkey, U.S., Ukraine, United Kingdom, Zimbabwe
Dual Board System	Austria, Belgium, China, Croatia, Czech Republic, Denmark, Estonia, Georgia, Germany, Holland, Indonesia, Latvia, Mauritius, Poland, Spain, Taiwan
Mixed Board Structures	Bulgaria, Finland, France, Switzerland

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