Corporate Governance in a Competitive Environment*

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September 20, 2006

Abstract

We examine a firm's corporate governance choices within a competitive environment. A firm can choose a delegating board that assigns decision rights to the executive manager, or an investigating board that retains these rights. We characterize the equilibrium governance choices and find that the presence of a competitor increases the likelihood that a firm chooses a delegating board. We discuss how the governance choice is affected by the rate of technological innovation, board expertise, the discount rate, the benefit of using new technology, and the cost of operating an internal control system. Finally, we analyze consequences of the Sarbanes-Oxley Act.

*We thank Rajib Doogar, Gary Hecht, Steve Kaplan, Dave Larcker, Kevin Murphy, Stefan Reichelstein, and Scott Richardson for helpful discussions. We thank workshop participants at Emory University, University of Illinois, and Stanford University for useful suggestions.

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1 Introduction

The separation of ownership from control is one of the most significant features of the modern corporation. Shareholders do not participate in the day-to-day management of a firm, but rather appoint a board of directors. The board, in turn, selects managers to execute the firm's business strategy. The board then monitors and advises the managers to comply with its fiduciary responsibility to the firm (Reiling, Thompson, Brady, and Macchiarola, 1981).

In response to the recent wave of governance scandals in which board monitoring of executive managers was often inadequate, the U.S. Congress passed the Sarbanes-Oxley Act of 2002 that established new corporate governance requirements. The New York Stock Exchange and the NASDAQ also have altered their listing requirements; they now require, for instance, listed companies to have a majority of independent directors. As a consequence of these new requirements, firms have been reevaluating their systems of corporate governance—the set of mechanisms that affects the firm's allocation of its resources. If a firm's governance mechanisms are too weak, then it cannot adequately safeguard its resources; on the other hand, if its governance mechanisms are too constraining, then in a competitive environment the firm might not be able to respond effectively as new opportunities arise. This paper examines the optimal choice of a firm's corporate governance in a competitive environment.

To analyze a firm's choice of corporate governance, we consider an industry with two firms and analyze a game that contains four stages. First, the shareholders of each firm choose a board of directors with a governance style that we label as being either *delegating* or *investigating*. Second, each firm has a manager that pursues an opportunity that only one of the firms in the

industry can exploit. Third, after a manager learns the cost of exploiting the opportunity and develops a business plan, the manager proposes the plan to the firm's board. A delegating board offers the manager a capital budget, and the manager then decides whether to implement the plan; because the board does not know the cost of the project, it installs an internal control system to limit the manager's ability to misappropriate the surplus that the project generates. An investigating board takes time to investigate the plan, learn the cost of the project, and decides whether to implement it. Fourth, one of the firms exploits the opportunity or both firms turn it down, after which the shareholders' payoffs are realized.

The primary trade-off in the model is between a delegating board that delegates control rights to the manager, and hence can more quickly pursue these opportunities, and an investigating board that retains control rights over the firm's resources, but can less rapidly respond to transient business opportunities. The emphasis on the allocation of control rights and its consequences for manager self-dealing and rent extraction reflects our view that these problems are salient to shareholders and motivated key provisions of the Sarbanes-Oxley Act (see Hamilton, 2003; Becht, Bolton, and Roell, 2005).

We characterize the equilibria to the game. Depending on the model parameters, there is an equilibrium where both firms choose investigating boards, an equilibrium where both firms choose delegating boards, and equilibria where one firm chooses an investigating board and its rival chooses a delegating board and vice versa. We find that the competitive environment affects governance choices in two ways. First, firms are more likely to choose a delegating board when a competitor is present, because the time taken by an investigating board increases the chances that the investment opportunity is preempted by a rival. Second, there are cases in which the costs and benefits of a the governance style depends on the competitor's governance style. An important consequence of the effects of a competitor on a firm's governance style is that there generally is no systematic relation between

measures of corporate governance and firm performance.

We also examine how the choice of governance style is affected by the rate of technological innovation in an industry, board expertise at evaluating plans to implement new technology, the risk of the business environment, the benefit of using new technology, and the cost of operating an internal control system to monitor the manager. Finally, we analyze the consequences of implementing the Sarbanes-Oxley Act on firm governance behavior and competitiveness. This analysis allows us to reconcile claims from opponents of the Act that it has been burdensome to firms and it has reduced firms' competitiveness, and from proponents that it has enhanced firm efficiency and competitiveness.

Several papers have considered the effect of board monitoring on firm performance. Burkart, Gromb, and Panunzi (1997) consider a setting where shareholders trade-off the gains from monitoring a manager to the gains from managerial initiative. They suggest that the manager's incentive to become informed about projects that the firm can pursue depends on the likelihood that the manager will have effective control. They establish that it is optimal for shareholders to commit to leave some control with the manager by having a fraction of the firm allocated to a large shareholder with strong incentives to monitor the manager and the remaining fraction allocated to dispersed small shareholders with weak incentives to monitor. In related work examining why boards might not monitor too intensively, Hermalin and Weisbach (1998) model the board selection process, and thereby board monitoring intensity, as a bargaining game between the manager and board. They find that board monitoring intensity declines following strong firm performance. Almazan and Suarez (2003) show that shareholders find it optimal to relinquish control to the manager to save on incentive and severance pay. In more recent work recognizing that boards monitor by influencing managers' project choices, Adams and Ferreira (2006) examine a board that serves the dual role of monitoring and advising management. By sharing information,

management can improve the board's ability to offer advice. However, the board can use this information to more closely monitor management, thereby discouraging the manager from sharing information with the board. Accordingly, they find conditions under which shareholders prefer a board that does not monitor the manager too intensively. Harris and Raviv (2005a) also consider the role of the board as serving a dual role of monitoring and advising management and examine when it is optimal to have executive directors or independent directors control the board. Among their findings, they suggest that it is optimal to have executive directors control the board when executive directors' private information is important relative to the private benefits they obtain from self-serving actions.

Our focus on alternative corporate governance styles is reminiscent of work examining centralized versus decentralized organizational structures (e.g., Aghion and Bolton, 1992; Aghion and Tirole, 1994, 1997; Bolton and Farrell, 1990; Harris and Raviv, 2005b). In work closely related to ours, Aghion and Tirole (1997) explore how the assignment of effective control over decisions—or *real authority*—to an agent can increase an agent's initiative to gather information and take actions. The conferring of real authority entails a loss of control to the principal. Hence, they find that authority is likely to be delegated when, for instance, the task is unimportant to the principal, the task is sufficiently innovative that the principal does not have the competency to accomplish the task, or a decision needs to be made urgently because the opportunity will expire. Harris and Raviv (2005b) also examine the centralization or decentralization of investment decision rights in an organization. In their model, a chief executive officer and a divisional manager have private information about an investment but, because their incentives are misaligned, they cannot credibly communicate their non-verifiable information. They establish that the assignment of decision rights depends on the relative usefulness of each player's information and the extent to which their incentives are misaligned.

While our paper is similar to this antecedent work in that we emphasize that it is might not be optimal to have intensive monitoring, the fundamental distinction between the prior work and ours is that we examine the allocation of control rights within a competitive setting where heightened board monitoring might reduce a firm's ability to preempt competitors from exploiting a business opportunity. We find that a firm's governance style may depend on the governance style of its competitor. In addition, we consider the relation between the board, executive management, and the internal control system while holding the organizational structure constant. Hence, we highlight a different set of relations that might be helpful to empiricists as they investigate the relation between corporate governance and firm performance.

There is much empirical work examining the relation between corporate governance mechanisms and firm performance. In recent work, Gompers, Ishii, and Metrick (2003), Cremers and Nair (2004) and Brown and Caylor (2004) find that firms with higher governance scores appear to have superior performance, although they are unable to infer causality. In contrast, Larcker, Richardson, and Tuna (2004) are unable to show that governance has a significant effect on a number of performance measures. Likewise, Hermalin and Weisbach (2003) in their survey of the empirical literature suggest that board composition does not seem to predict corporate performance. Hence, consistent findings regarding the importance of corporate governance for understanding firm performance is yet to emerge. Our analysis emphasizes that in some industries it is optimal for firms to install an investigating board that retains decision-making rights and in other industries it is optimal for firms to install a delegating board that delegates these rights to executive management. In a cross-section of firms from a variety of industries, therefore, a systematic relation between firm performance and governance mechanisms might not be observed. We consequently suggest ways of partitioning a sample of firms so as to increase the likelihood of finding the hypothesized relation.

The paper proceeds as follows: Section 2 describes the model. Section 3 characterizes the firm's governance choices when it does not have a competitor. Section 4 determines a firm's payoffs given its corporate governance choice and that of its competitor, and it characterizes the equilibria to the game. Section 5 analyzes the equilibria and discusses their implications. Section 6 concludes. All proofs are in the Appendix.

2 Model

We consider shareholders' governance choices within an industry composed of two firms. Each firm has shareholders who are risk-neutral and have perfectly congruent interests, a board of directors appointed by the firm's shareholders, and an executive manager who seeks to exploit a business opportunity for the firm. At date zero it is common knowledge that the opportunity with benefit $B \in (0, 1]$ exists. This benefit can be exploited by one and only one firm in the industry. The firms' managers, however, do not immediately know how to exploit the opportunity. As an example of this setting, consider the existence of a start-up venture that controls a patented technology. Because the technology is innovative, firms in the industry do not immediately know whether they can commercialize the patented technology, and consequently, are wary about acquiring the venture that controls the technology. Nevertheless, the firms are aware of the benefit and contemplate ways of introducing the technology into their products and services. A firm manager's discovery of a way to commercialize the technology follows a Poisson process. The probability that any one of the firms' managers discovers the means to commercialize the technology during the next short interval of time dt, given that the technology has not been exploited up to that point, is θdt. At date zero, the probability of this discovery before time t is $1 - e^{-\theta t}$, and the corresponding probability density function is $\theta e^{-\theta t}$. Upon discovering the way to exploit the technology, the manager privately observes the cost

realization, denoted c, of pursuing the opportunity, where the random variable $\tilde{c}$ is uniformly distributed on the $[0, 1]$ interval. The manager's signal is non-verifiable and therefore cannot be credibly revealed to the firm's board. The firms' cost realizations are independent draws.

At date zero, shareholders choose their respective firm's corporate governance style.[1] The shareholders can choose a delegating board or an investigating board. A *delegating board* has the feature that after the manager informs it about the plan to implement the technology, it authorizes a budget, denoted b, which the manager can use to implement the project. Because the delegating board does not know the cost c, the manager has the opportunity to spend some of the surplus $(B - c)$ from the project on perquisites that do not benefit the shareholders. To limit the manager's self-dealing and information rent, the delegating board installs an information and control system, denoted a, which ensures that the firm retains a fraction a of the surplus from the project; the remaining $1 - a$ of the surplus goes to the manager in the form of perquisite consumption. When setting the budget, the board realizes that the manager will not pursue the project if the budget is less than the cost realization that the manager privately observes. When choosing the control system, the board recognizes that the control system's installation and maintenance costs are increasing in its capacity to reduce the manager's misappropriation of firm resources. Formally, a delegating board chooses a budget b and information and control system a to maximize the firm's expected profits after deducting the costs of the information and

[1] While in principle shareholders choose the governance style when they appoint directors, in practice they might have little effective control. However, the market for corporate control, directors' concern for their reputations, and the guidance that corporate governance consultants offer might cause firms' governance systems to approximate the systems shareholders find optimal (Hermalin and Weisbach, 1998; Fuhrmans, 2006). In related work, Adams and Ferreira (2006) also assume the shareholders choose the board's governance style.

control system; that is,

$$\max_{b,a} \int_0^b \left(a\left(B - \tilde{c}\right) - ka^2\right) d\tilde{c}, \tag{1}$$

where $k > 0$ parameterizes the cost of the control system's capacity to prevent the manager from misappropriating assets. Notice that as a increases, where $a \in [0, 1]$, the control system monitors the manager' self-dealing more closely and thereby allows shareholders to retain more of the profits from the business opportunity.[2] To determine the board's optimal budget and control system choices, we differentiate the objective function in (1) with respect to b and a, express the first-order conditions in terms of b and a, and then solve these two expressions simultaneously to yield the optimal choices

$$b^* = \frac{2B}{3} \text{ and } a^* = \frac{B}{3k}; \tag{2}$$

the second-order sufficient condition is satisfied. To focus on a control system choice that does not always completely eliminate the manager's self-dealing, that is $a^* \in (0, 1)$, we assume that $k > B/3$. Such a control system comports more closely with the institutional environment where agency problems do in fact occur than does a control system that eliminates them.[3] Thus, we assume that k is the realization of a continuously distributed random variable

[2] Antle and Eppen (1985) examine the use of a capital budget in a setting where the firm's owner and manager are asymmetrically informed about a proposed project's rate of return. To reduce the expected slack that the manager can consume, they find that it is optimal to set a budget that rations resources in some states. Our analysis extends their work by recognizing that a firm's information and internal control system complements its budgeting and planning system to mitigate the agency problem.

[3] Witness, for instance, the fact that the founder of Adelphia Communications Corporation, John Rigas and members of his family were found guilty of fraudulently excluding billions of dollars in liabilities from Adelphia's consolidated financial statements; falsifying operating statistics and inflating earnings; and concealing rampant self-dealing, including the use of Adelphia's funds to finance open market stock purchases and purchase luxury condominiums in New York and elsewhere for the Rigas Family. For further details of the charge, see Securities and Exchange Commission; Litigation Release No. 17627 / July 24, 2002 and Accounting and Auditing Enforcement Release No. 1599 / July 24, 2002.

on the interval $[B/3, \overline{k}]$, where $\overline{k}$ is an arbitrarily large bounded real number.

An *investigating board* has the feature that after the manager informs it about a plan to implement the technology, it investigates the implications of the technology for the firm, the manager's plan to introduce the technology, and the cost of pursuing the opportunity. New technology can range from being fairly simple to being highly complex and requiring considerable expertise and effort on the part of the board to understand its implications for the firm. Accordingly, the time the board takes to complete its investigation of the technology and commit to the manager's plan varies from opportunity to opportunity. The board's investigation follows a Poisson process, which is independent of the Poisson process describing the manager's discovery of a way to commercialize the technology. The probability that the board completes its investigation during the next short interval of time dt, given that the manager has provided a plan to implement the technology, is λdt. If the manager discovers how to commercialize the technology on date n, the probability that the board discovers the cost of the project before date $n+t$ is $1-e^{-\lambda t}$, and the corresponding probability density function is $\lambda e^{-\lambda t}$. On completion of its investigation, the board observes the firm's cost realization c. The board proceeds with the manager's business plan if $c \leq B$; alternatively, if $c > B$, the firm leaves the opportunity for a competitor who might enjoy lower costs of implementing the technology. Because the board knows both B and c, it ensures all of the net benefits of the project, $B-c$, go to the shareholders.

Finally, once the firms have exploited the opportunity or turned it down, the game ends and their payoffs are realized. The discount rate is $r > 0$. The time line of events and the model's notation is summarized in Figure 1.

We focus on Nash equilibria in pure strategies where at date zero the shareholders of each firm i, where $i = 1, 2$, choose from a set $G_i = \{$investigating board, delegating board$\}$. The set $G = G_1 \times G_2$ is the set of all four possible combinations of firm governance choices. When multiple Nash equilib-

ria exist, we focus on the Pareto-dominant equilibrium. In this game, the Pareto-dominant equilibrium is the unique Aumann strong equilibrium: a *strong* equilibrium requires that no subset of firms, taking the choices of the others as given, can jointly deviate in a fashion that increases the payoffs of all its members (see Fudenberg and Tirole, 1991). Further, the Pareto-dominant equilibrium should be focal in the institutional setting we examine because corporate governance consultants, such as Institutional Shareholder Services, Inc., recommend corporate governance provisions that they expect will increase shareholder value.

Before proceeding, we discuss several features of the model. First, the precise role of the board of directors as an intermediary between shareholders and executives is at present unresolved in the literature (Becht, et al., 2005; Holmstrom, 2005; Roberts, McNulty, and Stiles, 2005). While there are many consideration that need to be kept in mind when appointing a board of directors, we characterize shareholders as choosing between an investigating and a delegating governance style. The fundamental distinction between the two governance styles is the allocation of control rights or discretion over how to invest shareholders' funds. An investigating board learns the cost of the project and the board decides whether to implement the manager's plan. A delegating board, in contrast, authorizes a budget and allows the manager to decide whether to pursue the opportunity; the manager chooses not to proceed if the budget is less than the manager's privately observed cost realization. An empirical construct for an investigating board is the extent to which the board is composed of executive directors and outside directors with extensive experience in the firm's industry and who hold few other directorships. A proxy for a delegating board might be the extent to which the board is composed of outside directors who do not have extensive experience in the firm's industry but rather have business experience in other industries and hold directorships in firms in these other industries.[4]

[4]Like Aghion and Tirole (1997), we view monitoring overload as a credible commitment

In addition, the frequency of board meetings, the presence of a shareholder with a large block holding, the presence of debt holders, or the presence of a lead director who can call meetings of all outside directors might further distinguish an investigating board from a delegating board (see Shleifer and Vishny, 1997).

Second, we assume the investigating board perfectly observes the cost realization c. If we suppose, instead, that an investigating board seeks to acquire an informative, but not necessarily perfect signal about the cost realization c and installs an internal control system to reduce the manager's self-dealing, then the paper's insights are not qualitatively altered provided the cost of the control system is lower for a firm with an investigating board than a delegating board. Furthermore, we assume that any monetary cost to a firm of an investigating board evaluating the manager's plan before it is implemented (i.e., learning c) is equal to the monetary cost to the firm of a delegating board scrutinizing the firm's financial accounts after the manager's plan has been implemented. Therefore, the choice between having an investigating or delegating board features a trade-off between the costs of delaying the project while the investigating board investigates the project and the costs of ka^2 incurred to operate the internal control system when the delegating board assigns decision rights to the manager.

Third, we suppose a firm's shareholders install the corporate governance system at date zero rather than choosing it at the date the manager proposes the business plan to pursue the opportunity. We view the choice as occurring at date zero because board members are elected at the annual shareholders meeting to serve for at least a year. Consequently, the composition of

to choose a delegating governance style. Indeed, Core, Holthausen, and Larcker (1999) argue that old directors and directors who serve on multiple boards are less active monitors of management than young directors and directors who serve on fewer boards. Larcker, et al. (2004) document that on average 20 percent of a firm's board members are executive directors; they also find that approximately nine percent of a firm's non-executive directors serve on four or more boards and 27 percent of a firm's executive directors serve on two or more boards.

the board typically cannot change in response to the business opportunities which present themselves through the year even though these opportunities might call for different styles of governance. Moreover, we suppose that when shareholders appoint directors with extensive industry experience, they expect their appointees to fulfill their fiduciary responsibility, which requires then to use their expertise to actively investigate the manager's plan.

Finally, to emphasize the effect of competition on shareholders' corporate governance choices, we abstract from the problem of motivating the manager, and assume the manager receives a constant wage equal to his reservation wage of zero. Of course, the rate of discovery θ and the cost c of exploiting a new technology are typically a function of a manager's incentive scheme, which might depend on the firm's governance structure and the assignment of control rights (see Aghion and Tirole, 1997; Burkart, et al., 1997). However, we note that several empirical studies have questioned the effectiveness of monetary incentives (see Becht, et al., (2005) and Shleifer and Vishny (1997) for surveys).

3 Governance style without a competitor

This section considers a firm's governance choice when it is the sole participant in its industry. In this benchmark setting, we first determine the firm's expected payoff when it chooses an investigating board and then the firm's expected payoff when it chooses a delegating board. We compare the expected payoffs and suggest circumstances where a firm without a competitor is more likely to choose an investigating than a delegating board.

When a firm installs an *investigating board*, its expected payoff at date zero is given by

$$E\left[V_{inv}\right] = \int_0^\infty V_{inv} \times h_i\left(t\right) \times e^{-rt} dt, \tag{3}$$

where: V_{inv} denotes the firm's expected payoff at date t when the board proceeds with the manager's business plan and is given by

$$V_{inv} \equiv \int_0^B (B - \tilde{c}) \times \frac{1}{B} d\tilde{c} = \frac{B}{2}, \tag{4}$$

$h_i(t)$ is the probability density that the board will proceed with the manager's plan at date t, and e^{-rt} is the appropriate discount factor given the board proceeds with the manager's plan at date t. To obtain $h_i(t)$, observe that a firm will proceed with the manager's plan at date t if and only if the firm's board has learned the cost of exploiting the opportunity at date t *and* the firm's cost of exploiting the opportunity is less than B. The probability that the firm's board has learned the cost of pursuing the opportunity by date t is given by the cumulative distribution function

$$F(t) = \int_0^t \left(\int_n^t \lambda e^{-\lambda(m-n)} dm \right) \left(\theta e^{-\theta n} \right) dn = 1 - \frac{e^{-\theta t}\lambda - e^{-\lambda t}\theta}{\lambda - \theta}. \tag{5}$$

To construct this expression, we recognize that the board's investigation follows a Poisson process that is independent of the Poisson process describing the manager's discovery of plan to commercialize the technology. Therefore, we can express the probability that the board learns c at date t as a convolution of $\int_n^t \lambda e^{-\lambda(m-n)} dm$, which reflects the probability that the board discovers c by date t given that the manager has presented the plan to the board at date n, and $\theta e^{-\theta n}$, which is the probability that at date n the manager develops a plan to pursue the opportunity. In then follows that the probability that the board learns the cost of pursuing the opportunity at date t is given by the probability density function

$$f(t) = \frac{\partial F(t)}{\partial t} = \frac{\theta\lambda \left(e^{-\theta t} - e^{-\lambda t} \right)}{\lambda - \theta}. \tag{6}$$

Given (6) and recognizing that the firm will only precede with the manager's

plan if c is less than B yields

$$h_i(t) = \frac{\theta\lambda e^{-\theta t} - \theta\lambda e^{-\lambda t}}{\lambda - \theta} \times B. \tag{7}$$

Finally, substituting (4) and (7) into (3) yields the firm's expected payoff at date zero when it has an investigating board,

$$E[V_{inv}] = \frac{B^2}{2} \frac{\lambda\theta}{(\lambda + r)(\theta + r)}. \tag{8}$$

When a firm installs a *delegating board*, it expected payoff at date zero is given by the expression

$$E[V_{del}] = \int_0^\infty V_{del} \times h_d(t) \times e^{-rt} dt, \tag{9}$$

where: V_{del} denotes the firm's expected payoff at date t when the board proceeds with the manager's business plan, after having chosen the optimal budget b^* and control system a^* at date zero, and is given by

$$V_{del} \equiv \int_0^{b^*} \left(a^*(B - \tilde{c}) - k(a^*)^2\right) \times \frac{1}{b^*} d\tilde{c} = \frac{B^2}{9k}, \tag{10}$$

and $h_d(t)$ is the probability density that the board will proceed with the manager's plan at date t. To obtain $h_d(t)$, observe that a firm will only proceed with the manager's plan at date t if and only if the manager has informed the board of the business plan at date t *and* the manager accepts the budget that the board authorizes to exploit the opportunity. The probability density that the manager informs the board of the business plan at date t is $\theta e^{-\theta t}$, and the probability that the manager accepts the budget that the board authorizes equals $b^* = 2B/3$. Combining these factors yields

$$h_d(t) = \theta e^{-\theta t} \times \frac{2B}{3}. \tag{11}$$

Now, substituting (10) and (11) into (9) yields the firm's expected payoff at date zero when it has a delegating board,

$$E\left[V_{del}\right] = \frac{2B^3}{27k}\frac{\theta}{(\theta + r)}. \tag{12}$$

Comparing the expected payoffs in (8) to (12) yields

$$E\left[V_{inv}\right] - E\left[V_{del}\right] \propto \frac{\lambda}{\lambda + r} - \frac{4B}{27k},$$

where $\propto$ indicates that the two expressions are proportional to each other (i.e., they have the same sign.) Hence, in this setting, shareholders are more likely to install an investigating board rather than a delegating board when, all else equal, the technology the firm seeks to exploit is such that the rate λ at which an investigating board can investigate a manager's business plan is high, the discount rate r is low, the benefit of exploiting the opportunity B is low, and finally, the cost of the control system k for monitoring the manager is high; in particular, for all monitoring costs

$$k > k^* \equiv \frac{4B\left(\lambda + r\right)}{27\lambda}, \tag{13}$$

shareholders prefer an investigating to a delegating board.

4 Equilibrium

In this section we consider the firms' governance choices when the firms are in a competitive environment. Within this strategic setting, we first determine the firms' expected payoffs for each profile of governance choices $g \in G$ and then characterize the Nash equilibria to the game. There are four combinations of firm governance choices in the set G. The next lemma characterizes a firm's expected payoff for each combination.

Lemma 1 *A firm's expected payoff at date zero when the firm and its rival have investigating boards equals*

$$E\left[V_{inv,inv}\right] = \frac{B^2}{2}\frac{\theta\lambda}{(\theta+r)(\lambda+r)}\left(1-\frac{\lambda\theta(2\lambda+2\theta+3r)}{(2\lambda+r)(2\theta+r)(\lambda+\theta+r)}B\right). \tag{14}$$

A firm's expected payoff at date zero when the firm and its rival have delegating boards equals

$$E\left[V_{del,del}\right] = \frac{2B^3}{27k}\frac{\theta}{(\theta+r)}\left(1-\frac{2B}{3}\frac{\theta}{(2\theta+r)}\right). \tag{15}$$

A firm's expected payoff at date zero when it has an investigating board and its rival has a delegating board equals

$$E\left[V_{inv,del}\right] = \frac{B^2}{2}\frac{\lambda\theta}{(\lambda+r)(\theta+r)}\left(1-\frac{2B}{3}\left(1-\frac{(\lambda+r)(\theta+r)}{(2\theta+r)(\theta+\lambda+r)}\right)\right). \tag{16}$$

A firm's expected payoff at date zero when it has a delegating board and its rival has an investigating board equals

$$E\left[V_{del,inv}\right] = \frac{2B^3}{27k}\frac{\theta}{(\theta+r)}\left(1-B\frac{\theta\lambda}{(2\theta+r)(\theta+\lambda+r)}\right). \tag{17}$$

Having determined the firm's expected payoff for the combinations of firm governance choices in the set G, we now compare payoffs for each profile $g \in G$. A firm's expected payoff $E\left[V_{inv,inv}\right]$ when both firms choose investigating boards, from (14), is at least as large as its expected payoff $E\left[V_{del,inv}\right]$ when the firm chooses a delegating board and its competitor chooses an investigating board, from (17), if and only if

$$k \geq \frac{4B(\lambda+r)(2\lambda+r)((2\theta+r)(\theta+r)+\lambda(\theta(2-B)+r))}{27\lambda(r(2\lambda+r)(\lambda+r)+\theta(2\lambda+2\theta+3r)(\lambda(2-B)+r))} \equiv k^*_{inv}. \tag{18}$$

Analogously, a firm's expected payoff $E[V_{del,del}]$ when both firms choose delegating boards, from (15), is at least as large as its expected payoff $E[V_{inv,del}]$ when the firm chooses an investigating board and its competitor chooses a delegating board, from (16), if and only if

$$k \leq \frac{4B(\lambda+r)(\lambda+\theta+r)(3r+2\theta(3-B))}{27\lambda\left(3r(\lambda+r)+2\lambda\theta(3-B)+r\theta(9-4B)+2\theta^2(3-2B)\right)} \equiv k^*_{del}. \tag{19}$$

Comparing (18) and (19), we observe that when the control system's cost parameter k is high, shareholders prefer an investigating board; when k is low, shareholders prefer a delegating board. A delegating board does not delay the implementation of the manager's business plan, and accordingly, choosing a delegating board reduces the likelihood that a competitor will preempt the investment opportunity. However, to mitigate the agency problem that arises from the board authorizing a plan that it has not fully vetted, a delegating board relies on the control system to limit the manager's self-dealing and information rents. Of course, shareholders will only choose a delegating board and rely on the control system if it is not too costly to operate.

Against this background, we characterize the equilibria to the game. There are both *symmetric* equilibria (i.e., both firms choose the same governance system) and *asymmetric* equilibria (i.e., one firm chooses an investigating board while the other chooses a delegating board). Accordingly, when characterizing the equilibria, we separately consider the setting where $k^*_{inv} \leq k^*_{del}$, which occurs if and only if

$$\lambda \leq \frac{1}{2}\sqrt{\theta^2(1-B)^2+4r(r+\theta)} - \frac{1}{2}\theta(1-B), \tag{20}$$

and the converse setting where $k^*_{inv} > k^*_{del}$. We bifurcate the setting in this fashion because when $k^*_{inv} \leq k^*_{del}$, we find that all equilibria are symmetric, but when $k^*_{inv} > k^*_{del}$, we find that there are additional equilibria that are asymmetric. We formalize these observations in the next two propositions.

Proposition 2 *If* $\lambda \leq \frac{1}{2}\sqrt{\theta^2 (1-B)^2 + 4r(r+\theta)} - \frac{1}{2}\theta(1-B)$*, then there is a unique Pareto-dominant Nash equilibrium characterized by the firms both choosing investigating boards when* $k \geq k^*_{inv}$ *and a unique Nash equilibrium characterized by the firms both choosing delegating boards when* $k < k^*_{inv}$*.*

Proposition 3 *If* $\lambda > \frac{1}{2}\sqrt{\theta^2 (1-B)^2 + 4r(r+\theta)} - \frac{1}{2}\theta(1-B)$*, then there is a unique Nash equilibrium characterized by the firms both choosing investigating boards when* $k \geq k^*_{inv}$*, a unique Nash equilibrium characterized by the firms both choosing delegating boards when* $k \leq k^*_{del}$*, and Nash equilibria characterized by one firm choosing an investigating board and the other firm choosing a delegating board when* $k \in (k^*_{del}, k^*_{inv})$*.*

These propositions highlight the effect of a firm's competitive environment on its choice of governance style. To develop intuition for these choices, we describe the equilibrium choices of governance styles in terms of the board expertise parameter λ and the monitoring cost parameter k—two key features of the corporate governance environment. First, suppose λ is arbitrarily close to zero, which implies that it is difficult for the board to evaluate the manager's business plan and discover the cost of the project. When λ is arbitrarily close to zero, then $\overline{k} < \min\{k^*_{inv},\, k^*_{del}\}$, which implies that both firms will choose delegating boards for any realization of k. Next, suppose λ is arbitrarily high, which implies that it is easy for the board to discover the cost of the project. When λ is arbitrarily high, then $B/3 > \max\{k^*_{inv},\, k^*_{del}\}$, which implies that both firms will choose investigating boards for any realization of k.

Finally, suppose that λ takes on an intermediate value for which $B/3 < \min\{k^*_{inv}, k^*_{del}\} < \max\{k^*_{inv},\, k^*_{del}\} < \overline{k}$. The firms' governance choices then depend jointly on all of the model's parameters. More specifically, when the board expertise is such that $\lambda \leq \frac{1}{2}\sqrt{\theta^2 (1-B)^2 + 4r(r+\theta)} - \frac{1}{2}\theta(1-B)$, then Proposition 1 characterizes the equilibrium with both firms choosing investigating boards when $k \geq k^*_{inv}$ and both firms choosing delegating boards

when $k < k^*_{inv}$; we illustrate Proposition 1 in Figure 2. When the monitoring cost parameter is high, i.e., $k \geq k^*_{del}$, each firm has a dominant strategy of choosing an investigating board—irrespective of its rival's choice—because the cost of monitoring the manager is so high that it better to have the board take the time to discover the cost *ex ante* instead of using the internal control system to constrain the manager *ex post.* When the cost parameter is low, i.e., $k < k^*_{inv}$, each firm has a dominant strategy of choosing a delegating board because the cost of monitoring the manager is so low that the firm can install an internal control system that effectively constrains the manager's opportunism. When $k \in [k^*_{inv}, k^*_{del}]$, then a firm's governance choice is affected by its rival's choice: in particular, there is an equilibrium where both firm's choose investigating boards and an equilibrium where both firm's choose delegating boards. We find, however, that both firms strictly prefer to have investigating boards than delegating boards because this choice lowers the firms' monitoring costs. When either of these two *symmetric* equilibria arise, the industry is said to be characterized by firms having *homogeneous* governance styles.

Alternatively, when the board of directors have a level of expertise such that $\lambda > \frac{1}{2}\sqrt{\theta^2 (1-B)^2 + 4r(r+\theta)} - \frac{1}{2}\theta(1-B)$, then Proposition 2 characterizes the possible equilibria, which we illustrate in Figure 3. Both firms have a dominant strategy to choose investigating boards when $k \geq k^*_{inv}$, and both firms have a dominant strategy to choose delegating boards when $k \leq k^*_{del}$. But when $k^*_{del} < k < k^*_{inv}$, the equilibrium is *asymmetric*, and the industry is said to be characterized by firms having *heterogeneous* governance styles. An asymmetric equilibrium arises because the benefit from choosing a delegating board is greater when facing a rival with an investigating board than when facing a rival with a delegating board. Therefore, there exists a range of k values within which one firm prefers to choose a delegating board when facing an investigating rival because the benefits of preempting the rival outweigh the costs of capital rationing and monitoring the manager;

however, the rival prefers to be investigating because the benefits of choosing a delegating board when facing a delegating rival are outweighed by these costs. Consequently, otherwise identical firms in an industry may choose heterogeneous governance styles.

In summary, this analysis suggest that governance choices reflect trade-offs between governance mechanisms and interactions between competitors. In industries for which it is difficult for a firm's board to discover the manager's private information—firms have low λ—all firms choose delegating boards and rely on the firm's internal control system to limit the manager's opportunistic behavior *ex post.* We expect to observe delegating boards in industries populated by small firms that pursue innovative technologies because the boards of these firms often lack the expertise needed to evaluate a business plan for pursuing a new technology. But in industries in which a manager's private information is readily verified—firms have high λ—all firms choose investigating boards. We expect to observe investigating boards in stable, mature industries. Intermediate cases present more subtle trade-offs: board style depends both on how costly it is to limit managerial opportunism and on the rival's board choice.

An important consequence of Propositions 2 and 3 is that relations between measures of corporate governance and firm performance depend on equilibrium governance choices, which are expected to vary across industries. The expected payoff to a board in a symmetric investigating equilibrium is increasing in the rate at which a firm can evaluate the manager's plan to pursue the opportunity, i.e., $\partial E\left[V_{inv,inv}\right]/\partial\lambda > 0$. Accordingly, strengthening governance mechanisms that cause a board to scrutinize a manager's business plan more closely, such as by increasing the proportion of unaffiliated directors with firm industry experience on the board, is anticipated to enhance the firm's value. The expected payoff to a board in a symmetric delegating equilibrium, however, is unaffected by these changes, i.e., $\partial E\left[V_{del,del}\right]/\partial\lambda = 0$. On the other hand, a delegating board relies on the information and control

system to *ex post* report on the manager's actions; this monitoring serves as a substitute for the *ex ante* evaluation of the manager's business plan. The cost of the information and control system, therefore, more strongly affects the expected payoff of a firm with a delegating board than a firm with an investigating board; i.e., $\partial E\left[V_{del,del}\right]/\partial k < 0$ whereas $\partial E\left[V_{inv,inv}\right]/\partial k = 0$. In this light, when empirically examining the relation between measures of firm performance and corporate governance in a cross-section of firms drawn from a variety of industries, it is important to partition firms according to whether they have investigating or delegating boards before looking for these relations. Failure to make this partitioning provides an explanation for the failure to find the hypothesized relations in some of the empirical literature (e.g., Larcker, et al., 2004).[5]

5 Analysis

This section analyzes the equilibria and discusses their implications. First, we discuss how the presence of a competitor affects a firm's governance choices. Second, we show how the likelihood of observing the governance style changes with changes in the parameters of the game. Third, we consider the implications of the Sarbanes-Oxley Act on firms' control system costs and missed business opportunities.

5.1 Effect of a competitor

The presence of a competing firm alters the choice of governance style in two important ways. First, comparing (13) to (18) and (19) shows that $k^*_{inv} > k^*$

[5] In a different modeling environment, Harris and Raviv (2005a) also show the relation between the number of outside directors and firm profits arises endogenously. Hence, their results are also consistent with the empirical studies that fail to find a correlation between performance and the fraction of independent directors (see Hermalin and Weisbach (2003) for a survey).

and $k^*_{del} > k^*$. Firms are more likely to choose delegating boards in a competitive environment where they are at risk of being preempted than in a setting where there is no competitor and thus no risk of being preempted. Second, when $k \in [k^*_{inv}, k^*_{del}]$ or $k \in [k^*_{del}, k^*_{inv}]$, then a firm's preferred governance style depends on the rival's choice. In the first case, the firm prefers to choose the same governance style as the rival; in the second, the firm prefers a different style. In both cases, the costs and benefits of different governance styles depends on the competitor's choice. The appropriateness of a firm's governance choice, therefore, ought to be evaluated recognizing the choices that other firms in its industry have made.

5.2 Prevalence of Corporate Governance Styles

To offer predictions about the prevalence of alternative governance styles, we examine how the equilibrium thresholds k^*_{inv} and k^*_{del} in Propositions 2 and 3 change in response to changes in parameters of the firms' competitive environment. These predictions, which hold irrespective of whether λ is greater than or less than $\frac{1}{2}\sqrt{\theta^2 (1-B)^2 + 4r(r+\theta)} - \frac{1}{2}\theta(1-B)$, are highlighted in the next corollary.

Corollary 4 *An industry is more likely to feature a symmetric equilibrium where both firms choose* delegating *boards and less likely to feature a symmetric equilibrium where both firms choose* investigating *boards when:*

1. *The technological innovation rate θ* increases*;*
2. *The rate λ at which a firm's board can evaluate a manager's business plan* decreases*;*
3. *The discount rate r* increases*;*
4. *The benefit of implementing the new technology B* increases*; and,*

5. *The cost k of a control system to monitor the manager's behavior* decreases.

The intuition for these relations is as follows. First, when the rate of technological innovation increases, a firm becomes more concerned that the competitor will discover the opportunity and invest before the firm acts. Consequently, the shareholders increasingly prefer a delegating board that immediately commits to a budget and authorizes the manager to pursue the opportunity over an investigating board that takes time evaluating the manager's proposal before investing. Second, when a board's effectiveness at assessing a manager's business plan decreases, possibly because it does not immediately have the expertise to do so and has to seek advice from outside experts, the firm's shareholders increasingly prefer a delegating board over an investigating board. A decrease in λ makes an investigating board less attractive because it will take longer for the investigating board to discover the cost of the project, which makes it more likely that the rival will preempt the investment opportunity. Third, as the discount rate increases, the shareholders are more eager to implement the manager's plan and begin enjoying the benefits of the opportunity. Consequently, they prefer a delegating board over an investigating board. Fourth, when the benefit of exploiting the opportunity increases, the shareholders become increasingly concerned that the firm might lose the opportunity to a competitor. To reduce the likelihood of this eventuality, they prefer a delegating board to an investigating board. Fifth, as the costs of the control system decreases, the delegating board optimally chooses a more effective control system. Shareholders then find a delegating board increasingly desirable because they recognize that the board can grant the manager authority to take advantage of investment opportunities as they arise, knowing that there is a control system in place that will more effectively limit the manager's self-dealing and information

rents.[6]

5.3 Implications of the Sarbanes-Oxley Act

When President Bush signed the Sarbanes-Oxley Act of 2002, he claimed it included "the most far-reaching reforms of American business practices since the time of Franklin Delano Roosevelt" (Fried, et al., 2002, 1). Perhaps the most controversial section of this Act is the requirement in Section 404 that firm management assess the effectiveness of the internal control structure and procedures for financial reporting and publicly report any material weaknesses. This section has been severely criticized because the cost of compliance is typically significant and falls disproportionately on smaller companies that are least able to afford it; further, many have argued that complying with this section has shifted management's focus from developing and implementing its business strategy and, as a consequence, has reduced firm competitiveness. To mitigate this cost, the Securities and Exchange Commission's (SEC) Advisory Committee on Smaller Public Companies has proposed an exemption or partial exemption from Section 404 for approximately 70 percent of the smallest public companies. This proposal, however, has not received unanimous support: indeed, the former SEC Chairman, Arthur Levitt, former Federal Reserve Bank Chairman, Paul Volker, and former U.S. comptroller general and former head of the Public Oversight Board, Charles Bowsher, among others, in a letter to the SEC argue that relaxing the provision of Section 404 would be misguided and would undermine the intent of the legislation to insure better reporting and better auditing (Rapoport, 2006). Likewise, the Government Accountability Office has also recently stated that the exemption proposed for smaller public companies needs to be reconsidered (Hughes, 1996).

[6] A change in each parameter affects k^*_{act} and k^*_{pas} in the same way. Therefore, the probability that an asymmetric equilibrium will arise could increase or decrease as any parameter changes, depending on the underlying distribution of the cost parameter k.

Against this background, we examine the implication of Section 404 within the context of our model. To comply with Section 404, Auditing Standard No. 2 (AS2) issued by the Public Company Accounting Oversight Board in March 2004 states that management is required to assess the effectiveness of the firm's internal controls using a recognized control framework (AS2, paragraph 13). It notes that the Committee of Sponsoring Organizations of the Treadway Commission (COSO) offered a suitable framework (AS2, paragraph 14). The COSO framework identifies three primary objectives of internal control: efficiency and effectiveness of operations, financial reporting, and compliance with laws and regulations. It notes that "all controls that could materially affect financial reporting, including controls that focus primarily on the effectiveness and efficiency of operations or compliance with laws and regulations and also have a material effect on the reliability of financial reporting, are a part of internal control over financial reporting" (AS2, paragraph 15). The standard further points out that combinations of controls should be recognized because the absence of a specific control might not be a deficiency if other controls are present; further, controls that exist at the company level—such as the assignment of authority and responsibility, controls to monitor results of operations, and the period-end financial reporting process—have a pervasive impact on controls at the process, transaction, or applications level (AS2, paragraphs 52 and 53). Given the breadth of this notion of internal control, we consider an investigating board that authorizes the manager's actions and a delegating board that uses the information and control system to report on the manager's actions to be control substitutes.

To illustrate how an investigating board and a delegating board can serve as control substitutes, note the information equivalence of a board that authorizes during a fiscal period all of the firm's checks and deposits and, alternatively, a board that examines at the end of the fiscal period the cash account in the firm's ledger reporting the manager's activities and relies on the presence of an internal control to insure the integrity of the cash ac-

count in the ledger.[7] It is important to observe that even though the two tacks provide identical information, they differ in the assignment of control rights—the key feature distinguishing governance styles in this paper.

Under Section 404, a firm's internal controls are effective when no material weaknesses exist, which we interpret as imposing the constraint that a firm must have a control system that eliminates the possibility of resource misappropriation. In the context of our model, therefore, a firm must have either an investigating board or a delegating board that implements a control system that prevents the manager from taking the project's surplus.

Implementing Section 404 in our model does not alter a firm's payoff for the governance choice profile $g = \{\text{investigating board, investigating board}\}$, but almost always alters a firm's payoff when it or its competitor chooses a delegating board. Specifically, when a firm with a delegating board must install a control system that satisfies Section 404, i.e., $a^*_{SOX} = 1$ in (1), the optimal capital budget is given by $b^*_{SOX} = B - k$. When $B < k$, operating a control system required under the Act is so costly that a firm would choose not to pursue the opportunity. To avoid this uninteresting case, we suppose for the remainder of this analysis that $B - k > 0$.[8]

We characterize the implications of Section 404 for the firms' governance styles in the next proposition.

Proposition 5 *After implementing the Sarbanes-Oxley Act, an industry is more likely to feature a symmetric equilibrium where both firms choose* investigating *boards and less likely to feature a symmetric equilibrium where both firms choose* delegating *boards.*

After implementing the Sarbanes-Oxley Act, we find that industries are more likely to be characterized by firms having investigating boards that retain

[7] The principal tool for determining the integrity of the cash account in the ledger is an independently prepared reconciliation of the entries in the cash account to the firm's bank statement (Wallace, 1995).

[8] Our results are qualitatively unaffected if we more generally assume that implementing the Sarbanes-Oxley Act has the effect that $a^*_{SOX} \in (a^* = B/(3k), 1]$.

their control rights than delegating boards that delegate control rights to management. The intuition for the heightened likelihood of investigating boards is that compliance with the Section 404 has made the choice of installing a delegating board, which places greater reliance on an accounting internal control system to prevent the misallocation of the firm's resources, more costly. Hence, consistent with the commonly voiced criticism of the Act, we expect boards to spend more time actively monitoring management after implementation of the Act than they would have spent before its implementation.[9] Indeed, Linck, Netter, and Yang (2006) find evidence of more investigating boards after implementation of the Act: they document, for instance, that there has been an increase in the number of board meetings, a decrease in the average number of directorships that directors hold, and an increase in director emoluments.

An implication of Proposition 5 is that compliance with the Act might decrease a firm's competitiveness by increasing the probability that a firm's competitor will preempt it from exploiting the opportunity. The attitudes of the business community to the provisions of the Act have been mixed: opponents have complained that it has weakened firm competitiveness (e.g., Greifeld, 2006); while proponents have contended that it has led to firms being better managed and more competitive (e.g., Donaldson, 2003). Indeed, we find the Act's effect on the probability that a firm will be preempted is ambiguous. The probabilities that a firm is preempted in the various equilibria are formalized in the next corollary.

Corollary 6 *The probability that a firm will be preempted in an industry characterized by a symmetric equilibrium where firms choose* delegating *boards*

[9] The opposite predictions are obtained if one views the Sarbanes-Oxley Act as requiring all firms to have process, transaction, or applications level accounting controls. In this case, firms that previously relied more extensively on an investigating board to monitor executive management are now required to develop and install accounting controls. If these control costs are sunk, then these firms are more likely to switch from having an investigating board to having a delegating one.

was $\frac{1}{3}B$ *before implementation of the Sarbanes-Oxley Act and is* $\frac{1}{2}(B-k)$ *after its implementation. The probability that a firm will be preempted in an industry characterized by a symmetric equilibrium where firms choose* investigating *boards is* $\frac{1}{2}B$ *both before and after implementation of the Act.*

If both firms switch from having delegating boards before the Act to having investigating boards after the Act, then they are *more* likely to be preempted and therefore will perceive themselves as being less competitive. The reason for the decline in competitiveness is that investigating boards take time investigating the manager's business plan, which increases the probability that the firm's rival will preempt it. In contrast, if firms in an industry do not switch from having delegating boards but merely improve their internal control systems to comply with the provisions of Section 404, then they are *less* likely to be preempted, because $B/3 > (B-k)/2$ when $k > B/3$. Accordingly, these firms will perceive themselves as being more competitive. The intuition here is that Section 404 has had the effect of reducing a delegating board's capital budget from $b^* = 2B/3$ to $b^*_{SOX} = B - k$. In the post Sarbanes-Oxley environment, the firm's competitor is less likely to pursue the opportunity, leaving the firm's manager to decide whether to pursue the opportunity. Finally, the Act is expected to have no effect on those industries where firms have historically had investigating boards.[10]

6 Conclusion

We examine the choice of corporate governance structures in a competitive environment. In a setting where a firm can exploit an opportunity and thereby preempt its competitor from doing so, shareholders choose between

[10] Critics of the Act contend that compliance with the Act reduces the competitiveness of U.S. companies relative to foreign companies that do not need to comply with it (Greifeld, 2006). Because we assume that all firms in an industry comply with the same regulatory provisions, we do not address this criticism but rather leave considering it for future research.

an investigating board and a delegating board of directors. An investigating board investigates its manager's business plan to exploit the opportunity before authorizing the manager to proceed, whereas a delegating board provides the manager with a budget and allows the manager to decide whether to pursue the opportunity.

The key trade-off in the model is between an investigating board that retains control rights over the firm's resources but can less nimbly respond to transient business opportunities and a delegating board that delegates control rights to the manager and hence can more quickly pursue these opportunities before its rival can preempt it. Firms therefore strategically choose their governance styles in response to their rivals' choices. Depending on parameters of the industry, there is an equilibrium where both firms choose investigating boards, an equilibrium where both firms choose delegating boards, and equilibria where a firm chooses an investigating board and its rival chooses a delegating board and vice versa.

The competitive environment affects a firm's governance style in two ways. First, the presence of a competitor makes it more likely that a firm will choose a delegating governance style. Second, the costs and benefits of a the governance style may depend on the competitor's governance style. An important consequence of the competitive environment is that there generally is no systematic relation between measures of corporate governance, such as number of independent directors or monitoring by debt holders, and firm performance in a sample of firms drawn from various industries. We offer suggestions, however, as to how a sample of firms might be partitioned to expose this relation.

We characterize how shareholder choice of governance structures is affected by the rate of technological innovation in an industry, board expertise at evaluating plans to implement new technology, the risk of the business environment, the benefit of using new technology, and the cost of installing an internal control system to monitor the manager. Our analysis also predicts

some governance consequences of the Sarbanes-Oxley Act. After complying with the Act, we note that industries are more likely to be characterized by firms choosing investigating rather than delegating boards, which is consistent with claims that boards are now spending more time monitoring management. We also find that the effect of the Act on firm competitiveness is ambiguous: for industries that experience a switch from having firms with delegating boards to investigating boards, we note that a firm is more likely to be preempted by its rival, suggesting that the firm is less competitive; in contrast, for industries whose firms do not switch from having delegating boards but merely improve their internal control systems to comply with the Act, we find that a firm is less likely to be preempted by its rival. These observations reconcile claims that complying with the Act is burdensome and has reduced firm competitiveness with claims that the Act has improved corporate management and enhanced firm competitiveness.

7 Appendix

Proof of Lemma 1:

First, we determine a firm's expected payoff for the governance choice profile $g = \{\text{investigating board, investigating board}\}$. The firm's expected payoff at date zero when it has an investigating board and its competitor also has installed an investigating board is given by the expression

$$E\left[V_{inv,inv}\right] = \int_0^\infty V_{inv} \times h_{i,i}\left(t\right) \times e^{-rt} dt, \tag{21}$$

where: V_{inv} is given by (4); $h_{i,i}\left(t\right)$ is the probability density that the board will proceed with the manager's plan at date t; and e^{-rt} is the appropriate discount factor given the board proceeds with the manager's plan at date t.

To obtain $h_{i,i}\left(t\right)$, observe that a firm will proceed with the manager's plan at date t if and only if, first, the firm's board has learned the cost of exploiting the opportunity at date t, second, the firm's competitor has not exploited the opportunity by date t thereby preempting the firm from doing so, and third, the firm's cost of exploiting the opportunity is less than B. Therefore, to determine $h_{i,i}\left(t\right)$ note that:

- The probability that the firm's board has learned the cost of exploiting the opportunity by date t is given by the probability density function $f\left(t\right)$ from (6).

- The cumulative probability that the firm's competitor with an investigating board has not exploited the opportunity by date t equals

$$1 - \left(1 - \frac{e^{-\theta t}\lambda - e^{-\lambda t}\theta}{\lambda - \theta}\right) B; \tag{22}$$

  that is, the complement of the probability that the competitor has exploited the opportunity by date t. The probability that the competitor exploits the opportunity by date t equals the product of the probability

that the competitor's board has discovered its cost by date t, $F(t)$, and this cost is less than the opportunity's benefit, B.

Combining (6) and (22) and recognizing that the firm will only proceed with the manager's plan if c is less than B yields

$$h_{i,i}(t) = \left(\frac{\theta\lambda e^{-\theta t} - \theta\lambda e^{-\lambda t}}{\lambda - \theta}\right) \times \left(1 - \left(1 - \frac{e^{-\theta t}\lambda - e^{-\lambda t}\theta}{\lambda - \theta}\right) B\right) \times B. \quad (23)$$

Finally, substituting (4) and (23) into (21) yields a firm's expected payoff at date zero when both firms have investigating boards

$$E[V_{inv,inv}] = \frac{B^2}{2} \frac{\theta\lambda}{(\theta + r)(\lambda + r)} \left(1 - \frac{\lambda\theta(2\lambda + 2\theta + 3r)}{(2\lambda + r)(2\theta + r)(\lambda + \theta + r)} B\right). \quad (24)$$

Second, we determine a firm's expected payoff for the governance choice profile $g = \{\text{delegating board, delegating board}\}$. The firm's expected payoff at date zero when it has a delegating board and its competitor also has installed a delegating board is given by the expression

$$E[V_{del,del}] = \int_0^\infty V_{del} \times h_{d,d}(t) \times e^{-rt} dt, \quad (25)$$

where: V_{del} is the firm's expected payoff at date t when the manager proceeds with the business plan after the board has chosen the optimal budget b^* and control system a^* at date zero, and is given in (10); and $h_{d,d}(t)$ is the probability density that the firm will proceed with the manager's plan at date t. To obtain $h_{d,d}(t)$, observe that a firm will proceed with the manager's plan at date t if and only if, first, the manager has informed the board of the business plan at date t, second, the firm's competitor has not exploited the opportunity by date t and thereby preempted the firm from doing so, and third, the manager accepts the budget that the board authorizes to exploit the opportunity. The probability density that the manager informs the board of the business plan at date t is $\theta e^{-\theta t}$; the cumulative probability that firm's

competitor with a delegating board has not exploited the opportunity by date t equals the complement of the probability that the competitor has exploited the opportunity by date t, which equals $\left(1 - b^* \left(1 - e^{-\theta t}\right)\right)$; and the probability that the manager accepts the budget that the board authorizes equals $b^* = 2B/3$. Combining these factors yields

$$h_{d,d}(t) = \theta e^{-\theta t} \times \left(1 - \frac{2B}{3}\left(1 - e^{-\theta t}\right)\right) \times \frac{2B}{3}. \tag{26}$$

Substituting (10) and (26) into (25) yields a firm's expected payoff at date zero when it and its rival have delegating boards

$$E[V_{del,del}] = \frac{2B^3}{27k} \frac{\theta}{(\theta + r)} \left(1 - \frac{2B}{3} \frac{\theta}{(2\theta + r)}\right). \tag{27}$$

Third, we determine a firm's expected payoff for the governance choice profile $g = \{\text{investigating board, delegating board}\}$. The firm's expected payoff at date zero when it has an investigating board and its competitor has installed a delegating board is given by

$$E[V_{inv,del}] = \int_0^\infty V_{inv} \times h_{i,d}(t) \times e^{-rt} dt, \tag{28}$$

where: V_{inv} denotes the firm's expected payoff at date t when the board proceeds with the manager's business plan, and $h_{i,d}(t)$ is the probability density that the firm will proceed with the manager's plan at date t; therefore, $h_{i,d}(t)$ is given by the product of the probability density that the firm's board has learned the cost of exploiting the opportunity at date t, $\frac{\theta\lambda e^{-\theta t} - \theta\lambda e^{-\lambda t}}{\lambda - \theta}$ (from (6)), the cumulative probability that the firm's competitor with a delegating board has not exploited the opportunity by date t, $\left(1 - b^* \left(1 - e^{-\theta t}\right)\right)$, and the firm's cost of exploiting the opportunity is less than the benefit, B; that is,

$$h_{i,d}(t) = \frac{\theta\lambda e^{-\theta t} - \theta\lambda e^{-\lambda t}}{\lambda - \theta} \times \left(1 - \frac{2B}{3}\left(1 - e^{-\theta t}\right)\right) \times B. \tag{29}$$

Substituting these factors into (28) yields

$$E\left[V_{inv,del}\right] = \frac{B^2}{2}\frac{\lambda\theta}{(\lambda+r)(\theta+r)}\left(1-\frac{2B}{3}\left(1-\frac{(\lambda+r)(\theta+r)}{(2\theta+r)(\theta+\lambda+r)}\right)\right). \tag{30}$$

Fourth, we determine a firm's expected payoff for the governance choice profile $g = \{\text{delegating board, investigating board}\}$. The firm's expected payoff at date zero when it has a delegating board and its competitor has installed an investigating board is given by the expression

$$E\left[V_{del,inv}\right] = \int_0^\infty V_{del} \times h_{d,i}(t) \times e^{-rt}dt, \tag{31}$$

where: V_{del} denotes the firm's expected payoff at date t when the manager proceeds with the business plan, and $h_{d,i}(t)$ is the probability density that the firm will proceed with the manager's plan at date t, which is given by the product of the probability density that the manager has informed the board of a business plan at date t, $\theta e^{-\theta t}$, the cumulative probability that the firm's competitor with an investigating board has not exploited the opportunity by date t, $\left(1-\left(1-\frac{e^{-\theta t}\lambda - e^{-\lambda t}\theta}{\lambda-\theta}\right)B\right)$ (from (22)), and the probability that the manager accepts the budget that the board authorizes, $2B/3$; that is,

$$h_{d,i}(t) = \theta e^{-\theta t} \times \left(1-\left(1-\frac{e^{-\theta t}\lambda - e^{-\lambda t}\theta}{\lambda-\theta}\right)B\right) \times \frac{2B}{3}. \tag{32}$$

Then substituting (10) and $h_{d,i}(t)$ into (31) yields

$$E\left[V_{del,inv}\right] = \frac{2B^3}{27k}\frac{\theta}{(\theta+r)}\left(1-B\frac{\theta\lambda}{(2\theta+r)(\theta+\lambda+r)}\right). \tag{33}$$

This analysis completes the determination of the expected payoffs. ■

Proof of Proposition 2:

If $\lambda \leq \frac{\sqrt{\theta^2(1-B)^2+4r(r+\theta)}-\theta(1-B)}{2}$, then $k^*_{inv} \leq k^*_{del}$. If $k \leq k^*_{del}$, then $E\left[V_{del,del}\right] \geq E\left[V_{inv,del}\right]$; consequently, it is an equilibrium for both firms

to choose delegating boards. If $k \geq k^*_{inv}$, then $E[V_{inv,inv}] \geq E[V_{del,inv}]$ and therefore it is an equilibrium for both firms to choose investigating boards. On considering the relations in (18) and (19) it is clear that the equilibrium in each case is unique. When $k \in [k^*_{inv}, k^*_{del}]$, i.e., k satisfies both (18) and (19), then there exist multiple equilibria: one where both firm's choose investigating boards and one where both firms choose delegating boards.

Since we emphasize the Pareto-dominant Nash equilibrium and claim that this equilibrium is characterized by both firms choosing investigating boards rather than delegating boards, it remains to show that if $k \in [k^*_{inv}, k^*_{del}]$, then $E[V_{inv,inv}] \geq E[V_{del,del}]$. Observe that an increase in k decreases $E[V_{del,del}]$, but has no effect on $E[V_{inv,inv}]$. Therefore, to establish that $E[V_{inv,inv}] > E[V_{del,del}]$ for all $k \in [k^*_{inv}, k^*_{del}]$, it is sufficient to show that $E[V_{inv,inv}] > E[V_{del,del}]$ for the lowest value of k that satisfies both (18) and (19). Hence, we set k equal to the right-hand side of the (18). Note that

$$E[V_{inv,inv}] - E[V_{del,del}] \propto (2\theta + 2r - \lambda),$$

where $\propto$ indicates the two expressions are proportional to each other (i.e., have the same sign). Because $\frac{\partial\left(\left(\sqrt{\theta^2(1-B)^2+4r(r+\theta)}-\theta(1-B)\right)/2\right)}{\partial B} > 0$ and the project benefit $B \in (0, 1]$, it follows that $\lambda < \sqrt{r^2 + r\theta}$. But, if $\lambda < \sqrt{r^2 + r\theta}$, then $(2\theta + 2r - \lambda) > 0$. Thus, we conclude that both firms choosing investigating boards Pareto dominates both firms choosing delegating boards. ■

Proof of Proposition 3:

If $\lambda > \frac{\sqrt{\theta^2(1-B)^2+4r(r+\theta)}-\theta(1-B)}{2}$, then $k^*_{del} < k^*_{inv}$. If $k \leq k^*_{del}$, then $E[V_{del,del}] \geq E[V_{inv,del}]$; consequently, it is an equilibrium for both firms to choose delegating boards. If $k \geq k^*_{inv}$, then $E[V_{inv,inv}] \geq E[V_{del,inv}]$ and therefore it is an equilibrium for both firms to choose investigating boards. On considering the relations in (18) and (19), we observe that the equilibrium in each case is unique. When $k \in [k^*_{del}, k^*_{inv}]$, then there exists an equilibrium where a firm chooses a delegating board and the other firm chooses

an investigating board, and another equilibrium where the firms' choices are reversed. ■

Proof of Corollary 4:

Consider the case when $\lambda \leq \frac{\sqrt{\theta^2(1-B)^2+4r(r+\theta)}-\theta(1-B)}{2}$. It is straightforward to show : $\frac{\partial k^*_{inv}}{\partial \theta} > 0$, $\frac{\partial k^*_{inv}}{\partial \lambda} < 0$, $\frac{\partial k^*_{inv}}{\partial r} > 0$, and $\frac{\partial k^*_{inv}}{\partial B} > 0$. Consider the case when $\lambda > \frac{\sqrt{\theta^2(1-B)^2+4r(r+\theta)}-\theta(1-B)}{2}$. In addition to using the above relations, it is again straightforward to show: $\frac{\partial k^*_{del}}{\partial \theta} > 0$, $\frac{\partial k^*_{del}}{\partial \lambda} < 0$, $\frac{\partial k^*_{del}}{\partial r} > 0$, and $\frac{\partial k^*_{del}}{\partial B} > 0$. Finally, lower (higher) values of k are associated with a symmetric delegating (investigating) equilibrium. ■

Proof of Proposition 5:

To establish the proposition, we show that the restrictions imposed by the Sarbanes-Oxley Act (SOX) yield threshold values for k, denoted, k^{SOX}_{inv} and k^{SOX}_{del} such that $k^{SOX}_{inv} < k^*_{inv}$ and $k^{SOX}_{del} < k^*_{del}$.

First, suppose the competitor chooses an investigating board in the absence of SOX. The firm chooses an investigating board if $E\left[V_{inv,inv}\right]/E\left[V_{del,inv}\right] \geq 1$. Using (14) and (17), this condition can be expressed as:

$$\frac{E\left[V_{inv,inv}\right]}{E\left[V_{del,inv}\right]} = \frac{\frac{B^2}{2}\frac{\theta\lambda}{(\theta+r)(\lambda+r)}\left(1-\frac{\lambda\theta(2\lambda+2\theta+3r)}{(2\lambda+r)(2\theta+r)(\lambda+\theta+r)}B\right)}{\frac{2B^3}{27k}\frac{\theta}{(\theta+r)}\left(1-B\frac{\theta\lambda}{(2\theta+r)(\theta+\lambda+r)}\right)} \geq 1. \qquad (34)$$

In the presence of SOX (i.e., when $a^*_{SOX} = 1$, $b^*_{SOX} = B-k$, $V^{SOX}_{del} = (B-k)/2$,and $h_{d,i}(t) = \theta e^{-\theta t} \times \left(1-\left(1-\frac{e^{-\theta t}\lambda - e^{-\lambda t}\theta}{\lambda-\theta}\right)B\right) \times (B-k)$), the corresponding expression is:

$$\frac{E\left[V^{SOX}_{inv,inv}\right]}{E\left[V^{SOX}_{del,inv}\right]} = \frac{\frac{B^2}{2}\frac{\theta\lambda}{(\theta+r)(\lambda+r)}\left(1-\frac{\lambda\theta(2\lambda+2\theta+3r)}{(2\lambda+r)(2\theta+r)(\lambda+\theta+r)}B\right)}{\frac{(B-k)^2}{2}\frac{\theta}{(\theta+r)}\left(1-\frac{B\theta\lambda}{(2\theta+r)(\theta+\lambda+r)}\right)} \geq 1. \qquad (35)$$

Using (34) and (35), it follows that:

$$\frac{E\left[V_{inv,inv}\right]}{E\left[V_{del,inv}\right]}-\frac{E\left[V_{inv,inv}^{SOX}\right]}{E\left[V_{del,inv}^{SOX}\right]}=-\frac{\lambda\left(B-\frac{3}{4}k\right)\left(B-3k\right)^{2}\left(1-\frac{\lambda\theta(2\lambda+2\theta+3r)B}{(2\lambda+r)(2\theta+r)(\lambda+\theta+r)}\right)}{B\left(\lambda+r\right)\left(B-k\right)^{2}\left(1-\frac{\lambda\theta B}{(2\theta+r)(\lambda+\theta+r)}\right)}<0. \tag{36}$$

At k_{inv}^{*} given in (18),

$$E\left[V_{inv,inv}^{SOX}\right]/E\left[V_{del,inv}^{SOX}\right]>E\left[V_{inv,inv}\right]/E\left[V_{del,inv}\right]=1.$$

Because (35) is increasing in k, the threshold for k in the presence of SOX for which $E\left[V_{inv,inv}^{SOX}\right]/E\left[V_{del,inv}^{SOX}\right]=1$, denoted k_{inv}^{SOX}, must be less than the threshold k_{inv}^{*} in the absence of SOX.

Second, suppose the competitor chooses a delegating board in the absence of SOX. The firm chooses a delegating board if $E\left[V_{del,del}\right]/E\left[V_{inv,del}\right]\geq 1$. Using (15) and (16), this condition can be expressed as:

$$\frac{E\left[V_{del,del}\right]}{E\left[V_{inv,del}\right]}=\frac{\frac{2B^{3}}{27k}\frac{\theta}{(\theta+r)}\left(1-\frac{2B}{3}\frac{\theta}{(2\theta+r)}\right)}{\frac{B^{2}}{2}\frac{\lambda\theta}{(\lambda+r)(\theta+r)}\left(1-\frac{2}{3}B\left(1-\frac{(\lambda+r)(\theta+r)}{(2\theta+r)(\theta+\lambda+r)}\right)\right)}\geq 1. \tag{37}$$

In the presence of SOX (i.e., when $a_{SOX}^{*}=1$ and $b_{SOX}^{*}=B-k$), the corresponding expression is:

$$\frac{E\left[V_{del,del}^{SOX}\right]}{E\left[V_{inv,del}^{SOX}\right]}=\frac{\frac{(B-k)^{2}}{2}\frac{\theta}{(\theta+r)}\left(1-\frac{\theta(B-k)}{(2\theta+r)}\right)}{\frac{B^{2}}{2}\frac{\lambda\theta}{(\lambda+r)(\theta+r)}\left(1-(B-k)\left(1-\frac{(\lambda+r)(\theta+r)}{(2\theta+r)(\theta+\lambda+r)}\right)\right)}\geq 1. \tag{38}$$

Using expressions (37) and (38), it follows that:

$$\begin{aligned}
&\frac{E\left[V_{del,del}\right]}{E\left[V_{inv,del}\right]}-\frac{E\left[V_{del,del}^{SOX}\right]}{E\left[V_{inv,del}^{SOX}\right]}\\
\propto\ &\left[3r^{2}\left(\lambda+r\right)\left(4B-3k\right)\left(3k-B\right)\right]+\left[\theta\lambda r\left(4B-3k\right)\left(3k-B\right)\left(3k+12-5B\right)\right]\\
&+\left[\theta r^{2}\left(4B^{2}\left(-15+8B\right)+Bk\left(225-117B\right)-k^{2}\left(135-108B\right)-27k^{3}\right)\right]\\
&+\left[2\lambda\theta^{2}\left(2-B+k\right)\left(4B-3k\right)\left(3k-B\right)\left(3-B\right)\right]+\left[r\theta^{2}\left(-16B^{2}\left(6-6B+B^{2}\right)\right.\right.\\
&\left.\left.+kB\left(360-351B+76B^{2}\right)-k^{2}\left(96B^{2}-324B+216\right)-k^{3}\left(81-36B\right)\right)\right]\\
&+\left[-2\theta^{3}\left(8B^{2}\left(3-B\right)\left(1-B\right)+3k^{2}\left(3-2B\right)\left(6-8B+3k\right)\right.\right.\\
&\left.\left.-kB\left(3-2B\right)\left(30-19B\right)\right)\right]. \qquad (39)
\end{aligned}$$

Each term in square brackets is positive when $k\in[B/3,B]$. This can be verified by inspection for the first, second, and fourth bracketed terms. The other bracketed terms are concave in k, and are positive at $k=B/3$ and $k=B$, so

$$E\left[V_{del,del}\right]/E\left[V_{inv,del}\right]\geq E\left[V_{del,del}^{SOX}\right]/E\left[V_{inv,del}^{SOX}\right].$$

It then follows that at k_{del}^{*}, which is given in (19),

$$E\left[V_{del,del}\right]/E\left[V_{inv,del}\right]=1>E\left[V_{del,del}^{SOX}\right]/E\left[V_{inv,del}^{SOX}\right].$$

Because (38) is decreasing in k, the threshold for k in the presence of SOX for which $E\left[V_{del,del}^{SOX}\right]/E\left[V_{inv,del}^{SOX}\right]=1$, denoted k_{del}^{SOX}, must be less than the threshold k_{del}^{*} in the absence of SOX. ■

Proof of Corollary 6:

We calculate the probability that a firm's competitor will preempt the firm from exploiting the opportunity conditional on the firm being able to decide whether or not to pursue the opportunity depending on its cost realization. The firm is in a position to decide to pursue the opportunity if and only if its rival has not preempted it.

To determine the probability before implementation of the Sarbanes-Oxley Act that a firm will be preempted in an industry characterized by a symmetric equilibrium where firms choose *delegating* boards, take (26), adjust it for the probability of competitor preemption and eliminate $2B/3$, which is the probability that the firm's manager decides to pursue the opportunity, to obtain

$$\int_0^\infty \theta e^{-\theta t} \times \frac{2B}{3}\left(1 - e^{-\theta t}\right) dt = \frac{1}{3}B.$$

Similarly, the probability after implementation of the Sarbanes-Oxley Act that a firm will be preempted in an industry characterized by a symmetric equilibrium where firms choose *delegating* boards is given by

$$\int_0^\infty \theta e^{-\theta t} \times (B-k)\left(1 - e^{-\theta t}\right) dt = \frac{1}{2}(B-k).$$

To determine the probability that a firm will be preempted in an industry characterized by a symmetric equilibrium where firms choose *investigating* boards, take (23), adjust it for the probability of competitor preemption and eliminate B, which is the probability that the firm's board decides to pursue the opportunity, to obtain

$$\int_0^\infty \frac{\theta\lambda e^{-\theta t} - \theta\lambda e^{-\lambda t}}{\lambda - \theta} \times \left(1 - \frac{e^{-\theta t}\lambda - e^{-\lambda t}\theta}{\lambda - \theta}\right) B dt = \frac{1}{2}B. \blacksquare$$

References

[1] Adams, R.B., and D. Ferreira. "A Theory of Friendly Boards." *Journal of Finance*, forthcoming (2006).

[2] Aghion, P., and P. Bolton. "An Incomplete Contracts Approach to Financial Contracting." *The Review of Economic Studies*, Vol. 59, No. 3 (1992): 473-494.

[3] Aghion, P., and J. Tirole. "The Management of Innovation." *The Quarterly Journal of Economics*, Vol. 109, No. 4 (1994): 1185-1209.

[4] Aghion, P., and J. Tirole. "Formal and Real Authority in Organizations." *The Journal of Political Economy*, Vol. 105, No. 1 (1997): 1-29.

[5] Almazan, A., and J. Suarez. "Entrenchment and Severance Pay in Optimal Governance Structures." *Journal of Finance*, Vol. 58, No. 2 (2003): 519-547.

[6] Antle, R., and G.D. Eppen. "Capital Rationing and Organizational Slack in Capital Budgeting." *Management Science*, Vol. 31, No. 2 (1985): 163-174.

[7] Becht, M., P. Bolton, and A. Roell. "Corporate Governance and Control." Finance Working Paper No. 02/2002: European Corporate Governance Institute.

[8] Bolton, P., and J. Farrell. "Decentralization, Duplication, and Delay." *The Journal of Political Economy*, Vol. 98, No. 4 (1990): 803-826.

[9] Brown, L.D., and M.L. Caylor. "Corporate Governance and Firm Performance." Working paper: Georgia State University (December 2004).

[10] Burkart, M., D. Gromb, and F. Panunzi. "Large Shareholders, Monitoring, and the Value of the Firm." *Quarterly Journal of Economics*, Vol. 112, No. 3 (1997): 693-728.

[11] Core, J.E., R.W. Holthausen, and D.F. Larcker. "Corporate governance, chief executive officer compensation, and firm performance." *Journal of Financial Economics*, Vol. 51 (1999): 371-406.

[12] Cremers, K.J.M., and V.B. Nair. "Governance Mechanisms and Equity Prices." *Journal of Finance*, Vol. 60, No. 6 (2005): 2859-2894.

[13] Donaldson, W.H. *Testimony Concerning Implementation of the Sarbanes-Oxley Act of 2002 Before the Senate Committee on Banking, Housing and Urban Affairs* (September 9, 2003).

[14] Fuhrmans, V. "Calpers Puts Pressure on Board of UnitedHealth." *Wall Street Journal* (April 26, 2006): A3.

[15] Fried, Frank, Harris, Shriver and Jacobson, Legal Brief (August 2, 2002).

[16] Fudenberg, D., and J. Tirole. *Game Theory*, The MIT Press: Cambridge, MA. (1991).

[17] Gompers, P., J. Ishii, and A. Metrick. "Corporate Governance and Equity Prices." *Quarterly Journal of Economics*, Vol. 118 (2003): 107-155.

[18] Greifeld, B. "It's Time To Pull Up Our SOX." *Wall Street Journal* (March 6, 2006): A14.

[19] Hamilton, R.W. "The Seventh Annual Frankel Lecture Address: The Crisis in Corporate Governance: 2002 Style." *Houston Law Review*, Vol. 40 (Spring 2003): 1-75.

[20] Harris. M. and A. Raviv. "A Theory of Board Control and Size." Working paper: University of Chicago and Northwestern University (February 21, 2005a).

[21] Harris. M. and A. Raviv. "Allocation of Decision-Making Authority." Working paper: University of Chicago and Northwestern University (March 11, 2005b).

[22] Hermalin, B.E., and M.S. Weisbach. "Endogenously Chosen Boards of Directors and Their Monitoring of the CEO." *American Economic Review*, Vol. 88, No. 1 (1998): 96-118.

[23] Hermalin, B.E., and M.S. Weisbach. "Boards of Directors as an Endogenously Determined Institution: A Survey of the Economic Literature." *Federal Reserve Bank of New York Economic Policy Review*, Vol. 9, No. 1 (April 2003): 7-26.

[24] Holmstrom, B. "Pay without Performance and the Managerial Power Hypothesis: A Comment." *Journal of Corporate Law*, forthcoming (November 2005).

[25] Hughes, S. "GAO Seeks Smaller Exemption To Sarbanes-Oxley Provisions." *Wall Street Journal* (May 9, 2006): C4.

[26] Larcker, D.F., S.A. Richardson, and I. Tuna. "How Important is Corporate Governance?" Working paper: University of Pennsylvania (September 24, 2004).

[27] Linck, J.S., J.M. Netter, and T. Yang. "Effects and Unintended Consequences of the Sarbanes-Oxley Act on Corporate Boards." Working paper: University of Georgia and Clemson University (May 16, 2006).

[28] Rapoport, M. "Financial Stars Urge Regulators To Not Dilute Sarbanes-Oxley." *Wall Street Journal* (Tuesday, February 21, 2006): C3.

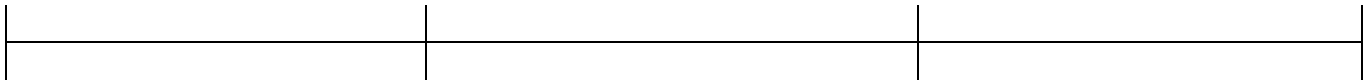
[29] Reiling, H.B., G.C. Thompson, G.P. Brady, and F.J. Macchiarola. *Business Law*, Kent Publishing Company: Boston, MA. (1981).

[30] Roberts, J., T. McNulty, and P. Stiles. "Beyond Agency Conceptions of the Work of the Non-Executive Director: Creating Accountability in the Boardroom." *British Journal of Management*, Vol. 16 (2005): S5-S26.

[31] Shleifer, A., and R.W. Vishny. "A Survey of Corporate Governance." *Journal of Finance*, Vol. 52, No. 2 (1997): 737-783.

[32] Wallace, W.A. *Auditing*, Third Edition, South-Western College Publishing: Cincinnati, OH. (1995).

Figure 1: Time line of events



At date t equal to zero, each firm's shareholders choose a board of directors that is either delegating or investigating. The players know the benefit B of exploiting a new technology but not how to do so.

Each firm's manager seeks a plan to commercialize the technology; the rate of discovery follows a Poisson process with parameter θ. On discovery of the plan, the manager privately observes the project's cost c.

The manager proposes the plan to the board. A delegating board chooses a control system of quality a (at a cost ka^2) and authorizes a budget b; the manager decides whether to pursue the opportunity. An investigating board investigates the plan and decides whether to authorize it; the rate of completion of its investigation to learn the cost of the project c follows a Poisson process with parameter λ.

Once the firms have exploited the opportunity or turned it down, the game ends and the shareholders' payoffs are realized. The discount rate is r.

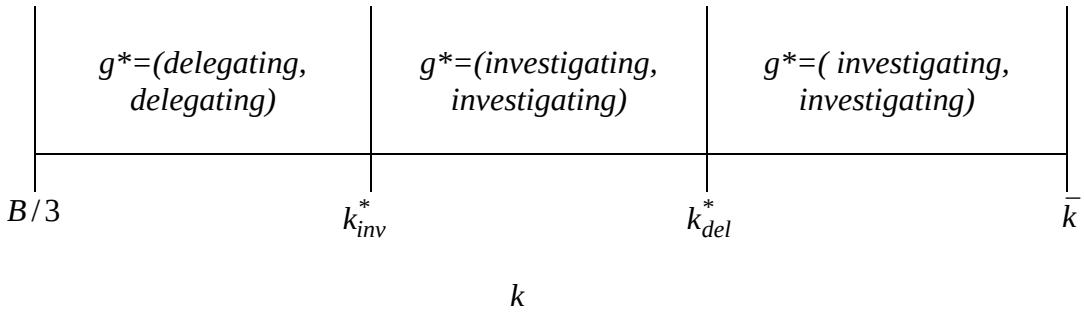


Figure 2
Pareto-dominant Nash equilibria when board expertise is such that

$$\lambda \leq \frac{\sqrt{\theta^2(1-B)^2 + 4r(r+\theta)} - \theta(1-B)}{2}$$

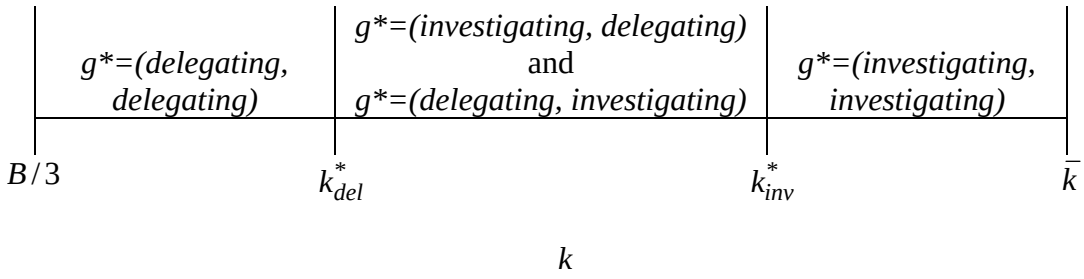


Figure 3
Nash equilibria when board expertise is such that
$$\lambda > \frac{\sqrt{\theta^2(1-B)^2 + 4r(r+\theta)} - \theta(1-B)}{2}$$