Governance Mechanisms and Corporate Disclosure*

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Current Version August 2005

JEL Classification: G21, L51, O31

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Abstract

This paper explores a firm’s reliance on internal and external governance mechanisms as part of the firm’s overall governance policy. We argue that firms’ disclosure policies, by promoting greater transparency, foster external scrutiny and thus activity in the market for corporate control. Takeovers and internal board monitoring are therefore substitute instruments for corporate governance. However, agency problems between the board and shareholders can lead to inefficient levels of both monitoring and disclosure. In this context, technological progress which increases the returns to information acquisition and reduces the cost of disclosure can diminish the cost of such inefficiencies. We show that improvements in dissemination technology lead to more disclosure and improved external governance, allowing the board to monitor less. By contrast, advances in information processing lead to less disclosure since they allow more information to be extracted for any given set of data. From a social welfare perspective, we find that firms disclose too little, thus providing a rationale for regulation that enforces minimal disclosure standards.
1 Introduction

Identifying and correcting inefficiencies in the running of a firm is one of the most important tasks delegated to corporate boards. In performing this task, directors can rely not only on their own internal monitoring of management’s activities, but also on external mechanisms such as the market for corporate control. While both internal and external governance actions can increase shareholder value through, for instance, the replacement of ineffective management, directors can take steps to further one form of corporate oversight over another. For example, directors can dedicate resources to the promotion of internal accountability through monitoring, an action likely to discourage external scrutiny by reducing the expected return to a takeover. Conversely, directors can also facilitate the acquisition of information by outsiders through the firm’s disclosure policy. Hence, a firm’s reliance on internal versus external governance mechanisms is itself an aspect of a firm’s governance policy that depends to a large extent on its board’s actions.

A wave of recent, well-publicized corporate scandals including Enron, Tyco, Worldcomm, and Global Crossing, to name a few, has brought corporate-governance reform to the forefront of the regulatory and political agenda. In response, firms have taken steps to strengthen their governance by making boards more independent and by enhancing corporate transparency through the adoption of higher disclosure standards. At the same time, advances in information technology, such as financial information systems (FIS),\(^1\) XBRL-enabled reporting,\(^2\) or open conference-call technology,\(^3\) have greatly facilitated this endeavor by ensuring the timely generation and cost-effective dissemination of corporate information. Such technological progress not only raises the returns to information acquisition for internal oversight, it also bolsters the effectiveness of takeovers as a disciplining device, a channel for governance that crucially relies on firm-specific intelligence. Hence, improvements in information technology have the potential to shift the balance between competing forms of governance.

To study these issues, we present a model in which shareholders charge a corporate board with

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\(^1\)See Krishnan and Lai (2001) on the incidence of financial information systems on firm value.

\(^2\)XBRL (Extensible Business Reporting Language) is a newly developed financial-reporting markup language that allows firms to move to real-time financial reporting and that facilitates directed searches of financial statements. Proponents state that it has the potential to influence users’ acquisition and processing of financial information by allowing them to more effectively and efficiently carry out financial analysis (see Hodge et al., 2004 and the references therein).

\(^3\)See Bushee et al. (2003) on the effect of advances in internet-based information technology on conference calls.
maximizing firm value by identifying and replacing ineffective management. Directors, while concerned about increasing the return to shareholders, may also wish to pursue their own interests, such as reducing the probability that the board or management will be replaced. Directors take two possible actions: they decide what resources to dedicate to the monitoring of incumbent management, and they choose the degree of corporate transparency through the firm’s disclosure policy. Board monitoring represents internal governance whose success depends on directors’ effort. By contrast, corporate disclosure improves governance by fostering an external market for corporate control. An outside takeover specialist (a “raider”) may screen potential targets and bid in order to restructure poorly-run firms, sharing the surplus from the restructuring with the firm’s shareholders. The raider’s ability to identify promising targets depends on her screening effort, with greater disclosure reducing the marginal cost of information acquisition by the raider.

In equilibrium, the board relies on both mechanisms in providing corporate governance. By conducting its own internal monitoring, the board is able to pre-empt a possible takeover and thus can appropriate a larger fraction of the restructuring gains. Whenever its own internal monitoring is inconclusive, however, the board can still rely on the external takeover market. The existence of a market for corporate control thus creates an incentive for directors to promote greater transparency by increasing corporate disclosure. We show that, although the information-gathering activities of the board and the raider are substitute instruments for effecting a value improvements, the firm’s disclosure policy is complementary to the raider’s screening activity. Hence, greater internal monitoring reduces the incentives for an external raider to screen, whereas greater disclosure encourages more external scrutiny, leading to a more active takeover market. Given the conflict of interest between the board and shareholders, however, the board’s incentives to both disclose information and monitor will be muted.

In this setting, we argue that technological progress can act as a partial substitute to a resolution of the underlying agency problem. We show that when the ability to process information improves, the board increases its monitoring. This comes at the cost, however, of a reduction in the level of disclosure by the firm, thus reducing screening by the raider. This reduction occurs because better information systems improve internal governance, thereby discouraging external scrutiny and takeover offers. By contrast, improvements in the technology for disseminating information have the exact opposite effect: by reducing the cost of corporate disclosure, they encourage greater
transparency, leading to more screening by the raider. This increase in external governance activity then allows the board to reduced its own (internal) monitoring. Thus, advances in information technology improve corporate governance and can mitigate the inefficiencies associated with boards whose interests may not be perfectly aligned with those of shareholders. At the same time, however, technological progress can shift the firm’s reliance from one form of governance to the other.

From a social welfare perspective, we show that firms’ optimal disclosure policies fall short of what is optimal, providing a rationale for regulation that enforces a minimal disclosure standard. This shortfall occurs because the board does not fully internalize the benefit that disclosure confers to the raider and to shareholders: it reduces the former’s cost and increases the latter’s return. These findings are relevant in the context of recent regulations, such as the Sarbanes-Oxley Act, which have called for increased disclosure as well as more accountability in internal governance.

Our main contribution is to link the choice between internal and external mechanisms for corporate control to a firm’s governance decisions, such as its internal monitoring activity and its disclosure policy. We argue that a firm’s reliance on a particular instrument is itself part of the governance policy of the firm, in that directors can take actions to foster or hinder the market for corporate control. We also contribute to the extant literature by presenting a simple, tractable model of governance that incorporates a role for technological progress into governance decisions, allowing us to better understand the likely effects of recent regulations, such as the Sarbanes-Oxley Act or the SEC’s Regulation FD, that rely on modern information technology for compliance. For instance, Bushee et al. (2003) investigate firms’ decision to hold “open” conference calls using modern information technology (webcasts) to immediately, broadly, and inexpensively communicate information to all investors, as compared to traditional “by invitation only” conference calls, which restricted access to invited professionals.

There has been little work to date on understanding how firms can influence the effectiveness of competing corporate-governance mechanisms. Hirshleifer and Thakor (1998) is one of the few papers to explicitly consider the role of internal vs. external governance mechanisms, but they do not focus on the role of corporate disclosure or technological progress. The notion that the takeover market can be a substitute for internal governance goes back to Grossman and Hart (1980) and has been analyzed in Scharfstein (1988), who focuses on the disciplinary effect of takeovers on management. Hermalin (2004) investigates how recent trends in corporate governance, including
legal and regulatory changes, affect the effectiveness of boards. Boot and Thakor (2001) focus on selective disclosure of information, and Admati and Pfleiderer (2000) study the social value of disclosure when firm values are correlated (see also Diamond, 1985, for an early model of the benefits of disclosure to investors). By contrast, our work focuses on how disclosure can aid external parties to gather information and use it for governance purposes.

There has been much work on the broad topic of corporate governance (see Shleifer and Vishny, 1997 for a survey) and some recent trends have a particular bearing for our work. Holmström and Kaplan (2001, 2003) trace the evolution of corporate governance and takeover activity in the last 20 years and discuss the effect of legal and regulatory changes on the effectiveness of boards and takeovers as disciplining devices. Hermalin and Weisbach (2001) survey the empirical and theoretical literature on boards as governance mechanisms while Roe (2004) discusses the institutions of corporate governance from a legal perspective. The findings from this literature help motivate our analysis and provide a backdrop for the discussion of our results.

The paper is organized as follows. In the next section we describe our model. The screening and monitoring equilibrium is derived in Section 3. In Section 4, we study the incidence of advances in information technology. Section 5 analyzes the role of regulation and competition in the market for corporate control. Section 6 discusses further implications and concludes. Proofs are mostly relegated to the Appendix.

2 Model Description

Suppose that a firm’s current operations are worth $1 and generate an observable and contractible terminal cash flow $X$ with probability $p_0$ and 0 with probability $1 - p_0$, where $\theta \in \{l, h\}$ denotes the type of the firm’s management (high or low quality).\(^4\) We assume that the success probability is higher for high-quality management: $p_h > p_l$. The probability that management is of high quality is $q$ and this distribution is common knowledge, although management’s type is unknown. We also assume that $p_l X < 1 < p_h X$, so that it is efficient to leave good managers in place but not bad ones. Moreover, letting $\overline{p} \equiv qp_h + (1 - q)p_l$ denote the average success probability of managers,\(^4\)

\(^4\)Alternatively, we can interpret our setup in terms of managerial effort provision and assume that any existing incentive devices are not sufficient to fully overcome the inherent moral hazard problem so that management is either diligent (high quality) or lazy (low quality). This assumption implies that the option to fire management is valuable and is available to both a raider and the board.
we assume that \( pX > 1 \), so that it is *ex ante* efficient to replace a management team identified as being of low quality.

The firm’s shareholders charge a board of directors with its day-to-day governance. This board has three functions: to monitor incumbent management, to set the firm’s disclosure policy, and to accept or reject outside bids for the firm. To this end, the board invests resources \( x_b \geq 0 \) (“monitoring effort”) that with probability \( \phi_b = 1 - e^{-Ix_b} \) yield a perfectly informative signal about the management’s quality and with complementary probability yield no information. For simplicity, the cost of this effort is linear: \( x_b \). The state variable \( I \) captures the quality of technology dedicated to generating corporate information and aiding firms to decipher such data. Examples consist of internal IT systems for performance measurement such as Financial Information Systems, whose cost, quality, and extent must be disclosed under current SEC regulation. To guarantee that it is always optimal to implement some measure of internal governance, we assume throughout that \( I \geq 1 \).

The board also sets the firm’s disclosure policy by determining the extent and quality of the firm’s financial reports, SEC filings beyond minimal statutory requirements, earnings reports, etc., which comes at cost \( \frac{1}{2}D \). Higher values of \( D \) therefore represent greater disclosure by the firm or, equivalently, a greater degree of external transparency. The state variable \( t \) captures the quality of technology available to disseminate corporate disclosures, such as future real-time filing systems, open conference-call technology via webcasts, etc. An outside raider can also expend effort \( x_r \geq 0 \) to discover, with probability \( \phi_r = 1 - e^{Ix_r} \), the quality of the firm’s management; with complementary probability she learns nothing. Since greater transparency facilitates external scrutiny, we assume that effort by the raider incurs a cost \( ke^{-Dx_r} \), which is decreasing in the firm’s disclosure \( D \).

If management is found to be of low quality by either party, it will be replaced with a new management team brought in from the outside pool. Hence, replacing low-quality management

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5In principle, a firm could also choose to disclose information that is material to its investment decisions, such as making public its plans for expansion or its sensitivity analyses of future investment projects. From this perspective the “cost” of disclosure to the firm can also represent any loss in competitive position resulting from inadvertently providing such information to rival firms, as in Bhattacharya and Chiesa (1995) or Yosha (1995).

6We later relax the assumption that the state of information processing technology \( I \) affects both the raider and the board equally. See the analysis in Section 4.3.

7A “raider” in our framework can be interpreted as a firm that specializes in identifying good targets for an acquisition and needs access to information in order to perform this function. The setup therefore allows for the possibility that information useful to the raider is not necessarily useful in internal governance conducted by the board.
improves the firm’s prospects in expected value by $pX - q\min(p_h, p_l)X$. If neither party learns anything, there is no value in replacing the incumbent management so that the total expected surplus conditional on discovering management’s type is $\Pi = (1 - q)q\min(p_h, p_l)X$.

If the raider does not become informed about the firm’s management, she will refrain from bidding for the firm. We also assume that board monitoring and screening by a potential raider occur simultaneously. Management can then only be changed subsequent to the board’s monitoring activity. In other words, the board cannot observe a takeover bid, learn the bidder’s assessment of management quality, and then reject a takeover bid so as to replace management itself.

We also assume that the board enjoys a first-mover advantage in replacing management so that no outside bid occurs when it is successful at uncovering negative information about management. In this case, the firm captures all the governance surplus $\Pi$. Conversely, when the board receives a bid but is uninformed, it cannot simply fire management as a way of preempting the takeover. Instead, the surplus must be shared between the board and the raider, with the latter obtaining a fraction $(1 - \alpha)\Pi$. We can think of this fraction as the Nash bargaining solution with parameter $\alpha \in (0, 1)$ so that $\alpha$ can represent, for instance, the degree of board entrenchment. Similarly, $\alpha$ can be viewed as the value-extraction parameter in Grossman and Hart (1980). Alternatively, we can interpret $\alpha$ as a measure of the institutional environment with higher values of $\alpha$ implying a stronger board position vis-à-vis outside bidders.

Finally, we allow for an agency problem between the board and shareholders by letting $\gamma \in [0, 1]$ represent the probability that the board acts in shareholders’ best interest. For high values of $\gamma$, board and shareholder interests agree, whereas low values of $\gamma$ represent situations where the board pursues its own interests or is possibly aligned with management, and so would not perceive much value in replacing an ill-performing management team. A successful takeover may also impose a (possibly non-pecuniary) cost $c \geq 0$ on the board, which captures, for instance, any expected loss of reputation, career prospects, or perquisites if the directors are replaced as part of the restructuring. Our representation of agency in corporate governance is consistent with the findings

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8One possible justification for this assumption are statutory limitations on board actions during takeover bids.
9Recent corporate governance scandals illustrate that, since shareholders delegate the monitoring and replacement of management to the company’s directors, significant agency conflicts may exist between shareholders and boards.
10We can interpret $\gamma$ as measuring the degree of board-shareholder congruence in the sense of Burkart et al. (1997). Alternatively, we could assume that non-executive directors require a fraction $\gamma \in (0, 1)$ of the restructuring gains as incentives to monitor and replace management. While this interpretation would slightly change shareholders’ payoffs, the board’s payoffs remain the same.
in Harford (2003), who reports that outside directors of target firms are often removed after a takeover. He also finds that they hold fewer directorships in the future and suffer a direct negative financial impact following a takeover, especially if they fail to monitor and are ousted as part of the external control process.

3 Internal and External Governance

We solve the model by backward induction. Starting in the information-discovery stage of the game, we first characterize the screening and monitoring equilibrium for a given level of disclosure $D$. Let the board’s and raider’s *ex ante* expected payoffs be denoted by $\pi_b$ and $\pi_r$, respectively. The board’s payoff is given by

$$\pi_b = \phi_b \gamma \Pi + (1 - \phi_b) \phi_r (\gamma \alpha \Pi - c) - x_b - \frac{1}{t} D$$  \hspace{1cm} (1)$$

The board maximizes equation (1) with respect to monitoring effort $x_b$.\footnote{We assume throughout that $\gamma \alpha \Pi - c \geq 0$, so that the board does not strictly prefer to prevent all takeover activity by disclosing no information.} A similar expression holds for the corporate raider, which she maximizes by choosing screening effort $x_r$:

$$\pi_r = (1 - \phi_b) \phi_r (1 - \alpha) \Pi - ke^{-D} x_r$$  \hspace{1cm} (2)$$

The board and the raider choose monitoring and screening efforts simultaneously. In the following proposition, we summarize the optimal level of monitoring and screening in terms of information-discovery success probability $\phi^*_i$ for a given disclosure policy $D$:

**Proposition 1** For $D > \ln \left( \frac{k \gamma}{1 - \alpha} \right)$, the optimal monitoring and screening success probabilities for the board and raider, respectively, are given by

$$\phi^*_b (D) = 1 - \frac{\Pi (1 - \alpha) - ke^{-D} (\gamma \alpha \Pi - c)}{\Pi (1 - \alpha) (\gamma (1 - \alpha) \Pi + c)}$$ \hspace{1cm} (3)$$

$$\phi^*_r (D) = 1 - \frac{\gamma (1 - \alpha) \Pi + c}{(1 - \alpha) \Pi e^D - (\gamma \alpha \Pi - c) k}$$ \hspace{1cm} (4)$$

where $\phi^*_i (D) = 1 - e^{-Ix^*_i}$, $i = b, r$. 

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For $D \leq \ln \left( \frac{k\gamma}{1-\alpha} \right)$ and $k \geq 1$, board monitoring and raider screening are given instead by

\begin{align}
\phi^*_b(D) &= 1 - \frac{1}{\gamma\Pi} \\
\phi^*_r(D) &= 0
\end{align}

(5)
(6)

**Proof.** See the appendix. ■

When disclosure is sufficiently high (i.e., $D > \ln \left( \frac{k\gamma}{1-\alpha} \right)$), both the board and the raider find it optimal to exert effort to ascertain the quality of a firm’s management and, using that information, to increase their return along with firm value. However, when the board provides very little information to public markets (i.e., for $D$ low enough), the raider finds it too costly to obtain useful information and will therefore exert no effort in screening. Anticipating this outcome, the board adjusts its own monitoring activities accordingly as it will not be able to benefit from the external governance provided by the takeover market.

For the case where both parties exert effort, we verify below that, in equilibrium, the preceding probabilities of discovering information ($\phi^*_b$ and $\phi^*_r$) are well defined. Simple differentiation with respect to the quality of disclosure $D$ reveals that

\begin{align}
\frac{\partial \phi^*_b}{\partial D} &= -\frac{(\gamma \alpha \Pi - c) ke^{-D}}{(\gamma (1 - \alpha) \Pi + c) (1 - \alpha) \Pi} < 0 \\
\frac{\partial \phi^*_r}{\partial D} &= \frac{(1 - \alpha) (\gamma (1 - \alpha) \Pi + c) k \Pi e^{D}}{((1 - \alpha) \Pi e^{D} - (\gamma \alpha \Pi - c) k)^2} > 0
\end{align}

Hence, board monitoring decreases in the level of disclosure, whereas screening by the raider increases with better disclosure. Intuitively, the internal (i.e., monitoring) and external (i.e., screening by a raider) governance mechanisms are substitutes for each other from the shareholders’ perspective.\(^\text{12}\) Disclosure, however, acts as a complement to the external governance mechanism, so that when the quality of disclosure rises, external screening success increases and an outside bid for the company becomes more likely. Since the board appropriates at least a fraction $\alpha$ of the resulting restructuring gains, they can reduce their own monitoring effort and, hence, their probability

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\(^\text{12}\)Formally, this observation follows from the first order conditions for maximization of expressions (1) and (2) in the proof of Proposition 1 because the reaction function for either party is decreasing in the other’s level of effort: $\frac{\partial x_i}{\partial x_j} < 0$, $i, j \in \{b, r\}$, $i \neq j$. 

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of discovering management’s type. By increasing external scrutiny, greater disclosure acts as a substitute for internal monitoring.

Substituting the optimal monitoring and screening probabilities into Equation (1) and maximizing with respect to disclosure level \( D \) yields the firm’s optimal disclosure policy.

**Proposition 2** For any \( 0 < \alpha < \bar{\alpha} < 1 \), there exists a value \( t > 0 \) such that the board’s optimal disclosure policy is given by

\[
D^* = \ln \left( \frac{k(t + I)(1 - \alpha)}{\Pi(1 - \alpha)} \right),
\]

for \( \alpha \in (\alpha, \bar{\alpha}) \) and \( t \geq t_* \). This \( D^* \) implies well-defined monitoring and screening probabilities

\[
\phi_b^*(D^*) = 1 - \frac{t}{(1-I)\Pi(1-\alpha)\Pi+\epsilon}
\]

and \( \phi_r^*(D^*) = 1 - \frac{I(\gamma(1-\alpha)\Pi+c)}{(\gamma\Pi(1-\alpha)\Pi+c)} \) in equilibrium.

For \( t < t_* \), the optimal disclosure policy is \( D^* = 0 \).

**Proof.** See Appendix.

Propositions 1 and 2 taken together characterize the unique equilibrium in which a board first sets its disclosure policy \( D^* \) and then monitors incumbent management. The propositions imply that the division of governance surplus determines which of the two different governance regimes applies. For very high values of the bargaining parameter \( \alpha \), the raider’s return to screening is so low that the level of disclosure necessary to induce her to screen and bid becomes prohibitively costly for the board. In this instance, the board prefers not to disseminate information so that the raider is not active in the takeover market. Conversely, for very low values of \( \alpha \) the benefit to the board of having the raider screen the potential target is extremely low because shareholders do not capture much of the surplus from the raider’s activities. Since disclosure is costly, the board will optimally choose to disseminate very little or no information, thus again causing the raider to cease screening.

However, for intermediate values of the bargaining parameter \( \alpha \), the board finds it optimal to rely on two different tools to provide corporate governance. In addition to its own internal monitoring, the board uses the corporate disclosure to foster information acquisition and takeover activity by the raider. While internal monitoring has the direct consequence of aiding directors in the discovery of mismanagement (or lack of talent) within the firm, disclosure works indirectly by stimulating external takeover activity, and thus provides a second channel for successful governance.
Hence, we identify a new role for disclosure policy as an instrument that enables a board to
adjust the mix of internal oversight and external governance. The restriction on the technology
for dissemination $t$ merely says that the disclosure of corporate information must be sufficiently
inexpensive from the board’s perspective. We restrict the subsequent analysis to this latter case,
i.e., $\alpha \in (\underline{\alpha}, \bar{\alpha})$ and $t \geq t^*.$

3.1 The Cost of Board-Shareholder Agency Problems

Consider the effect of an increase in $\gamma$, which brings directors’ interests into greater alignment
with those of shareholders, on the firm’s disclosure policy.\textsuperscript{13} Here, we find that the firm’s optimal
disclosure policy is increasing in the level of congruence: $\frac{dD^*}{d\gamma} = \frac{\alpha \Pi}{\gamma \alpha - c} > 0.$ This occurs because
when the congruence of board and shareholder interests increases, a larger fraction of the gains
from external governance and takeover activity accrues to the board, inducing it to increase the
level of disclosure.

Similarly, we can analyze the effect of a reduction in the cost to the board of being dismissed on
the optimal disclosure policy. We find that a higher dismissal cost following a takeover decreases
disclosure: $\frac{dD^*}{dc} = -\frac{1}{\alpha} \frac{dD^*}{d\gamma} < 0.$ Since the board internalizes the losses from takeover activity, it
reduces the level of disclosure to protect itself from replacement. The converse, of course, is that
a reduction in the board’s concern for being dismissed should lead to an increase in the level of
disclosure.

Turning to information production and governance actions, we find that greater board-shareholder
congruence increases internal monitoring, $\frac{d\phi^*_b}{d\gamma} = \Pi \frac{1 - \alpha}{(\gamma \alpha - c - \gamma \Pi)} \frac{t}{(t+I)} > 0.$ The more the board’s
interests are aligned with those of shareholders (higher $\gamma$), the more the board stands to gain from
monitoring and internal restructuring so that its own effort level increases in $\gamma$. As noted above,
however, the increased alignment between the board and shareholders leads to greater disclosure,
which is sufficient to outweigh any negative impact on takeover activity of the board’s increased
monitoring. In other words, we obtain that $\frac{d\phi^*_r}{d\gamma} = \Pi \frac{c}{t (\gamma \alpha - c)^2} > 0.$\textsuperscript{14}

\textsuperscript{13}One simple reason why the board’s interests may be more aligned with those of shareholders than with management
is that the board may be largely composed of “outsiders”. For evidence that boards with a greater fraction of
outside directors are more willing to fire and replace management, see Weisbach (1988).

\textsuperscript{14}These results are consistent with the findings in Shivdasani (1993), who documents that a hostile takeover is
less likely when outsiders represent a larger fraction of the directors. Since monitoring by the board increases, the
likelihood that a raider will be able to take over the firm decreases.
We next analyze the effect of a reduction in the cost to the board of being dismissed on the discovery probabilities and find that

\[
\frac{d\phi^*_b}{dc} = \frac{1}{(\gamma \alpha \Pi - c - \gamma \Pi)^2 I (t + I)} > 0
\]

\[
\frac{d\phi^*_r}{dc} = -\frac{I}{t (\gamma \alpha \Pi - c)^2} < 0
\]

The sensitivity of board monitoring with respect to dismissal costs is especially revealing: the greater the cost imposed on the board by takeover activity, the more diligent will the board be in monitoring and disciplining management. By making board dismissal costly in case of a takeover, shareholders can provide incentives for internal governance. This result is reminiscent of the “kick-in-the-pants” effect in Hirshleifer and Thakor (1998), who find that the threat of dismissal makes boards act more in line with shareholder interests. In the context of our model, however, this comes at the cost of a decreased reliance on the takeover market as a mechanism for discipline, and thus leads to a reduction in value overall. The board’s reaction can be contrasted to that of the raider, who engages in less screening the higher the dismissal cost because the board’s increase in governance effort decreases the raider’s return to takeover activity and increases the cost of information acquisition through the reduction in \(D\).

### 3.2 Disclosure under Full Congruence

It is illuminating to analyze the benchmark case characterized by the absence of any conflict of interest between the board and shareholders, so that directors act in the best interests of shareholders. Full board-shareholder congruence corresponds to the limiting case where \(\gamma = 1\) and \(c = 0\), for which we obtain the following optimal level of disclosure:

\[
D^* = \ln \left( \frac{k \alpha (t + I)}{I (1 - \alpha)} \right),
\]

yielding equilibrium board monitoring \(\phi^*_b = 1 - \frac{t}{(t+I)I(1-\alpha)\Pi}\) and raider screening \(\phi^*_r = 1 - \frac{I(1-\alpha)}{\alpha t}\).

We note that in the absence of an agency problem the board’s optimal disclosure policy becomes independent of the degree of asymmetric information about management quality and the degree of underperformance (i.e., the benefit of replacing management). These two aspects, however, have
been identified in the literature as potentially important determinants of a firm’s disclosure policy (see, e.g., Healy and Palepu, 2001, and the references therein). The preceding result suggests that focusing on corporate disclosure policy in isolation may be misleading for it neglects the interaction between different policy variables under the board’s control.

To see this, consider optimal disclosure for a given level of monitoring effort, i.e., holding the board’s monitoring success fixed at $\phi_b$. Maximization of the board’s payoff in Equation (1) with respect to disclosure now yields the following condition:

$$
(1 - \overline{D}_b) \alpha \Pi \frac{\partial \phi^*_b}{\partial D} - \frac{1}{t} = 0 \quad (9)
$$

Define $\tilde{D}$ as the solution to Equation (9), which is clearly a function of the expected restructuring gains $\Pi$:

$$
\tilde{D} = \tilde{D} (I, t, \Pi, \overline{D}_b).
$$

These gains, given by $\Pi = (1 - q) q (p_h - p_l) X$, incorporate both the degree of asymmetric information in terms of the variance of management quality, $(1 - q)q$, as well as the return to restructuring $(p_h - p_l) X$.

Note that, ceteris paribus, an increase in $\Pi$ increases the equilibrium level of disclosure $\tilde{D}$, holding the board’s monitoring success $\phi_b$ fixed. However, our analysis reveals that, once we allow the board to choose both its level of monitoring the disclosure policy, the board internalizes the expected benefits of restructuring primarily via its internal monitoring,

$$
\phi_b^* (D^*, \Pi) = 1 - \frac{t}{(1-t) \Pi (1-\alpha)},
$$

rather than through its disclosure policy. Hence, we can express the optimal disclosure policy as

$$
D^* (I, t) = \tilde{D} (I, t, \Pi, \phi_b^* (D^*, \Pi)),
$$

which itself does no depend on $\Pi$. While the promise of restructuring gains clearly encourages directors to enhance corporate governance, the firm’s disclosure policy need not reflect this value as other variables adjust to account for these gains.\footnote{Corporate disclosure could of course be a function of expected restructuring gains even in the absence of an agency problem between the board and shareholders under suitable variations of our model. Our point is simply that, with more than one instrument for governance, there is no automatic link between restructuring benefits $\Pi$ and the firm’s disclosure policy.}

### 3.3 Sensitivity to Bargaining Power

The impact of advances in information technology on corporate governance are also likely to depend on institutional factors stemming from the legal, regulatory, and market environment. Not only have new legal devices such as staggered boards and poison pills made hostile takeovers more expensive in the 1990s (Holmström and Kaplan, 2001), they have also shifted the initiative from...
outside bidders back to boards in M&A transactions. At the same time, hostile takeovers to restructure underperforming companies have given way to amicable mergers to exploit growth opportunities in new technologies and markets (Holmström and Kaplan, 2003). This move away from hostile external governance, together with rising takeover costs, suggests reduced competition in the market for corporate control.

Although increases in board entrenchment would correspond to a strengthening of the board’s bargaining power $\alpha$, a less competitive takeover market may imply that $\alpha$ has instead been falling in the last decade.\footnote{In Section 5.2 we disentangle the effects of competition in the market for corporate control from those related to institutional factors that can change the degree of board entrenchment.} Focusing on disclosure, the impact of a change in the board’s bargaining power $\alpha$ can be calculated as

$$\frac{dD^*}{d\alpha} = \frac{\gamma \Pi - c}{(1 - \alpha)(\gamma \alpha \Pi - c)} > 0$$

An increase in $\alpha$ can therefore be seen as increasing the incentive for the board to disclose information. This occurs because the increase in $\alpha$ raises the return to the board from having a takeover occur, thus providing the board with a greater incentive to disclose information in order to foster the external takeover market.

We can also see the effect of a change in $\alpha$ reflected in the firm’s governance policy.

$$\frac{d\phi^*_b}{d\alpha} = \frac{-\gamma \Pi}{(\gamma \Pi (\alpha - 1) - c)^2 I(t + t)} < 0$$

$$\frac{d\phi^*_r}{d\alpha} = \frac{\Pi \gamma^2}{t (\gamma \alpha \Pi - c)^2} > 0$$

Put together, these results imply that, as $\alpha$ increases, the board makes less heavy use of internal mechanisms for governance, and instead relies more intensely on external mechanisms. Not only does disclosure increase in equilibrium, but the board reduces its own level of monitoring even as the raider increases its efforts in screening the firm. The net effect is a shift away from internal mechanisms and towards external ones.
4 Technological Progress

The preceding analysis highlights the frictions introduced by the lack of perfect alignment between the board’s interest and those of shareholders, leading to inefficient governance policies. However, the analysis also suggests that technology can play an important role in determining the level of information-production effort exerted by both the raider and the board, as well as the firm’s disclosure policy. As such, technological developments may at least partly mitigate the negative consequences of agency problems within the firm, and act as a substitute instrument for improving corporate governance. In this section we study how technological advances influence the board’s reliance on internal versus external governance mechanisms by changing their relative efficacy and by altering the costs associated with disseminating company-specific information.

4.1 The Cost of Dissemination

Consider advances in the technology for information dissemination \( t \) that reduce the cost of corporate disclosure. Cases in point are the development of webcast technology for open conference calls over the internet, highly searchable financial reporting based on XBRL, and new real-time filing systems for material events mandated under the Sarbanes-Oxley Act, to name a few. From the optimal disclosure level \( D^* \) characterized in Equation (7) we obtain

\[
\frac{dD^*}{dt} = \frac{1}{t + I} > 0
\]

for \( \alpha \in (\underline{\alpha}, \bar{\alpha}) \). Equation (10) establishes that better or more cost-effective dissemination technology leads to greater disclosure. When technology reduces the cost of making firm-specific information available to outsiders, the optimal action of the board is naturally to disclose more information.\(^{17}\)

This result appears broadly in line with the findings of Bushee et al. (2003) that firms in high-tech industries and, therefore, with a superior installed base of technology, are more likely to host open-access conference calls to communicate supplemental information on recent earnings reports to investors.

This finding also suggests that reductions in the cost of dissemination may at least partially

\(^{17}\)One way of thinking of an improvement in the dissemination technology is that it allows disclosure of corporate data while preventing the leakage of information that would worsen the competitive position of the firm. In other words, technology may reduce the cost of transparency for the firm by allowing it to secure its proprietary data.
compensate for the existence of an agency problem between the board and shareholders, as measured by the congruence parameter $\gamma$. While low values of $\gamma$ lead to low levels of disclosure, more cost-effective dissemination technology increases disclosure even in the face of significant agency problems within the firm. Hence, investing in such technological progress represents a substitute instrument for aligning the actions of the board with those preferred by shareholders, even if the underlying conflict of interest cannot be readily solved. Advances in the diffusion of information may be especially important if the takeover market is seen as an important source of governance for the firm.

Similarly revealing is the response of both the board and the raider to improvements in information dissemination. Here, we find that

$$\frac{d\phi^*_b}{dt} = \frac{1}{(t + I)^2 (\gamma (\alpha - 1) \Pi - c)} < 0$$
$$\frac{d\phi^*_r}{dt} = I \gamma (1 - \alpha) \Pi + c (\gamma \alpha \Pi - c) t^2 > 0$$

As a consequence of an increase in $t$, the board relies more heavily on the external market to provide governance for the firm. Intuitively, such technological progress facilitates disclosure which, in turn, increases the success of external governance through takeovers. As a result, the board finds it optimal to substitute away from its own monitoring effort and, instead, to dedicate more resources to improving corporate disclosure. This increase in the external “transparency” of the firm leads to more outside screening and consequently a higher takeover probability. Hence, a reduction in the cost of dissemination tilts the governance mix towards a greater reliance on the external takeover market. Notice that while these effects go in the opposite direction from those associated with increased congruence (at least for the case of board monitoring), it is straightforward to see that increases in $t$ nevertheless unambiguously increase firm value.

4.2 Information Production

Technological advances can also enhance the return to monitoring and screening effort. These improvements in information-processing capabilities $I$ increase the ability to generate data and extract useful information from it for both the raider and board. Examples can be found in the development of financial information systems, data storage and retrieval technology, computational
and financial analysis tools, etc.

Advances affecting information processing have the opposite effect on the company’s disclosure policy to that found for improvements in dissemination technology:

\[
\frac{dD^*}{dI} = \frac{-t}{I(t + I)} < 0
\]

Two forces lie at the root of this effect. From the perspective of shareholders, external and internal governance are substitutes, so an improved ability to process information increases the effectiveness of monitoring and thereby reduces the need for takeovers. As a consequence, the importance of disclosure as a governance tool decreases as well. At the same time, such technological progress will also, ceteris paribus, increase the ability of a raider to screen. This latter effect attenuates the impact of the reduction in corporate disclosure. The net effect is an overall reduction in the level of disclosure when information-processing capabilities improve.

It can also be shown that, in equilibrium, advances in the ability to process information increase the overall success rate of board monitoring but decrease the efficacy of screening by a potential raider:

\[
d\phi^*_b = \frac{t + 2I}{I^2(t + I)^2} \left( \gamma(1 - \alpha)\Pi + c \right) > 0
\]

\[
d\phi^*_r = -\frac{\gamma(1 - \alpha)\Pi + c}{t(\gamma\alpha\Pi - c)} < 0
\]

The two previously mentioned effects are again at work here. As better financial information systems and other technology dedicated to performance measurement facilitate monitoring by the board, the board substitutes its own monitoring effort for disclosure, thereby enhancing the efficacy of internal governance. This improvement in internal governance, however, comes at the expense of external mechanisms: with the increase in the success of the board’s monitoring, the raider is less likely to benefit from a possible takeover bid despite her own increased screening success. Hence, the raider has a reduced incentive to exert screening effort, and this effect is further exacerbated by the board’s decision to cut back on the level of disclosure.\(^\text{18}\)

\(^\text{18}\)Formally, the effect of an improvement in technology \(I\) can be broken down as follows:

\[
\frac{d\phi^*_r}{dt} = \frac{\partial \phi^*_r}{\partial t} + \frac{\partial \phi^*_r}{\partial x_b} \frac{dx_b}{dt} + \frac{\partial \phi^*_r}{\partial D} \frac{dD}{dt}
\]

While the first term is clearly positive, the other two terms are sufficiently negative that \(\frac{d\phi^*_r}{dt} < 0\) in equilibrium.
An important consequence of our results in this section and the last is to that advances in information technology have the ability to affect the relative effectiveness of external and internal governance mechanisms. Although overall beneficial, the observed effects of such improvements depend on the exact nature of technological progress. Improvements in information dissemination, which facilitate the use of the market for corporate control as a disciplinary device, lead in equilibrium to a decrease in the relative effectiveness of internal governance mechanisms but a strengthening of external ones. Conversely, the development of improved systems for information processing increases the effectiveness of board monitoring but discourages external screening in equilibrium, thus reducing the firm’s reliance on the external control market.

4.3 Asymmetries in Information Processing

While advances in information technology have clearly affected both the effectiveness of internal governance and the market for corporate control, the effects need not necessarily be symmetric. So far, we have assumed that the state of technology characterizing the processing of information by both the board and the raider is the same. Instead, we could allow for information-processing technology to advance at different speeds for internal and external scrutiny. One possible rationale for considering such asymmetric advances stems from the informational improvements mandated under the Sarbanes-Oxley Act, which might well lead to an accelerated development of financial information systems and other internal monitoring devices that are independent of any improvements in information-processing systems at large.

To study such differential progress in information technology, we extend our model to let the board’s monitoring success probability be given by \( \phi_b(x_b) = 1 - e^{-I_b x_b} \), where the state variable \( I_b \) now indicates the quality of internal IT systems. Similarly, the raider’s screening success probability becomes \( \phi_r(x_r) = 1 - e^{-I_r x_r} \), where the state variable \( I_r \) measures the information processing capabilities available in the takeover market. We assume, as before, that \( I_b, I_r > 1 \), and that \( t \) is sufficiently large that some amount of disclosure is optimal in equilibrium. We can now state the following result:

\[\text{Hauswald and Marquez (2003) study the effect of technological progress on the competitiveness of financial markets. They find that whether markets become more or less competitive also depends on the exact nature of progress.}\]
Proposition 3 For states of technology $I_b$ and $I_r$, the optimal monitoring and screening success probabilities for the board and raider are given, respectively, by

$$
\phi^*_b (D) = \frac{kI_b e^{-D} (\alpha \gamma I_r - c) - (1 - \alpha) \Pi I_r (1 - I_b (\Pi \gamma (1 - \alpha) + c))}{I_r I_b \Pi (1 - \alpha) (\gamma \Pi (1 - \alpha) + c)}
$$

$$
\phi^*_r (D) = 1 - \frac{\Pi (e^D I_r (1 - \alpha) - k \gamma I_b)}{\Pi e^D I_r (1 - \alpha) - k I_b (\alpha \gamma I - c)}
$$

for $D$ sufficiently large. For any $0 < \alpha < \bar{\alpha} < 1$, there is a $t > 0$ such that the board’s optimal disclosure policy is given by

$$
D^* = \ln \left( \frac{k (t + I_b) (\gamma \alpha I_r - c)}{I_r \Pi (1 - \alpha)} \right),
$$

for $\alpha \in (\underline{\alpha}, \bar{\alpha})$ and $t \geq \frac{1}{\gamma}$. This $D^*$ implies well-defined $\phi^*_b (D^*)$, $\phi^*_r (D^*) \in (0, 1)$ in equilibrium.

Proof. See Appendix. □

The bounds $\underline{\alpha}$ and $\bar{\alpha}$ once again ensure that, in equilibrium, the firm discloses enough that an outside bidder is willing to screen and submit a takeover offer. As before, we focus on the case where $\alpha \in (\underline{\alpha}, \bar{\alpha})$ so that the firm relies on both internal and external mechanisms of corporate governance in equilibrium.

We find that the type of advance in information technology, whether facilitating monitoring by the board monitoring or screening by the raider, will have opposing effects on the company’s disclosure policy:

$$
\frac{dD^*}{dI_b} = \frac{1}{t + I_b} > 0
$$

$$
\frac{dD^*}{dI_r} = - \frac{1}{I_r} < 0
$$

Somewhat surprisingly, technological progress that improves internal monitoring also increases the level of corporate disclosure. This result holds despite the fact that technological progress along this dimension increases the efficiency of internal monitoring relative to relying on the external market. Conversely, innovations affecting the raider’s ability to identify worthwhile takeover targets lead to a decrease in the amount of information disclosed by the firm. Again, this result obtains despite the fact that such improvements enhance the efficacy of the takeover market relative to internal
evaluation mechanisms.

The intuition behind these findings stems from the respective roles the board’s and the raider’s activities play in effective corporate governance. Although both parties’ information gathering activities are substitutes for each other, they are also both independently valuable in providing pertinent, value-enhancing information. Consider then the effect of an increase in the quality of internal information systems \( I_b \) which makes monitoring by the board more effective. Given that the return to monitoring has increased, the board’s response should be to monitor more (an increase in \( x_b \)). The raider’s response to such an increase in board effort is to reduce her own level of screening effort \( x_r \), since the two mechanisms are strategic substitutes in the board and the raider’s optimal strategies. To compensate for this reduction in raider activity, the board finds it optimal to increase the firm’s level of disclosure so as to foster the external takeover market.

A similar logic applies to improvements in the raider’s ability to identify a likely target firm. When \( I_r \) increases, the raider increases her own effort in finding a takeover target (i.e., \( x_r \) increases). All things equal, the response of the board would be to reduce its own level of monitoring \( x_b \). But such a reduction has a negative consequence for the firm because shareholders capture a greater fraction of the restructuring surplus when the firm’s own internal mechanisms identify mismanagement. In order to minimize the effect of this relative shift in board versus raider monitoring, the board reduces the amount of information it discloses, making screening by the raider more difficult, reducing the overall cost to the firm, and attenuating the reduction in the board’s own monitoring effort.

Bushee et al. (2003) provide evidence that is consistent with our preceding finding concerning the effect of technological progress in external financial analysis on disclosure: \( \frac{\partial D^*}{\partial I_r} < 0 \). They find that firms with larger institutional shareholdership and greater analyst following are less likely to rely on open-access conference calls to communicate with their presumably more sophisticated shareholders. In the context of our model, such firms are less transparent in their communication with shareholders and engage in less disclosure. But institutional shareholders and financial analysts represent those market participants that we would associate with better and more sophisticated information-processing capabilities for financial analysis, i.e., higher \( I_r \). Their employers (mutual funds, investment advisors, investment banks) have been at the forefront in developing sophisticated IT systems for financial analysis.
Improvements in internal information systems $I_b$ that help boards to better monitor their firm’s operating performance (e.g., financial information systems) not only increase the aggregate amount of information produced, they also alter the relative importance of internal versus external mechanisms for governance. Specifically, we find that such advances increase the success of board monitoring at the expense of decreasing the screening success of outsiders in equilibrium:

$$
\frac{d\phi^*_b}{dI_b} = \frac{2I_b + t}{I^2_b (I_b + t)^2} \left( \gamma (1 - \alpha) \Pi + c \right) > 0
$$

$$
\frac{d\phi^*_r}{dI_b} = -\frac{\gamma (1 - \alpha) \Pi + c}{(\gamma \alpha \Pi - c) t} < 0
$$

Since monitoring-related technology increases the productivity of board effort, improvements in such systems lead to a higher level of effort $x_b$ and, hence, a better informed board. But this increase in the effectiveness of internal governance reduces the incentives for the raider to screen potential targets, thus reducing its own screening success.

Nevertheless, the increase in the success of board monitoring outweighs the decrease in screening by the raider, so that the aggregate amount of information being produced increases. These findings are consistent with the evidence in Krishnan and Lai (2003) and Sriram et al. (2004) who find a positive association between expenditures on financial information systems and firm value. To the extent that disclosed investments in financial information systems are a proxy for their quality, our results suggest that the observation of increased firm value might be the consequence of more overall information production and superior corporate governance, both externally and internally.

We also investigate the role of information technology $I_r$ that facilitates financial analysis and screening in the market for corporate control. Analyzing the screening and monitoring probabilities $\phi^*_b$ and $\phi^*_r$, we find the interesting result that

$$
\frac{d\phi^*_b}{dI_r} = 0 \text{ and } \frac{d\phi^*_r}{dI_r} = 0
$$

To understand why increases in $I_r$ have no effect on the aggregate amount of information that is obtained, it is important to keep in mind that $\phi_b$ and $\phi_r$ are both functions of the firm’s disclosure policy. An increase in $I_r$ makes screening by the raider more cost-effective, increasing the amount of screening she performs for any given level of disclosure. The board is able, therefore, to benefit
from the improved efficiency of the market for corporate control by reducing the level of disclosure \( \frac{dD^*}{dI_r} < 0 \), as shown above) and economizing on the associated costs. While shareholders are better off, in equilibrium the firm exactly offsets the raider’s increased efficiency by adjusting its disclosure policy accordingly.\(^{20}\)

5 Regulation and Competition

In the section we analyze two important issues related to the disclosure of corporate information. We first consider the role of regulation that imposes a minimum disclosure standard as a way of increasing social welfare. Second, we investigate how competition in the market for corporate control affects a firm’s incentives to disclose information.

5.1 Socially Optimal Disclosure

Recent regulatory proposals, most notably the Sarbanes-Oxley Act (SOX), have called for increased accountability of management and directors, as well as more transparency and disclosure by firms. Specifically, SOX stipulates that firms disclose larger amounts of pertinent and material information to the public in a more timely manner and that they certify both the accuracy of the information and the quality of the financial-reporting systems used (Section 404). However, the ability to comply with the regulation presupposes the existence of adequate means to collect, aggregate, and disseminate the required information. One implication of such regulation is therefore that firms might have to invest in information systems geared not only towards improving internal accountability but also towards improving disclosure.

Much emphasis recently has been placed on mandatory disclosure for firms, which in the context of our model is equivalent to imposing a requirement that \( D \geq D_r \), where \( D_r \) is the statutory minimum level of disclosure. It is straightforward to show that, if \( D_r \geq D^* \), the board maximizes its payoff by choosing a disclosure policy equal to the mandatory level \( D_r \). Otherwise, the difference \( D^* - D_r > 0 \) can be interpreted as the degree of voluntary disclosure for the firm.

\(^{20}\)Technically, we have that \( \frac{d\phi^*}{dI_r} = \frac{\partial\phi^*}{\partial I_r} + \frac{\partial\phi^*}{\partial D^*} \frac{dD^*}{dI_r} \), where \( \frac{dD^*}{dI_r} < 0 \). Since the direct and indirect effects exactly offset each other \( \left( \frac{\partial\phi^*}{\partial I_r} = -\frac{\partial\phi^*}{\partial D^*} \frac{dD^*}{dI_r} \right) \), we have that \( \frac{d\phi^*}{dI_r} = 0 \). While variants of the model may imply that \( \frac{d\phi^*}{dI_r} > 0 \), the basic insight nevertheless remains: improvements in a raider’s ability to obtain information allow the firm to reduce its expenses associated with disclosure.
Consider therefore social welfare in this context, given by

\[
W(D) = \left[1 - (1 - \phi^*_b(D))(1 - \phi^*_r(D))\right] \Pi - x^*_b(D) - ke^{-D} x^*_r(D) - \frac{1}{t} D,
\]

where we assume that a regulator can impose minimum disclosure standards but does not otherwise intervene in internal or external governance activities.\(^{21}\) Maximization with respect to a minimum level of disclosure yields the first order condition

\[
\frac{dW}{dD} = \left(\frac{\partial \phi^*_b}{\partial D}(1 - \phi^*_r) + \frac{\partial \phi^*_r}{\partial D}(1 - \phi^*_b)\right) \Pi - \frac{\partial x^*_b}{\partial D} - ke^{-D} \frac{\partial x^*_r}{\partial D} + ke^{-D} x^*_r - \frac{1}{t} = 0,
\]

which defines the socially optimal level of disclosure \(D\). We can use this expression to compare the regulator’s optimal choice of \(D\) to the firm’s (profit-maximizing) disclosure policy \(D^*\). Evaluating Equation (11) at \(D^*\) shows that

\[
\left. \frac{dW}{dD} \right|_{D^*} = \frac{\Pi}{(t + 1)(\gamma \alpha \Pi - c)t} \left( t \alpha + (1 - \alpha) \left( t \ln \left( \frac{(\gamma \alpha \Pi - c) t}{(\gamma (1 - \alpha) \Pi + c) I} \right) - I \right) \right),
\]

which is greater than zero given the assumptions on \(\alpha\) and \(t\), implying that the firm’s equilibrium disclosure policy falls short of the disclosure standard preferred by a regulator attempting to maximize social welfare. This shortfall suggests a rationale for regulating and enforcing minimal disclosure standards because, left to their own devices, firms will choose to provide too little information to the external market and instead rely more heavily on internal governance mechanisms. Moreover, this result continues to hold even in the absence of an agency conflict between shareholders and directors (i.e., for \(\gamma = 1\) and \(c = 0\)). Instead, it is a consequence of the board’s ability to internally restructure and appropriate the gains from governance actions in case it discovers poorly performing management, and thus failing to internalize the full social benefit that accrues when an outsider conducts the restructuring.

\(^{21}\)We note that, from a public policy perspective, disclosure may have additional benefits not captured by our model where disclosure merely facilitates external governance. To the extent that such benefits are not internalized by the firm, we expect that including additional roles for disclosure should not affect the qualitative nature of our results.
5.2 Competition in the Market for Corporate Control

We have so far assumed that corporate disclosure benefits only a single raider, who devotes resources to discover inefficiencies within the firm and takes it over if any are found. In practice, however, it is likely that a certain degree of competition exists in the market for corporate control, with more than one interested party vying to purchase an underperforming firm. Hence, such competition in the takeover market might have important consequences for social welfare since it affects not only the incentives each raider has to devote resources to information discovery, but also the firm’s decision of how much information to disclose to the external market.\(^\text{22}\) Moreover, explicitly modeling such competition allows us to disentangle the effect of changes in the competitiveness of takeover markets from other institutional factors that can increase the board’s bargaining power, \(\alpha\). To study these issues, we briefly extend the model to a setting with \(N\) potential raiders.

Specifically, assume that each raider \(i\) exerts effort \(x_i\) in screening the firm, discovering managerial inefficiencies with probability \(\phi_i = 1 - e^{-fx_i}\). To introduce competition in the market for corporate control into our model, we assume that if two or more raiders are successful in discovering the quality of management, a bidding war for the firm ensues so that the board captures the entire restructuring benefit \(\Pi\). If only one raider is successful, however, she bids to acquire the firm as before and splits the restructuring gain with the board receiving \((1 - \alpha)\Pi\). For tractability, we abstract here from any agency problem between the board and shareholders by assuming that \(\gamma = 1\) and \(c = 0\).

The payoff to the board can now be expressed as

\[
\pi_b = \phi_b \gamma \Pi + (1 - \phi_b) \sum_{k=1}^{N} \binom{N}{k} \phi_i^k (1 - \phi_i)^{N-k} \alpha_k \Pi - x_b - \frac{1}{l} D, \tag{13}
\]

where \(\alpha_k = \alpha\) for \(k = 1\), and is equal to 1 otherwise. Equation (13) reflects the fact that the board only splits the benefit \(\Pi\) with a raider when only one raider has successfully identified the quality.

\(^{22}\)To the extent that the disclosure of corporate information serves also to enlighten small investors, disclosure may make it more difficult for a raider to benefit from its acquisition of the target firm. While an analysis of this issue is beyond the scope of this paper, the effects should be similar to those of assuming that there are multiple raiders whose effort may erode each other’s return.
of management. For raider \(i\), we have

\[
\pi_i = (1 - \phi_b) \phi_i (1 - \phi_i)^{N-1} (1 - \alpha) \Pi - ke^{-D} x_i
\]  

(14)

We relegate the formal derivation of the equilibrium \((\phi^*_b, \phi^*_i, \text{and } D^*)\) to the appendix. Here, we investigate the consequences of competition in the market for corporate control by analyzing the effects of an increase in the number of raiders. We find that a more competitive takeover market leads to a decrease in the level of disclosure by the firm: \(\frac{dD^*}{dN} < 0\).\(^{23}\) This finding contrasts with the effect of an increase in \(\alpha\) which, by raising the return to the board of allowing a takeover, increases the incentives to disclose information, i.e., \(\frac{dD^*}{d\alpha} > 0\). Instead, greater competition among raiders allows the board to reduce the firm’s disclosure because there are more potential bidders who are capable of providing external governance.

A second important effect concerns the aggregate amount of information produced in equilibrium, denoted by \(\Phi^* = 1 - (1 - \phi^*_b) (1 - \phi^*_i)^N\). This measure is decreasing in \(N\) (i.e., \(\frac{d\Phi^*}{dN} < 0\)) for the simple reason that, with more active raiders, each raider is less likely to reap the benefit of its investment in screening the target firm, and hence reduces her screening effort \(\frac{dx^*_i}{dN} < 0\), which implies that \(\frac{d\phi^*_i}{dN} < 0\). Moreover, each raider’s reduction in screening is sufficiently large to outweigh the increase in the number of potential bidders so that in aggregate the total amount of information produced decreases. But less external scrutiny further reinforces the effect of competition on disclosure: since raiders reduce their information gathering activities as \(N\) increases, the board has less of an incentive to incur the cost of disseminating information.

6 Discussion

Recent regulation addressing perceived shortcomings in corporate governance has put a heavy emphasis on disclosure, improvements in firm transparency, and outsiders’ access to information, as well as on board and CEO accountability. In this paper, we argue that firms’ own governance policies may create incentives for corporate disclosure as a way of shifting the balance between using internal or external mechanisms for corporate oversight. We show that the mix between

\(^{23}\)This holds for \(N\) sufficiently large. For small values of \(N\), so that the market is not very competitive, a marginal increase in \(N\) can sometimes lead to greater disclosure. See the appendix for details.
internal monitoring and external takeover activity is therefore at least partly a function of the board’s governance choices.

We also investigate how technological progress, in the guise of advances in disseminating and processing information, affect internal and external modes of corporate governance and change their relative effectiveness. We show that technological advances improve the overall production of firm-specific information and aid overall governance. They can therefore be seen as partial resolutions to existing agency problems between the board and shareholders of the firm. While advances in dissemination technology enhance the effectiveness of the market for corporate control to the detriment of internal governance, advances in information processing have the exact opposite effect on the relative efficacy of board actions and external governance. The driving force behind these results is the differential effect of technological progress on disclosure policy: better dissemination technology stimulates corporate disclosure while better information processing leads to a substitution away from disclosure and external governance and toward more board oversight.

Our results hold important empirical implications. Consistent with the findings in Bushee et al. (2003) that high-tech firms with presumably more advanced information technology disclose more information more widely, we find that better dissemination technology increases corporate disclosure. In the same vein, we would expect such firms to attract more scrutiny from potential acquirers and face more takeover activity. At the same time, internal governance actions should be rarer for such firms. Recent trends in takeover activity seem to be broadly in line with our predictions as the recovery in M&A is mainly driven by high-tech acquisitions. Similarly, data reported by Lucier et al. (2003, 2004) indicate that CEO turnover has been lower in the information-technology sector than the national mean in recent years.

Furthermore, our analysis predicts that technological improvements affecting internal information production such as financial reporting and performance-measurement systems should strengthen voluntary disclosure standards. Hence, using data on firms’ compliance with Section 404 of the Sarbanes-Oxley Act and, more importantly, the reported changes to their financial reporting systems, investments, upgrades, etc., one could test how the new regulation has affected disclosure policies. Similarly, we would expect monitoring and CEO turnover to increase in the quality of such systems, a prediction that could be tested by exploiting the structural break created by the recent regulatory changes. By the same token, takeover activity aimed at restructuring underper-
forming firms should decrease the more firms comply with the upgrading of internal performance measurement and reporting systems.

An interesting avenue for research would be to explicitly study how governance considerations provide incentives for firms to develop and adopt information technology. One could then analyze the tradeoff between such development and other incentive mechanisms for achieving greater congruence of interests between those in charge of running the firm (i.e., directors, management) and those who own it (shareholders). We leave this issue for future research.
Appendix A: Proofs

Proof of Proposition 1. Given the disclosure policy $D$, maximization of the board’s and raider’s respective payoff functions with respect to monitoring and screening efforts yields the following FOCs:

- $\frac{\partial \pi_b}{\partial x_b} = I e^{-Ix_b} \gamma (1-\alpha) + I e^{-I(x_b+x_r)} (\gamma \alpha \Pi - c) + I e^{-Ix_b} c - 1 = 0$
- $\frac{\partial \pi_r}{\partial x_r} = \Pi e^{-I(x_b+x_r)} (1-\alpha) - ke^{-D} = 0$

We can now solve the preceding system of equations for optimal efforts $x_b^*$ and $x_r^*$ and then substitute back into the monitoring and screening probabilities to obtain

- $x_b^* = - \ln \left( \frac{-I e^{D} + \Pi e^{D} + \gamma \alpha \Pi c}{I} \right) + D \Rightarrow \phi_b^* (D) = 1 - \frac{\Pi (1-\alpha) - ke^{-D} (\gamma \alpha \Pi - c)}{\Pi (1-\alpha) (\gamma (1-\alpha) \Pi + c)}$
- $x_r^* = \ln \left( \frac{-I e^{D} + \Pi e^{D} + \gamma \alpha \Pi c}{k \Pi} \right) \Rightarrow \phi_r^* (D) = 1 - \frac{\Pi (1-\alpha) k}{\Pi (1-\alpha) \Pi e^{D} - (\gamma \alpha \Pi - c) \Pi}$

In order for $\phi^*_r$ to be positive, we need

- $\Pi (e^D (1-\alpha) - k \gamma) > 0 \Leftrightarrow e^D > \frac{k \gamma}{(1-\alpha)} \Leftrightarrow D > \ln \left( \frac{k \gamma}{(1-\alpha)} \right)$

If this is not satisfied, so that $D < \ln \left( \frac{k \gamma}{(1-\alpha)} \right)$, then $\phi^*_r \leq 0$, implying that the optimum must have the raider exerting zero effort. Given $x_r = 0$, maximization of the board’s objective function $\pi_b = \phi_b \Pi - x_b - \frac{1}{t^D} D$ yields the solution $x_b = -\frac{1}{t} \ln \frac{1}{\Pi}$, implying $\phi_b^* = 1 - \frac{1}{\Pi}$, as desired.  

Proof of Proposition 2. We prove the proposition in a series of steps.

Lemma 1 There is a value of $\alpha < 1$, $\alpha'$, such that $x^*_b = 0$ for $\alpha \geq \alpha'$.

Proof: We start by showing that the level of disclosure, $D$, must be bounded above in equilibrium. To see this, consider board profits, which in equilibrium must be non-negative.

- $\pi_b = \phi_b \gamma \Pi + (1-\phi_b) \phi_r (\gamma \alpha \Pi - c) - x_b - \frac{1}{t^D} D \geq 0$

Since $\phi_b$, $\phi_r$, $\alpha \leq 1$, the maximum revenue the board can obtain is bounded above by $\Pi$. Therefore, a minimal constraint for profits to be positive is that $\gamma \Pi - \frac{1}{t^D} D \geq 0 \Leftrightarrow D \leq t^D \Pi$. This provides an upper bound on what $D$ can be in equilibrium. Assume therefore that $D = t^D \Pi$, and consider now the raider’s profit,

- $\pi_r = (1-\phi_b) \phi_r (1-\alpha) \Pi - ke^{-D} x_r = (1-\phi_b) \phi_r (1-\alpha) \Pi - ke^{-t^D \Pi} x_r$

The FOC for profit maximization wrt to $x_r$ is

- $\frac{\partial \pi_r}{\partial x_r} = (1-\phi_b) \frac{\partial \phi_r}{\partial x_r} (1-\alpha) \Pi - ke^{-t^D \Pi}$
- $= (1-\phi_b) (1-\alpha) \Pi e^{-Ix_r} - ke^{-t^D \Pi} = 0$

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Again, since $\phi_b \leq 1$, this is bounded above by $(1 - \alpha)\Pi e^{-lx_r} - ke^{-lx_r}$. However, the term $\frac{\partial \phi_b}{\partial x_r} = Ie^{-lx_r}$ is itself bounded above by $I$ for $x_r \geq 0$. Therefore, for a large enough $\alpha$, the FOC cannot be satisfied. The optimal solution is therefore for $x_r^* = 0$ for large enough $\alpha$. □

Assuming that $\alpha$ is small enough so that the raider does indeed monitor, we can now find $D^*$ by substituting the optimal monitoring and screening probabilities in Proposition 1 back into the board’s objective function in Equation (1): $\pi_b(x_b^*, x_r^*)$. The FOC is then

$$\frac{\partial \pi_b(x_b^*, x_r^*)}{\partial D} = \frac{\Pi(1 - \alpha) - (I + t)e^{-Dk(\gamma\alpha\Pi - c)} - \Pi(1 - \alpha)}{tI(ke^{-D}(\gamma\alpha\Pi - c) - \Pi(1 - \alpha))} = 0$$

Solving the FOC for $D$ yields $D^* = \ln\left(\frac{(k(I + t\alpha\Pi - c))}{\Pi(1 - \alpha)}\right)$. For the monitoring and screening probabilities to be well-defined, $\phi^*_b, \phi^*_r \in [0, 1]$, we require that $D^* \geq \ln\left(\frac{k\gamma}{(1 - \alpha)}\right)$, or $\ln\left(\frac{(k + t\alpha\Pi - c)}{\Pi(1 - \alpha)}\right) - \ln\left(\frac{t\gamma}{(1 - \alpha)}\right) \geq 0$ which holds in equilibrium for $t$ large enough. Similarly, the SOC for a maximum, $\frac{\partial^2 \pi_b(x_b^*, x_r^*)}{\partial D^2} = \frac{\Pi k(e^{-D})(\alpha - 1)(\alpha\Pi - c)}{tI(ke^{-D}(\gamma\alpha\Pi - c) - \Pi(1 - \alpha))} < 0$, requires $\alpha\gamma - c > 0$, which holds by assumption.

This solution, however, assumes that $x_b, x_r$, and $D$ are positive in equilibrium. To check the validity of the solution, we compare this solution to that obtained assuming the board chooses a disclosure policy of $D = 0$. As a preliminary step, we have the following result:

**Lemma 2** There is a value of $\alpha > 0$, $\alpha''$, such that $x_r^* = 0$ for $\alpha \leq \alpha''$.

**Proof:** From the solutions for optimal monitoring and screening, we have

$$\phi^*_b = 1 - \frac{\Pi(1 - \alpha) - ke^{-D}(\gamma\alpha\Pi - c)}{t\Pi(1 - \alpha)(\gamma(1 - \alpha)\Pi + c)}$$

$$\phi^*_r = 1 - \frac{(\gamma(1 - \alpha)\Pi + c)k}{(1 - \alpha)\Pi e^{-D}(\gamma\alpha\Pi - c)k}$$

As $\alpha \to 0$, these expressions converge to $\phi^*_b = 1 - \frac{\Pi + ke^{-D}\Pi}{t\Pi(\gamma\Pi + c)}$ and $\phi^*_r = 1 - \frac{(\gamma\Pi + c)k}{t\Pi e^{-D}(\gamma\alpha\Pi - c)}$. Now consider the optimal choice of $D$, obtained above

$$D^* = \ln\left(\frac{k(\alpha\Pi - c)}{\Pi(1 - \alpha)}\right)$$

$$D^* = \ln\left(\frac{-k(\alpha\Pi - c)}{\Pi}\right)$$

As $\alpha \to 0$, the term inside the logarithm converges to $\frac{-k(\alpha\Pi - c)}{\Pi}$, so that $D^*$ is not well-defined, and consequently neither is $x_r^*$. Therefore, there is a minimum value of $\alpha, \alpha'$, such that $x_r > 0$ only if $\alpha > \alpha'$. □

We also need to ascertain that the board itself always finds it optimal to monitor, irrespective of whether the raider screens.

**Lemma 3** If $I > 1$, then in equilibrium $x_r > 0$.

**Proof:** We proceed as in the proof of Lemma 1, by deriving an upper bound for $D$, but vary the approach slightly by considering only those choices that are consistent with profit maximization.
Consider therefore the raider’s problem,

$$\max_{x_r} \pi_r = (1 - \phi_b) \phi_r (1 - \alpha) \Pi - ke^{-D} x_r$$

The raider’s incentives are maximized by imposing the out-of-equilibrium constraint that $\phi_b = \alpha = 0$. We can then solve to obtain

$$x_r^{\text{max}} = \frac{1}{l} \ln \left( \frac{k}{\Pi} \right) D \Rightarrow \phi_r^{\text{max}} = 1 - \frac{k}{\Pi} e^{-D}$$

Now consider the board’s problem,

$$\pi_b(x_b, x_r^{\text{max}}) = \phi_b \Pi + (1 - \phi_b) \phi_r^{\text{max}} \alpha \Pi - x_b - \frac{1}{t} D$$

and maximize this with respect to $D$:

$$\frac{\partial \pi_b}{\partial D} = (1 - \phi_b) \frac{\partial \phi_r^{\text{max}}}{\partial D} \alpha \Pi - \frac{1}{t} = 0$$

Using the definition of $\phi_r^{\text{max}}$ and solving for $D$ obtains

$$D^{\text{max}}(\phi_b) = \ln \left( \frac{(1 - \phi_b) k \alpha t}{I} \right)$$

Evaluated at $\phi_b = 0$, $D_0^{\text{max}} = D^{\text{max}}(0) = \ln \left( \frac{k \alpha t}{I} \right)$, this expression determines the maximum amount of disclosure the board would want to do, assuming that the incentives for effort provision of the raider are maximized.

Now consider whether, given this maximal level of effort provision by the raider (and hence a maximal incentive to free-ride on the raider’s screening), the board will find it optimal to nevertheless monitor. In other words, consider the problem of finding the optimal level of effort for the board, assuming it will disclose as much as $D_0^{\text{max}}$:

$$\max_{x_b} \pi_b(x_b, x_r^{\text{max}}) = \phi_b \Pi + (1 - \phi_b) \phi_r^{\text{max}} \alpha \Pi - x_b - \frac{1}{t} D_0^{\text{max}}$$

The FOC is

$$\frac{\partial \pi_b}{\partial x_b} = \frac{\partial \phi_b}{\partial x_b} \Pi (1 - \phi_r^{\text{max}} \alpha) - 1 = 0$$

Letting $\alpha \to 1$, and solving, we obtain $x_b = -\frac{1}{l} \ln \left( \frac{t}{I} \right)$, which will be positive as long as $I > 1$. □

The final step is to show that for $\alpha \in [\alpha, \bar{\alpha}]$, with $\alpha < \bar{\alpha}$, $x_b, x_r, D > 0$. For this, we compare the board’s proposed equilibrium profits $\pi^*_b = \pi_b(x^*_b, x^*_r)$ with those obtained if instead $x_r = 0$, which we denote as $\tilde{\pi}_b = \pi_b(\tilde{x}_b, 0)$, where $\tilde{x}_b = \arg \max_{x_b} [\phi_b \Pi - x_b]$. This difference can be written as

$$\pi^*_b - \tilde{\pi}_b = \frac{1}{I} \ln \left( \frac{t \Pi}{(t + I)(\gamma \Pi (1 - \alpha) + c)} \right) + \frac{1}{t} \ln \left( \frac{\Pi (1 - \alpha)}{k (t + I) (\gamma \alpha \Pi - c)} \right)$$

It is straightforward now to show that there is always a value $t > 0$ such that $\pi_b(x^*_b, x^*_r) - \pi_b(\tilde{x}_b, 0) > 0$ for all $t > \tilde{t}$ (for sufficiently small $c$, which is a necessary condition for the board to be willing to participate). Therefore, for $t$ sufficiently large there is an open set $(\alpha, \bar{\alpha})$ such that $x_b, x_r, D > 0$ in equilibrium, with the optimal values as described above, thus demonstrating the proposition. □
Proof of Proposition 3. Substituting $\phi_b = 1 - e^{-I_b x_b}$ and $\phi_r = 1 - e^{I_r x_r}$ into the payoff equations (1) and (2) that we maximize with respect to monitoring and screening effort we obtain the following FOCs for a given disclosure policy $D$:

$$\frac{\partial \pi_b}{\partial x_b} = I_b e^{-I_b x_b} \Pi - I_b e^{-I_b x_b} \alpha \Pi + I_b e^{-I_b x_b} - I_r x_r \alpha \Pi - 1 = 0$$

$$\frac{\partial \pi_r}{\partial x_r} = I_r \Pi \exp (-I_b x_b - I_r x_r) - I_r \Pi \exp (-I_b x_b - I_r x_r) \alpha - ke^{-D} = 0$$

As before, we solve the preceding system of equations for optimal efforts $x_b^*$ and $x_r^*$:

$$x_b^* = -\ln \left( \frac{-I_r \Pi e^{D} + I_r \Pi e^{D} + I_b \Pi \alpha k - I_b k e^{D} }{I_b} \right) + D$$

$$x_r^* = \frac{\ln -I_r \Pi e^{D} + I_r \Pi e^{D} + I_b \Pi \alpha k - I_b k e^{D} }{I_r}$$

We can now substitute these back into the monitoring and screening probabilities to get

$$\phi_b^* (D) = \frac{k I_b e^{-D} (\alpha \Pi - c) - (1 - \alpha) \Pi I_r (1 - I_b - \Pi I_b \gamma (1 - \alpha))}{I_r I_b (1 - \alpha) (\gamma \Pi (1 - \alpha) + c)}$$

$$\phi_r^* (D) = \frac{\Pi (e^{D} I_b (1 - \alpha) - k I_b)}{\Pi e^{D} I_r (1 - \alpha) - k I_b (\alpha \Pi - c)}$$

To find $D^*$, substitute the optimal monitoring and screening probabilities above back into the board’s objective function in Equation (1) to find $\pi_b(x_b^*, x_r^*)$. The FOC is then

$$\frac{\partial \pi_b (x_b^*, x_r^*)}{\partial D} = I_r \Pi (1 - \alpha) - (I_b + t) k e^{-D} (\gamma \Pi - c)$$

$$t (I_b k e^{-D} (\gamma \Pi - c) - I_r \Pi (1 - \alpha)) = 0$$

that we solve for $D^* = \ln \left( \frac{k (t + I_b) (\gamma \Pi - c)}{I_r \Pi (1 - \alpha)} \right)$. For the monitoring and screening probabilities to be well-defined, i.e., $\phi_b^*, \phi_r^* \in [0, 1]$, we require that $D^* \geq \ln \left( \frac{k I_b}{I_r \Pi (1 - \alpha)} \right)$, or that $\ln \left( \frac{(t + I_b) (\gamma \Pi - c)}{I_r \Pi (1 - \alpha)} \right) > 0 \iff (t + I_b) (\gamma \Pi - c) > I_r \Pi$, which holds in equilibrium for large $t$. Similarly, the SOC for a maximum, $\frac{\partial^2 \pi_b (x_b^*, x_r^*)}{\partial D^2} = -\frac{(\alpha \Pi - c) (\alpha - 1) (e^{D}) k \Pi I_r}{(I_b k e^{-D} (\gamma \Pi - c) - I_r \Pi (1 - \alpha))^2} < 0$ since $\alpha < 1$. As before, this solution is only valid if both the board and the raider exert effort, which by similar arguments as used above will be true for $\alpha \in \left[ \frac{\alpha}{\alpha}, \frac{\alpha}{\alpha} \right]$, where $0 < \alpha < \alpha < 1$, when $t$ is sufficiently large. To show that there are value of $t$ such that $\alpha < \alpha$, consider the case where $I_b = I + \epsilon_b$ and $I_r = I + \epsilon_r$. As $\epsilon_b, \epsilon_r \to 0$, we are in the exact setting as above, so that we know that there is always an open set of values $\alpha$ for which $x_b, x_r$, and $D > 0$. □

Appendix B: The Case with $N$ Raiders

For the $N$ raider case, we focus on technological improvements that affect both the raiders and the board equally. As in the text, we have that $\phi_k = 1 - e^{I_k x_k}$, $k = b, i$. Maximizing the board’s and the raiders’ payoff functions, Equations (13) and (14), with respect to $x_b$ and $x_i$, respectively,
and imposing symmetry for all raiders (i.e., that \( x_i = x_j, i \neq j \)), yields the following solutions:

\[
x^*_i(D) = \frac{\ln \left( \frac{1 - \alpha}{k} \right) + D - N \ln \left( \frac{e^{D(1-\alpha)} + k(N(1-\alpha) - 1)}{kN(1-\alpha)} \right)}{I}
\]

\[
x^*_i(D) = \frac{1}{I} \ln \left( \frac{e^{D(1-\alpha)} + k(N(1-\alpha) - 1)}{kN(1-\alpha)} \right)
\]

These solutions yield monitoring and screening probabilities for a given level of disclosure \( D \) as:

\[
\phi^*_b(D) = 1 - \frac{k e^{D(N-1)}}{(1-\alpha)I} \left( \frac{1 - \alpha + ke^{-D}(N(1-\alpha) - 1)}{kN} \right)^N
\]

\[
\phi^*_i(D) = 1 - \frac{k N(1-\alpha)}{(1-\alpha)(e^D + kN) - k}
\]

for \( D > \ln \left( \frac{k}{1-\alpha} \right) \). Otherwise, the raiders exert no effort (\( x^*_i = 0 \)), and \( \phi^*_b \) is as defined in Proposition 1. Note that, as \( N \) increases, for \( D > \ln \left( \frac{k}{1-\alpha} \right) \) we have

\[
\frac{\partial \phi^*_b(D)}{\partial N} = \frac{k (1-\alpha)(k - (1-\alpha)e^D)}{(k (1 - N (1 - \alpha)) - e^D (1 - \alpha))^2} < 0
\]

As before, we calculate the optimal level of disclosure from the FOC for board profit maximization:

\[
\frac{\partial \pi_b}{\partial D} (x^*_b, x^*_i, D) = \frac{(ke^{-D}t(N+a-2N+1)+(1-\alpha)(N+1)\alpha)}{(1-\alpha)k e^{-D}t (N+a-1-\alpha)} \frac{1}{D} = 0,
\]

as

\[
D^* = \ln \left( \frac{k ((t+I) \alpha ((2-\alpha)N-1) - I(N-1))}{(1-\alpha)(I(1-\alpha) + t\alpha(N-1))} \right)
\]

Note that we require again that \( t \) be sufficiently large for the equilibrium to be well defined. The equilibrium monitoring and screening probabilities now become

\[
\phi^*_b = 1 - \frac{(at(N-1) + (1-\alpha)I)^{1-N}}{(1-\alpha)(1-t\alpha(N-1) - I(N-1))} \frac{N^N \alpha^N t^N}{I!}
\]

\[
\phi^*_i = 1 - \frac{t\alpha(N-1) + (1-\alpha)I}{Nat}
\]

Comparative statics of \( D^* \) with respect to \( N \) yields

\[
\frac{dD^*}{dN} = \frac{(1-\alpha)(a(t+I) - I)^2}{(t\alpha(N-1) + (1-\alpha)I)(at(N\alpha-2N+1) - I(1-\alpha)(N\alpha + 1 - N))},
\]

which is negative when \( N \) is large, given \( t \) sufficiently large that disclosure is optimal. Similarly, we find that, in equilibrium, each raider screens less as competition in the market for corporate control increases:

\[
\frac{d\phi^*_i}{dN} = \frac{\partial}{\partial N} (1 - e^{-\rho_i}) = -\frac{(a(t+I) - I)}{N^2 t\alpha} < 0,
\]

for \( t > I \left( \frac{1-\alpha}{\alpha} \right) \).

For the aggregate amount of information produced in equilibrium, \( \Phi^* = 1 - (1 - \phi^*_b)(1 - \phi^*_i)^N = \)
1 - \frac{1}{\Pi((t+1)\alpha(2-\alpha)N-1-I(N-1))}, we find

\frac{d\Phi^*}{dN} = \frac{-(1-\alpha)(t+I-I)^2}{\Pi(\alpha N (\alpha^2 - 2) + I(1-\alpha)(N (1-\alpha) - I)^2} < 0,

as desired.
References


