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Abstract

We ask when and how a diverse board can benefit shareholders. Board diversity may be value-increasing even if some directors have agendas that are not perfectly aligned with shareholders' interests. Diversity commits the board to a high information standard because directors with opposing agendas are deadlocked unless they have persuasive information in support of the optimal course of action. Since deadlock is costly, diversity strengthens directors' incentives to gather information ex ante, which raises expected firm value. Diversity is more likely desirable if the firm's information environment is poor and if directors' opposing agendas are accompanied by sufficiently strong incentives for value maximization. However, if directors cannot credibly communicate their information, a homogeneous board dominates a diverse board.

JEL Classification: G34

Keywords: Boards of directors, diversity, Monitoring, deadlock

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When does board diversity benefit shareholders?

Strategic deadlock as a commitment to monitor*

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August 11, 2020

Abstract

We ask when and how a diverse board can benefit shareholders. Board diversity may be value-increasing even if some directors have agendas that are not perfectly aligned with shareholders interests. Diversity commits the board to a high information standard because directors with opposing agendas are deadlocked unless they have persuasive information in support of the optimal course of action. Since deadlock is costly, diversity strengthens directors incentives to gather information ex ante, which raises expected firm value. Diversity is more likely desirable if the firm's information environment is poor and if directors' opposing agendas are accompanied by sufficiently strong incentives for value maximization. However, if directors cannot credibly communicate their information, a homogeneous board dominates a diverse board.

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1 Introduction

The question what makes for an effective board continues to be the subject of intense debate. Recently, much attention has been paid to a specific board attribute: diversity. Policy makers and market participants in different countries promote diversity on boards through various measures, such as mandatory quotas or recommendations in corporate governance codes. At the same time, a growing body of research aims to identify the costs and benefits of board diversity. On the bright side, a greater range of skills, perspectives and experiences may result in more efficient decision making. But diversity may also create conflicts, lead to communication breakdowns, or result in deadlock.[1] In this paper, we develop a new theory of board diversity. Our main finding is that a more diverse board can be more effective in serving the interests of shareholders.[2]

Our model is based on two key features. The first is that the board performs two functions: directors gather information about the firm's optimal strategy (i.e., the strategy that maximizes firm value), an activity we call monitoring. Subsequently, directors collectively choose a strategy. The board's strategy choice in our model should be interpreted broadly. For example, it may refer to any fundamental operating or financial decision that the board needs to review and approve or to the selection of a new CEO. The second feature our model is based on is that a director's payoff consists of both firm value and a private benefit that reflects her personal strategy preference. Her payoff therefore has both a "common value" and a "private value" component. We refer to a director's personal preferences as her "bias." The board can be diverse or homogeneous. Its composition determines the correlation of directors' biases. On a diverse board, directors have opposing biases whereas they share the same bias on a homogeneous board.

In practice, board members differ in many characteristics, including educational background, industry experience, gender, insider status, or ethnic background. In our model, diversity is best interpreted as directors having distinct personal or professional agendas. For example, a director may push a "green" agenda because she has an intrinsic preference for sustainability. Alternatively, a director with union ties may be biased by these outside connections. Even among directors who view themselves as first and foremost representing the firm's shareholders, there may be diverse

[1] See Ferreira (2010) for a detailed overview of different costs and benefits of diversity identified in the academic literature.

[2] We do not mean to suggest that the potential broader benefits or costs of board diversity to society as a whole are unimportant. But understanding the consequences of diversity for shareholders is also important, not least because it sheds light on the role, if any, for regulation to foster diversity.

biases: Bolton et al. (2019) use proxy voting records to document heterogeneous preferences with regards to social, environmental, and governance issues among institutional investors.

We propose that diversity in the above sense can raise expected firm value because it strengthens directors' incentives to gather information. The argument is as follows. While directors always agree about the optimal strategy that maximizes expected firm value, opposing personal biases on a diverse board may lead to disagreement and deadlock. A deadlocked board is costly (for directors and for shareholders) because it fails to make use of all available information. Directors are more likely to disregard their biases and to converge on maximising firm value if the optimal strategy is supported by strong, persuasive information. Intuitively, greater certainty about the optimal "common value" strategy makes its implementation more profitable. Hence, more precise "objective" information discourages the pursuit of private benefits by raising directors' opportunity costs of voting along their biases at the expense of firm value. In contrast, greater uncertainty about the optimal course of action makes it more attractive for each director to follow her bias. In this environment, directors can foster consensus and prevent deadlock ex post by gathering information about the optimal strategy ex ante. The threat of deadlock on a diverse board can thus raise equilibrium monitoring efforts and firm value.

A diverse board may even dominate an unbiased board whose members have no personal biases and only seek to maximize firm value. The reason is that an unbiased board may face a commitment problem. When choosing a strategy ex post, unbiased directors always find it optimal to use *all* available information. However, from an ex ante perspective, it may be beneficial to credibly commit to a high information standard whereby the board responds only to very precise information (which comes with successful monitoring) but not to noisy yet still valuable information (which comes with monitoring failure). While a high information standard sacrifices firm value ex post, such a commitment can strengthen ex ante monitoring incentives and thus raise expected firm value. Even if the gains of additional effort outweigh the loss from ignoring noisy information ex post, unbiased directors cannot credibly commit to a high information standard. Conversely, board diversity can serve as a commitment device to respond only to very precise information. Due to their personal biases, directors only react to strong information collected through monitoring and are deadlocked otherwise. We characterize conditions under which expected firm value with a biased, diverse board is greater than with an unbiased board.

Our analysis has several implications for the design of governance policies and of decision-making rules on boards. First, deadlock is not necessarily unintended or undesirable, but may instead be a desired outcome. A large legal literature studies how corporations can resolve deadlock. Our findings suggest that such resolution mechanisms may be undesirable and that firms may benefit from the possibility of "strategic deadlock." Second, our analysis adds nuance to the literature on whether firms should maximize shareholder value or stakeholder welfare.[3] The literature on the appropriate objective function for firms views deadlock as a reason why companies should maximize shareholder value rather than stakeholder welfare (Tirole 2005). According to this argument, the maximization of stakeholder welfare requires the division of corporate control among different constituents which may be inefficient because the parties cannot converge on a joint decision. Taking a dynamic perspective, our analysis suggests that (the threat of) deadlock may facilitate decision making in the interest of shareholders. We identify conditions under which, perhaps counterintuitively, appointing directors who represent different stakeholders may benefit rather than harm shareholders.

Extant theoretical research on commitment problems in corporate governance focuses on the principal-agent relationship between monitors (e.g., the board of directors or a large shareholder) and management. Almazan and Suarez (2003) and Burkart, Gromb, and Panunzi (1997) develop the idea that monitors may want to commit not to intervene with management. Managerial autonomy can be beneficial because it fosters managerial initiative. In these models, the manager's discretion increases her rents ex post, which in turn provides incentives ex ante to exert effort. In Burkart, Gromb, and Panunzi (1997), shareholders ensure managerial discretion through partial ownership dispersion, whereas Almazan and Suarez (2003) rely on weak boards to commit to a lenient firing policy. Adams and Ferreira (2007) argue that a "friendly board" allows shareholders to commit to monitor the CEO with low intensity. This commitment may be optimal because it encourages the CEO to share information, which improves the quality of the board's advice. In contrast to this line of research, we focus on the inner workings of the board as a team, rather than on its relationship with management, and examine how directors can collectively commit to a stringent decision rule that maximizes expected firm value. We propose that diversity can allow the board to commit to ex post conservatism and thus raise directors' incentives to gather information ex ante.

Recent work on boards of directors by Donaldson, Malenko, and Piacentino (2019) is closely

[3]Recently, the Business Roundtable in the U.S. announced a fundamental policy change, declaring that the purpose of a corporation is not only to serve shareholders but to create value for all stakeholders.

related to our analysis. They also argue that board diversity can lead to deadlock. In their model, deadlock is undesirable because it leads to CEO entrenchment. In contrast, we argue that (the threat of) deadlock can be desirable because it raises incentives to gather information.

Finally, our paper is related to the literature on committee decision making. Li (2001) models the tradeoff between a conservative ex post decision rule and ex ante incentives to gather information. However, he abstracts from the question of how such a standard can be implemented, which is a central feature of our analysis.

2 Setup

Consider a firm whose value Π depends on the activity of the board and on the underlying state of the firm. The state of the firm, $\theta \in \{0, 1\}$, is a priori unknown. Let α denote the probability that θ equals 1. Everyone holds the common prior belief that the two states are equally likely ($\alpha = 1/2$). Let $s \in \{0, 1\}$ denote the board's strategy choice. A strategy either fails, implying a firm value of zero ($\Pi = 0$), or it succeeds, implying a positive firm value ($\Pi = \pi > 0$). A strategy succeeds if it is adapted to the state ($s = \theta$) and fails otherwise ($s \neq \theta$):

		State of the firm	
		$\theta = 1$	$\theta = 0$
Board	s=1	π	0
decision	s=0	0	π

Firm value is thus maximized by aligning the strategy with the state. Under prior information, expected firm value is maximized with either strategy and equals $\frac{1}{2}\pi$.

The firm's board consists of two members, directors A and B.[4] Before the board selects a strategy, each director can devote resources to gathering information about the state, a task we label monitoring.[5] Let $m_d \in [0, 1]$ denote director d's monitoring effort, with $d = A, B$. With probability m_d, director d's effort is successful and she observes a perfect signal $\sigma_d^M \in \{0, 1\}$ about the state

[4] A small but growing theoretical literature studies decision making by multiple directors on corporate boards, rather than modeling the board as a single decision maker. See Chemmanur and Fedaseyeu (2018), Donaldson, Malenko, and Piacentino (2019), Harris and Raviv (2008), Levit and Malenko (2016), and Malenko (2014).

[5] A director's effort to collect information can encompass both monitoring and advising. For the sake of simplifying the exposition, we refer to the effort as monitoring.

of the firm: $\sigma_d^M = \theta$. Conditional on monitoring success, directors' signals are therefore perfectly correlated. With probability $1 - m_d$, monitoring fails and yields no information. For now, we assume that each director observes the other's signal. We relax this assumption in Section 6. Gathering information is privately costly for the directors. Monitoring costs can be interpreted as opportunity costs. For example, working on a board may limit a director's ability to generate income from other sources. Let $C_d(m_d) = \frac{1}{2}cm_d^2$ denote director d's cost function.

Independent of the monitoring outcome, the two directors always observe a noisy, informative signal $\sigma^F \in \{0, 1\}$ about the state of the firm. The signal is free and its precision γ is defined as $\text{Prob}(\sigma^F = i|\theta = i) = \gamma > \frac{1}{2}$ for all $i = 0, 1$. The board thus always learns something about the state, even if both directors' monitoring efforts fail. The free signal may reflect externally provided information (e.g., through the firm's stock price, by analysts, or from peer firms) or information that is serendipitously discovered internally.[6] Let $\alpha'(\sigma^F = i)$ denote the board's posterior belief that the state is i if the signal equals i.

The board faces one of two possible information sets, I, after the monitoring stage. Either it only has access to the free signal ($I = \sigma^F$) or monitoring success implies $I = (\sigma^F, \sigma^M)$.[7] Let $s^* \in \{0, 1\}$ denote the strategy that maximizes the expected firm value given all available information, $E[\Pi|I]$. Disregarding information is privately costly for directors. If the board does not implement strategy s^*, each director incurs a private cost of $D > 0$. For example, deviating from s^* may lead to a reputational loss that reduces a director's chances of being invited onto other boards.[8]

We allow directors to disagree over the strategy choice. Let $\beta_d \in \{0, 1\}$ indicate director d's strategy bias. She receives a private benefit B if and only if her preferred strategy is implemented ($s = \beta_d$). The direction of a director's bias, β_d, is common knowledge in all stages of the game.[9] The board can be homogeneous or diverse. Shareholders choose the type of board at the beginning of the game. Board type manifests itself in the degree of correlation between the directors' biases.

[6] The assumption that the board always receives information is not crucial. We could allow for a third state in which directors learn nothing and only have prior information.

[7] We drop the subscript d of the signal σ_d^M throughout the analysis except in Section 6, where the distinction between directors matters because directors cannot observe each other's signal.

[8] We take the reputational concern D as exogenously given. For a recent model that endogenizes directors' reputational concerns, see Levit and Malenko (2016).

[9] Our results are qualitatively unchanged if the direction of a director's bias is unknown to everyone, including the director herself. Specifically, our results also hold if a director only learns her bias after monitoring and before voting for a strategy.

Definition. If the directors have the same biases ($\beta_A = \beta_B$), the board is homogeneous. If the directors have opposite biases ($\beta_A \neq \beta_B$), the board is diverse.

Director d receives utility from shareholder value Π and from her private benefit B. Her payoff equals

$$U_d = \underbrace{\Pi - E[D \cdot 1_{\{s \neq s^*\}}]}_{\text{Common value}} + \underbrace{B \cdot 1_{\{s=\beta_d\}}}_{\text{Private value}} - \frac{1}{2} c m_d^2. \tag{1}$$

The payoff has both a "common value" component, which is shared by both directors, and a "private value" component. The utility from Π may reflect both monetary and non-monetary gains. On a homogeneous board, directors have the same objective function. On a diverse board, directors' objective functions differ because of the "private value" component.

After monitoring, the board votes on the strategy. Each director votes for the strategy that maximizes her expected payoff $E[U_d|I]$. If a strict majority (i.e., both directors) votes for strategy s, then s is implemented. If the directors disagree, the board is deadlocked. We assume that the decision is then taken according to the "random dictator" rule, whereby each director is allowed to choose her preferred strategy with probability $\frac{1}{2}$. This rule yields easily tractable solutions.[10] However, our results hold for a wider set of decision rules. For example, we could designate either strategy 0 or 1 as the status quo, which is implemented in case of deadlock.

Figure 1 presents the sequence of events in the model.

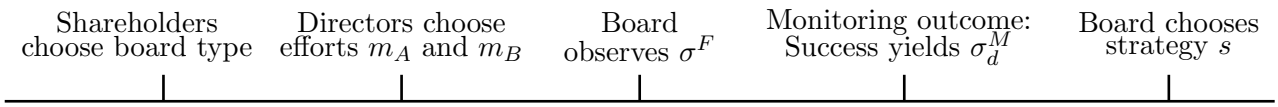

Figure 1: Timeline.

The analysis proceeds in three stages. In Section 3, we consider the benchmark case of unbiased directors and show that the board may raise shareholder value by committing to a high information standard whereby it ignores noisy information. Section 4 develops the central result of the paper: board diversity can serve as a commitment device that allows the board to credibly adopt a high information standard. A board with biased directors, whose personal preferences go in opposite directions, may therefore dominate a board with unbiased directors. Finally, in Sections 5 and 6 we

[10] See Malenko (2014) for a recent analysis of board behavior under the "random dictator" rule.

ask whether a board should be homogeneous or diverse. If we relax the assumption that directors can observe each other's monitoring information, a homogeneous board may dominate a diverse board because lack of trust limits information sharing when directors have opposing biases.

3 Benchmark Case: Unbiased Directors

3.1 Equilibrium Monitoring and Strategy Choice

We first characterize the board's behavior when directors are unbiased ($B = 0$). Without biases, directors choose the optimal strategy ex post given their information. Moreover, they choose their monitoring efforts to maximize expected firm value net of monitoring costs. The choice of board type is moot when directors are unbiased.

We solve the problem backwards. Unbiased directors are unanimous ex post in choosing the strategy s^* that maximizes expected firm value given all available information. There is no "private value" component and s^* maximizes not only $E[\Pi|I]$ but also $E[U_d|I]$. It is ex post efficient to choose the strategy that is closest to the expected state. That is, the optimal strategy corresponds to the state, which is more likely to occur. Neither director ever incurs the private cost D because the board always optimally responds to any information.

The board faces one of two possible information sets. If at least one director monitors successfully, the board learns the true state. Then the optimal strategy is $s^* = \sigma^M = \theta$, which implies that the firm's value is π for certain. Suppose instead that both directors' monitoring efforts fail. Then the board only observes the noisy signal σ^F before choosing a strategy. The board's posterior belief that the state equals the observed signal is $\gamma > \frac{1}{2}$. Hence, the optimal strategy is $s^* = \sigma^F$, which yields an expected firm value of $\gamma\pi$. The noisy signal is only decision-relevant if monitoring fails. Reducing uncertainty about the state θ by way of monitoring adds value: $\pi > \gamma\pi$. Moreover, the free signal is valuable since $\gamma\pi > \frac{1}{2}\pi$, where $\frac{1}{2}\pi$ is the expected firm value if the board acts only on prior information.

Lemma 1. *It is ex post optimal for the board to use all available information. If at least one director monitors successfully, then $s^* = \sigma^M$. If both directors' monitoring efforts fail, then $s^* = \sigma^F$.*

Directors choose their monitoring efforts ex ante non-cooperatively and simultaneously. Let (m_A^*, m_B^*) denote the Nash equilibrium efforts. Given her expectation of the other director's effort,

director d chooses her optimal effort as follows:

$$\max_{m_d} E[U_d] = E[\Pi] = \pi - (1 - m_A)(1 - m_B)(1 - \gamma)\pi - \frac{1}{2}cm_d^2, \text{ where } d = A, B. \tag{2}$$

With probability $(1 - m_A)(1 - m_B)$, the directors' monitoring efforts fail and the board observes only the noisy signal. Collective monitoring failure implies a loss in expected firm value of $(1 - \gamma)\pi$. The more precise the free signal, the smaller is the loss. The following first-order conditions must hold in an interior Nash equilibrium:[11]

$$\frac{\partial E[U_d]}{\partial m_d} = 0 \Leftrightarrow (1 - m_{-d})(1 - \gamma)\pi = cm_d, \text{ for } d, -d = A, B. \tag{3}$$

In equilibrium, director d's marginal cost of monitoring equals the marginal contribution of her signal to firm value. Monitoring efforts are strategic substitutes. Greater monitoring effort by one director reduces the marginal value of the other director's effort because, by assumption, both collect the same information.[12] Indeed, director d's optimal effort is zero if her co-director's effort equals one. Similarly, the free signal lowers monitoring incentives. The greater its precision γ, the lower a director's marginal value of monitoring.

Lemma 2. *With unbiased directors, the equilibrium monitoring efforts are equal to*

$$m_A^* = m_B^* = m^* = \frac{(1 - \gamma)\pi}{c + (1 - \gamma)\pi}. \tag{4}$$

Equilibrium monitoring effort increases in π, which reflects the benefit from selecting the right strategy. The greater is π, the greater is the value of taking an informed decision ex post. Equilibrium monitoring effort also increases in the additional information generated by monitoring success, as captured by $(1 - \gamma)$. Access to free information crowds out board monitoring.[13] If the free signal is

[11] We assume that the directors' first-order conditions have a unique stable intersection for any $\gamma \in \left[\frac{1}{2}, 1\right]$. That is, $c^2 - (\frac{1}{2}\pi)^2 > 0$.

[12] We borrow the notion of strategic interaction from the literatures on personnel economics and organization economics. Adapted to the board setting, strategic interaction implies that each director's incentive to monitor the firm depends on her expectation of the other directors' monitoring efforts. With strategic substitutability, increased monitoring by one director reduces the other directors' incentives to monitor. With strategic complementarity, directors benefit from each others' efforts, so that more monitoring by one director increases the other directors' incentives to monitor. Except in Section 6, our analysis assumes that both directors are informed as long as one of them is. This generates free-riding and strategic substitutability.

[13] Ljungqvist and Raff (2018) provide empirical evidence that public information tends to crowd out directors' monitoring efforts.

fully informative ($\gamma = 1$), there is no monitoring in equilibrium. Moreover, directors monitor more closely if monitoring costs are low.

3.2 The Value of Board Commitment

We now show that the board may raise firm value by committing to ignore noisy, but decision-relevant, information when choosing a strategy. There is a tension between the efficient ex post strategy choice and ex ante incentives to exert effort. A commitment to ignore noisy information ex post may be valuable because it increases directors' efforts to gather precise information ex ante.

So far, the analysis has proceeded on the implicit assumption that the board makes a *sequentially optimal* strategy choice. This means that the board decides "on the spot" which strategy to implement, given all available information. According to the ex post efficient rule in Lemma 1, the board optimally responds to *any* informative signal. We now allow directors to deviate from this rule and to commit ex ante, before choosing their monitoring efforts, to the following new rule. If monitoring is successful, the board follows the ex post efficient rule and chooses the strategy indicated by the signal σ^M. However, if monitoring fails and the board only observes the noisy signal, directors ignore it. Rather than selecting $s = \sigma^F$, the board then selects one of the two strategies according to the random dictator rule. It implements strategy 1 with probability q and strategy 0 with probability $1 - q$.[14] We denote the board's decision rule by $\tau \in \{0, 1\}$, where $\tau = 0$ corresponds to the ex post efficient rule in Lemma 1 and $\tau = 1$ corresponds to the new decision rule above.

The decision rule $\tau \in \{0, 1\}$ can be interpreted as an information standard that the board sets for itself. If $\tau = 1$, the board adopts a high information standard and only reacts to fully informative monitoring information. If $\tau = 0$, the board adopts a low information standard and reacts to any informative signal.

We now solve for the *ex ante* optimal rule τ^*. From an ex post perspective, a high information standard is excessively strict. When the board ignores the noisy signal ex post and instead randomly selects one of the two strategies, it sacrifices expected firm value $(\gamma - \frac{1}{2})\pi$. However, a high information standard may raise expected firm value because it raises directors' incentives to monitor. Director

[14] Randomization is without loss of generality. All results also hold for a deterministic rule ($q \in \{0, 1\}$).

d's expected payoff depends on the decision rule τ as follows:

$$E[U_d] = \pi - (1 - m_A)(1 - m_B)\left[\pi(1-\gamma) + \tau\left(\pi\left(\gamma - \frac{1}{2}\right) + \frac{1}{2}D\right)\right] - \frac{1}{2}cm_d^2, \text{ where } d = A, B. \quad (5)$$

The decision rule τ affects $E[U_d]$ through the expected loss from a joint monitoring failure, which is given in square brackets. For a low information standard ($\tau = 0$), the expected payoff in equation (5) coincides with the one in equation (2). A high information standard ($\tau = 1$) implies a greater expected loss from a joint monitoring failure. This effect is captured by the term $(\pi(\gamma - \frac{1}{2}) + \frac{1}{2}D)$. First, expected firm value is reduced by $\pi(\gamma - \frac{1}{2})$ if the board ignores noisy information. Second, director d suffers an expected disutility of $\frac{1}{2}D$ because the firm deviates from s^* with probability $\frac{1}{2}$.

With a low information standard, the equilibrium effort levels coincide with m^* in equation (4). With a high information standard, the equilibrium effort levels are equal to[15]

$$m_A^{*c} = m_B^{*c} = m^{*c} = \frac{\frac{1}{2}\pi + \frac{1}{2}D}{c + \frac{1}{2}\pi + \frac{1}{2}D}. \quad (6)$$

It can easily be checked that $m^{*c} > m^*$. A high information standard strengthens directors' incentives to gather information because it makes monitoring failure more costly compared to the case when $\tau = 0$.

The ex ante optimal decision rule τ^*, which maximizes expected firm value, trades off ex ante monitoring incentives and the ex post efficient use of information. The board optimally commits to a high information standard ($\tau^* = 1$) if the following condition holds:

$$E[\Pi|\tau = 1] > E[\Pi|\tau = 0] \Leftrightarrow \pi - (1 - m^{*c})^2\frac{1}{2}\pi > \pi - (1 - m^*)^2(1 - \gamma)\pi. \quad (7)$$

On the one hand, joint monitoring failure is less likely under a high information standard because directors monitor more closely ex ante ($(1 - m^{*c})^2 < (1 - m^*)^2$). On the other hand, conditional on monitoring failure, expected firm value is greater if the board uses all available information. With a high information standard, the board is more likely to choose the wrong strategy ex post. The expected gain from reacting to the noisy signal is $\pi(\gamma - \frac{1}{2})$.

Proposition 1. *A commitment to a high information standard raises expected firm value ($\tau^* = 1$)*

[15] We assume that the directors' first-order conditions have a unique stable intersection. That is, $c^2 - \frac{1}{4}(\pi + D)^2 > 0$.

if $c < \bar{c}$, $\gamma < \bar{\gamma}$, *and* $D > \bar{D}$.

Distorting the ex post strategy choice is only valuable if it raises ex ante monitoring levels sufficiently. The lower the cost of effort c and the greater the private loss from not reacting to relevant information, D, the greater the increase in ex ante effort. At the same time, the expected ex post loss from ignoring the free signal is low if the signal's precision is low. If the three conditions in Proposition 1 do not jointly hold, the ex post optimal decision rule in Lemma 1 is also ex ante optimal. Importantly, a high information standard requires commitment power. When deviating from the ex post optimal rule, the board forgoes a valuable strategy and each director incurs a personal cost of D. Hence, ex post directors are unanimous in following the low-information-standard decision rule $\tau = 0$. Unless the board can credibly commit to a high information standard, ex ante efforts cannot be raised.

Li (2001) considers a related setting in which a committee first gathers information and then takes a decision. He shows that ex ante efforts can be raised through a conservative rule whereby a decision is made against the committee's prior or preferred alternative unless that alternative meets an evidence standard that is excessively high from an ex post perspective. In contrast, Proposition 1 does not require such conservatism because directors suffer a direct personal disutility if a high information standard is not met. More importantly, Li (2001) does not address our main problem—how a group can commit to a decision rule—which is the subject to which we turn next.

4 Board Diversity as a Commitment Device

We now turn to the question how the board can credibly commit to a high information standard and implement $\tau^* = 1$. While a commitment to ignore noisy information may be valuable, it is not automatically credible, given that unbiased directors are unanimous ex post in choosing the optimal strategy given all available information. In this section, we show that board diversity can serve as a commitment device.

We now let directors have personal preferences or "biases" regarding the two strategies, as formalized in equation (1). Recall that with biases, a director's payoff U_d has both a common value and a private value component. This section focuses on a diverse board. Hence, the directors have opposing biases ($\beta_A \neq \beta_B$). The next section considers a board with homogeneous biases.

We solve the game backwards, starting with the equilibrium strategy choice ex post.

4.1 Ex Post Strategy Choice

Let s^*_{Div} denote the equilibrium strategy choice of a diverse board. Each director votes for the strategy that maximizes her personal payoff $E[U_d|I]$. One director is always biased toward the efficient strategy s^* while the co-director is biased toward the other strategy.[16] If personal biases are sufficiently strong, directors are no longer unanimous in maximizing expected firm value through the choice of s^*. If the board is deadlocked, a strategy is chosen randomly. (Recall that either strategy is then implemented with probability $\frac{1}{2}$.) Deadlock implies an expected firm value of $\frac{1}{2}\pi$. Moreover, both directors suffer a private disutility D if the strategy choice is inefficient ($s^*_{Div} \neq s^*$).[17]

Personal biases affect director d's strategy choice as follows. If the information I about the state and the director's bias go in the same direction ($\beta_d = s^*$), there is no trade-off between maximization of firm value and the pursuit of private benefits and the director votes for s^*. In contrast, if the information I goes against director d's bias ($\beta_d \neq s^*$), she faces the following trade-off:

- If director d votes for s^* in line with her co-director, she forgoes her private benefit and her expected utility simply equals expected firm value. Her vote maximizes $E[\Pi|I]$, which is π or $\gamma\pi$ (depending on the precision of the signal in support of s^*).

- If director d instead votes in line with her bias, the board is deadlocked and the strategy is chosen randomly. If the realization coincides with director d's bias, she receives the private benefit B. However, expected firm value is minimized and equals zero or $(1-\gamma)\pi$ (depending on the disregarded signal's precision), and both directors incur a private disutility of D.

All else equal, the greater the private benefit B, the stronger the director's incentive to ignore information that goes against her bias and to cause deadlock in the pursuit of private benefits. Conversely, the more precise the signal about the state θ, the greater the benefit from implementing the strategy that maximizes expected firm value and the costlier is the pursuit of private benefits.

[16] In our simple setup with a diverse two-member board and two strategies, one director is thus always more objective than the other (in the sense of favoring maximization of firm value). Our results do not depend on this feature and can be derived in a richer setting with more than two possible strategies, in which the two directors have opposing biases but are equally objective.

[17] The assumption of a collective reputation loss (i.e., that both directors suffer the disutility D and not only the director who voted against s^*) is without loss of generality. We obtain the same results if only the director who voted against s^* loses D.

While directors' biases go in opposite directions on diverse boards, successful monitoring aligns their preferences with value-maximization. More precise information about the firm's state reduces the circumstances in which deadlock arises. Intuitively, there is no disagreement over which strategy maximizes firm value and directors have a stronger incentive to choose the value-maximizing strategy if it is supported by stronger evidence. Conversely, the weaker the evidence about the state θ, the more likely a director is to maximize the private value component of her payoff and seize her private benefits. Given directors' opposing personal biases, this leads to deadlock. The following proposition summarizes the effect of personal biases on the equilibrium strategy choice of a diverse board:

Proposition 2. *The equilibrium strategy choice of a diverse board depends on the strength of directors' biases as follows:*

- *If biases are weak* ($B < (2\gamma - 1)\pi) + D$)*, the board always chooses the ex post optimal strategy* ($s^*_{Div} = s^*$)*.*
- *If biases are intermediate* ($(2\gamma - 1)\pi + D < B < \pi + D$)*, the board's choice depends on the information set. With full information, the board selects the ex post optimal strategy* ($s^*_{Div} = s^*$)*. With noisy information, the board is always deadlocked and chooses either strategy with probability* $\frac{1}{2}$*.*
- *If biases are strong* ($\pi + D < B$)*, the board is always deadlocked and chooses either strategy with probability* $\frac{1}{2}$*.*

Directors' biases lower the board's responsiveness to information. The stronger the biases, the more likely the board is to be deadlocked and to deviate from the ex post efficient decision in Lemma 1.

If biases are very strong ($\pi + D < B$), the board is always deadlocked. In that case, even full information about the state θ does not suffice to overcome opposition from the director who is biased against the efficient choice s^*.

If biases are intermediate ($(2\gamma - 1)\pi + D < B < \pi + D$)), the board's decision depends on the available information. Deadlock occurs unless the board has full information in favor of the optimal strategy. The director with a bias in favor of the efficient strategy s^* always votes for s^*. In contrast, the director with a bias against s^* votes against the optimal strategy if it is only supported by noisy

information. She enjoys a higher expected personal payoff if the adopted strategy is aligned with her personal bias rather than with the noisy signal. If, on the other hand, s^* is supported by a perfect signal, the returns to maximizing firm value are high enough and both directors agree to choose the ex post optimal strategy. More precise information about the common value Π can thus break deadlock that results from opposing personal biases. Noisy information is not enough to overcome the personal bias of the director whose preferences go against s^*. The threshold $(2\gamma - 1)\pi + D$ is increasing in γ. Intuitively, a director is less likely to follow her bias to the detriment of shareholder value if more precise information supports the efficient strategy choice.

Finally, if biases are very weak ($B < (2\gamma - 1)\pi + D$), they do not affect the board's strategy choice. In that case, the board's equilibrium strategy choice always corresponds to the first-best choice described in Lemma 1.

In the following analysis, we exclude the first and third case of Proposition 2. In the first case, if $B < (2\gamma - 1)\pi + D$, biases are so small that they never affect the ex post strategy choice. It can easily be seen that the entire analysis then reduces to the first-best case examined in Section 2. In the third case ($\pi + D < B$), directors' biases are so strong that the board never reacts to any information and is always deadlocked. Hence, there would be no monitoring in equilibrium. To streamline the exposition, we assume that directors have intermediate biases:

Assumption 1. A biased director ignores noisy information but responds to perfect information: $(2\gamma - 1)\pi + D < B < \pi + D$.

The first inequality implies that personal biases are strong enough that directors disregard noisy information. The second inequality states that monitoring success overcomes personal biases. If monitoring removes all uncertainty, the optimal strategy, which maximizes firm value, also yields the highest private payoff to each director regardless of her bias. In the terminology of Section 3.2, Assumption 1 implies that the board applies a high information standard.

4.2 Ex Ante Monitoring Choices

We now consider the ex ante monitoring equilibrium on a diverse board. Directors anticipate the strategy choice derived in Proposition 2 when choosing their efforts. Given her expectation of the

other director's effort, director d chooses her optimal effort m_d^* as follows:

$$\max_{m_d} E[U_d] = \pi - (1 - m_A)(1 - m_B)\left[\frac{1}{2}\pi + \frac{1}{2}D\right] + \frac{1}{2}B - \frac{1}{2}cm_d^2, \text{ where } d = A, B. \tag{8}$$

If joint monitoring efforts fail, the board is deadlocked which reduces expected firm value by $\frac{1}{2}\pi$ compared to the case of monitoring success. Moreover, deadlock implies an expected private disutility of $\frac{1}{2}D$ for each director because the board fails to implement the ex post efficient strategy s^* with probability $\frac{1}{2}$. Whether the strategy is aligned with the perfect signal (after monitoring success) or randomly chosen (after monitoring failure and deadlock), from an ex ante perspective a director expects her preferred strategy to be implemented with probability $\frac{1}{2}$. Hence, the director's expected private benefit is simply $\frac{1}{2}B$, regardless of her effort choice. That is, there is no *direct* effect of biases on effort on a diverse board. (Anticipating the subsequent analysis, this is not true if the board is homogeneous.) Biases affect effort choices *indirectly* through their effect on the ex post strategy choice.

We assume that the directors' first-order conditions have a unique stable intersection.[18] The equilibrium effort levels on a diverse board, (m_A^{*Div}, m_B^{*Div}), are equal to:

$$m_A^{*Div} = m_B^{*Div} = m^{*Div} = \frac{\frac{1}{2}\pi + \frac{1}{2}D}{c + \frac{1}{2}\pi + \frac{1}{2}D}. \tag{9}$$

The above effort levels exceed the equilibrium effort levels on an unbiased board given in equation (4). Directors on a diverse board monitor more closely than unbiased directors.[19] Intuitively, the threat of deadlock on a diverse board makes monitoring failure more costly. Deadlock reduces expected firm value by $\pi(\gamma - \frac{1}{2})$ and implies an expected private disutility of $\frac{1}{2}D$. The effort levels in equation (9) correspond to the "commitment levels" in equation (6). A diverse board implements a high information standard because it only reacts to perfect information and ignores noisy information. Equilibrium monitoring efforts are independent of the private benefit B because the outcome of monitoring has no effect on the probability that a director's preferred strategy is implemented.

[18] That is, we assume $c^2 - (\frac{1}{2}\pi + \frac{1}{2}D)^2 > 0$. The stability condition is the same as with a high information standard ($\tau = 1$) in Section 3.2.

[19] Giannetti and Zhao (2019) provide evidence consistent with the idea that diversity fosters monitoring. They find that firms with greater (ancestral) diversity have more board meetings.

4.3 Optimal Board Composition

Shareholders choose the board composition at the beginning of the game to maximize expected firm value. A comparison of the benchmark case of an unbiased board with that of a diverse board yields the following result.

Proposition 3. *Suppose that directors' biases are intermediate:* $(2\gamma - 1)\pi + D < B < \pi + D$. *Expected firm value is greater with a biased, diverse board than with an unbiased board if* $c < \bar{c}$, $\gamma < \bar{\gamma}$, *and* $D > \bar{D}$.

Shareholders may be better off with biased than with unbiased directors. Diversity of personal biases creates deadlock and thus commits the board to a high information standard. The commitment is credible because one of the directors is always sufficiently biased against the ex post optimal strategy to vote against it if there is only noisy information in its support. While expected firm value after monitoring failure would be maximized ex post by following the observed noisy signal, there is no consensus between directors. Deadlock can be avoided through successful monitoring. Strong information in favor of a strategy overcomes directors' biases. While diversity leads to excessive conservatism ex post (in the sense of an excessively high information standard), it is beneficial ex ante because the threat of deadlock raises equilibrium efforts. As long as the conditions in Proposition 3 are satisfied, the overall effect of diversity on expected firm value, $E[\Pi]$, is positive. A diverse board implements the high-information-standard decision rule $\tau = 1$ ex post. The thresholds $\bar{c}$, $\bar{\gamma}$, and $\bar{D}$ in Proposition 3 correspond to those in Proposition 1.

4.4 Discussion

Whether diversity is desirable depends on directors' incentives and on firm characteristics; that is, "one size" does not fit all firms. A diverse board is desirable if monitoring is valuable because alternative information sources (as proxied by γ) are scarce.[20] For example, a firm is all else equal more likely to benefit from diversity if its stock price is relatively uninformative.[21] Moreover, a biased board can only dominate an unbiased board if directors' monitoring efforts are sufficiently sensitive to the threat of deadlock. Specifically, reputational concerns D need to be sufficiently large. That is,

[20] Consistent with this result, Anderson et al. (2011) document a positive relation between board heterogeneity and firm performance for firms with complex operating environments.

[21] Ferreira, Ferreira, and Raposo (2011) focus on a different board attribute, independence, and document a negative relation between price informativeness and board independence.

the pursuit of opposing agendas needs to be accompanied by a sufficiently strong concern about the common goal of shareholder value maximization for diversity to increase shareholder value. Finally, a necessary condition for the desirability of board diversity is that directors' effort costs are sufficiently low.

An empirical test of Proposition 3 needs to take into account who has effective authority to appoint directors. To the extent that incumbent directors, rather than shareholders, have control over the appointment process, boards may not be diverse even if the conditions in Proposition 3 are satisfied. An incumbent director maximizes her own expected payoff, which includes not only shareholder value but also private benefits. Anticipating the analysis in the next section, expected private benefits are always greater on a homogeneous board than on a diverse board. Hence, directors may prefer to appoint directors whose personal preferences are congruent with their own, to the detriment of shareholders.

Proposition 3 contrasts with Donaldson, Malenko, and Piacentino (2019). They also argue that board diversity can lead to deadlock. However, in their framework, deadlock is something to be avoided, since it leads to CEO entrenchment and so unambiguously is harmful to shareholders. Accordingly, large parts of their analysis explore ways to mitigate deadlock. In our model, deadlock may be beneficial for shareholders.

5 Should a Board be Homogeneous or Diverse?

We next examine monitoring and strategy choices on a homogeneous board and compare them to those on a diverse board. A director on a homogeneous board is drawn from the same pool as a director on a diverse board. Hence, a director's cost of effort c, private benefit B, and reputation loss D are the same regardless on which type of board she serves. Crucially, the joint distribution of the biases (β_A, β_B) differs across the two board types. On a homogeneous board, both directors always share the same bias ($\beta_A = \beta_B$).

5.1 Ex Post Strategy Choice

We again solve the game backwards. Let s^*_{Hom} denote the equilibrium strategy choice of a homogeneous board. While a homogeneous board is never deadlocked (since directors always share the same

objective function), it may nevertheless make an inefficient strategy choice ex post. The following proposition describes the effect of homogeneity on the board's ex post strategy choice:

Proposition 4. *The equilibrium strategy choice of a homogeneous board depends on the strength of directors' biases as follows.*

- *If biases are weak* ($B < (2\gamma - 1)\pi + D$)*, the board always chooses the ex post optimal strategy* ($s^*_{Hom} = s^*$).
- *If biases are intermediate* ($(2\gamma - 1)\pi + D < B < \pi + D$)*, the board's choice depends on the information set. With full information, the board chooses the ex post optimal strategy* ($s^*_{Hom} = s^*$)*. With noisy information, the board follows its bias and chooses* $s^*_{Hom} = \beta_A = \beta_B$.
- *If biases are strong* ($\pi + D < B$)*, the board follows its bias and chooses* $s^*_{Hom} = \beta_A = \beta_B$.

The threshold levels in Proposition 4 are the same as for a diverse board in Proposition 2 because private benefits have the same magnitudes on either board. If biases are weak ($B < (2\gamma - 1)\pi + D$), directors choose the strategy that maximizes firm value given all available information. If biases are strong ($\pi + D < B$), directors always agree to pursue their private benefits, even if they have perfect information about the state of the firm. If biases are intermediate ($(2\gamma - 1)\pi + D < B < \pi + D$) and the homogeneous board observes a perfect signal, directors maximize firm value and choose $s^*_{Hom} = s^* = \sigma^M$. However, if only noisy information is available, directors agree to maximize their private benefits by aligning the strategy choice with their shared biases.

A comparison of Proposition 4 with Proposition 2 yields the following irrelevance result:

Corollary 1. *Ex post, a homogeneous board and a diverse board imply the same expected firm value for any given information set* I.

Board composition is irrelevant for firm value from an ex post perspective. That is, for a given information set, either board type yields the same expected firm value $E[\Pi|I]$. The equivalence arises even though the two boards may make different strategy choices ($s^*_{Div} \neq s^*_{Hom}$). Intuitively, if directors' biases are strong enough, directors do not respond to information, regardless of the board's composition. While non-reactivity takes the form of deadlock on a diverse board, it manifests itself in directors' pursuit of private benefits on a homogeneous board. Either way, information about the state of the firm is ignored, which implies an expected firm value of $\frac{1}{2}\pi$.

To provide a more precise explanation for Corollary 1, we consider the three cases in Propositions 2 and 4 in turn. If biases are weak, directors always maximize expected firm value ($s^* = s^*_{Div} = s^*_{Hom}$) regardless of the board's composition, implying an expected firm value of π or $\gamma\pi$, depending on whether or not monitoring suceeded. If biases are intermediate, both a homogeneous and a diverse board respond to a perfect signal, in which case firm value is π. If the board only receives a noisy signal, directors on a homogeneous board agree to pursue their private benefits. In contrast, a diverse board is deadlocked and makes a random strategy choice. Either way, expected firm value is $\frac{1}{2}\pi$. Finally, if biases are strong, neither type of board responds to any information. A diverse board is always deadlocked, whereas a homogeneous board always acts on directors' personal biases. Either way, expected firm value is $\frac{1}{2}\pi$.

5.2 Ex Ante Monitoring Choices

While the two board types imply the same expected firm value *conditional on available information*, board composition matters for firm value because it affects incentives to gather information ex ante. Equilibrium monitoring efforts depend on which of the three regimes in Proposition 4 obtains. Following Assumption 1, we focus on the case of intermediate biases because the analysis of the other two cases is trivial.[22] Given her expectation of the other director's effort, director d on a homogeneous board chooses her optimal effort as follows:

$$\begin{aligned}\max_{m_d} E[U_d] = \pi - (1-m_A)(1-m_B)\left[\frac{1}{2}\pi - \frac{1}{2}D\right] \\ + [1-(1-m_A)(1-m_B)]\frac{1}{2}B + (1-m_A)(1-m_B)B - \frac{1}{2}cm_d^2, \text{ where } d = A, B.\end{aligned} \tag{10}$$

A monitoring failure reduces expected firm value by $\frac{1}{2}\pi$, just like for a diverse board (Corollary 1). The director's expected private benefit is given in the second line in equation (10). Unlike for a diverse board, the probability that a director receives B now depends on the outcome of monitoring. If monitoring succeeds, which happens with probability $[1-(1-m_A)(1-m_B)]$, the board aligns the strategy with the state of the firm, which implies an expected private benefit of $\frac{1}{2}B$. The director enjoys a greater expected private benefit if monitoring fails. The board then always aligns the

[22] With weak biases, both ex ante equilibrium efforts and the ex post strategy choice coincide with the first-best outcomes for an unbiased board in Section 2, regardless of board composition. Similarly, with strong biases, directors never monitor and firm value is $\frac{1}{2}\pi$, regardless of board composition.

strategy with the shared bias, which implies a certain benefit of B. The congruence of directors' biases thus discourages monitoring because it makes monitoring failure less privately costly.

We assume that the directors' first-order conditions have a unique stable intersection.[23] The equilibrium effort levels on a homogeneous board, (m_A^{*Hom}, m_B^{*Hom}), are equal to

$$m_A^{*Hom} = m_B^{*Hom} = m^{*Hom} = \frac{\frac{1}{2}\pi + \frac{1}{2}D - \frac{1}{2}B}{c + \frac{1}{2}\pi + \frac{1}{2}D - \frac{1}{2}B}. \tag{11}$$

Equilibrium efforts are decreasing in the private benefit B because it lowers the private cost of monitoring failure. The other comparative statics results are the same as for the equilibrium effort levels on a diverse board in equation (9). It can immediately be checked that the equilibrium effort levels on a homogenous board are always lower than on a diverse board ($m^{*Div} > m^{*Hom}$).

5.3 Optimal Board Composition

We obtain the following result about optimal board composition.

Proposition 5. *Expected firm value is greater with a biased, diverse board than with a homogeneous board.*

A diverse board dominates a homogeneous board because of greater ex ante monitoring incentives. Board composition may affect expected firm value through two channels: the board's ex post strategy choice and directors' ex ante monitoring incentives. If directors were exogenously endowed with information about the optimal strategy, board composition would be irrelevant for expected firm value (Corollary 1). Once ex ante information gathering is taken into account, a diverse board dominates. The threat of deadlock strengthens monitoring incentives whereas congruent biases encourage the pursuit of private benefits, which discourages monitoring.

6 Information Sharing on Homogeneous and Diverse Boards

Board composition may affect a director's incentives to share information with her co-director about the state of the firm. To examine boardroom communication, we relax our assumption that each director observes the other's signal. Instead we assume that the information a director obtains through

[23] That is, we assume $c^2 - (\frac{1}{2}\pi + \frac{1}{2}D - \frac{1}{2}B)^2 > 0$. By Assumption 1, $(\frac{1}{2}\pi + \frac{1}{2}D - \frac{1}{2}B) > 0$.

monitoring ($\sigma_d^M \in \{0,1\}$) is soft information, in the sense that its validity cannot be verified by the other director.[24] Moreover, we assume that a director cannot observe whether her co-director's monitoring effort succeeded or failed. In our framework, both frictions are necessary for a non-trivial analysis of communication. If monitoring success or failure is observable, there is no communication problem. An uninformed director is always willing to follow her informed co-director's recommendation, even if the signal's realization is soft information. Intuitively, an informed director perfectly aligns the strategy with the true state, which maximizes the expected payoff for each director regardless of her personal bias.[25]

The two assumptions imposed in the previous paragraph imply that any communication between directors must be interpreted as a pure suggestion of a strategy choice. After the monitoring stage, each director may recommend a strategy to the co-director before the board votes. Directors can lie without facing any penalties and thus engage in cheap talk communication as in Crawford and Sobel (1982). If directors have congruent objectives, a director always trusts her co-director's strategy recommendation. However, an informed director on a diverse board may lack credibility because of a lack of congruence. Hence, deadlock may now arise even if one of the directors monitors successfully. Previously, deadlock on a diverse board could only arise if both directors' monitoring efforts failed. The subsequent analysis develops these ideas and their implications.

6.1 Homogeneous Boards

On a homogeneous board, there is no communication problem. The directors share the same objective function and a director therefore trusts her co-director's recommendation. To see this, suppose that director A's effort failed whereas director B monitored successfully. Director B always finds it optimal to recommend the ex post efficient strategy $s^* = \sigma_B^M = \theta$. Director A consents to director B's recommendation even if it goes against the common bias. The uninformed director can infer that the co-director's contrarian recommendation must be based on the successful acquisition of a perfect signal. Overall, equilibrium monitoring and strategy choices are the same as in Section 5.

[24] We omitted the subscript d from σ_d^M in the previous sections because the distinction between σ_A^M and σ_B^M did not matter. Now the distinction is crucial.

[25] By Assumption 1, even directors on a diverse board agree to align the strategy with the state if the state is perfectly known.

6.2 Diverse Boards

On a diverse board, lack of congruence may impede information sharing. Suppose again that director A's effort failed whereas director B monitored successfully. Director B again finds it optimal to recommend the optimal strategy $s^* = \sigma_B^M = \theta$. Whether director A follows director B's recommendation depends on whether she believes that director B seeks to maximize firm value or pursue her private benefit. A recommendation against one's own bias is always credible. If director B's recommendation goes against her own bias, the uninformed director A can infer that director B must have monitored successfully. Hence, she accepts director B's recommendation. However, suppose that director B's signal σ_B^M, and hence her recommendation, coincides with her bias ($\sigma_B^M = \beta_B$). Then director A's reaction depends on her belief about the co-director's monitoring intensity. This is seen most clearly by considering the two polar cases. If director A believes that director B always receives a perfect signal (i.e., she believes that m_B equals one), she will always follow director B's recommendation. On the other hand, as director A's belief about m_B goes to zero, she ignores her co-director's recommendation and votes in line with her own bias, which implies deadlock.

The following lemma summarizes this discussion:

Lemma 3. *When the outcome of monitoring is unobservable and the board is diverse, a director's recommendation is always credible if it goes against her personal bias. If a director's recommendation coincides with her personal bias, it is credible if and only if her anticipated monitoring effort is sufficiently large.*

6.3 Ex Post Strategy Choice With Limited Communication

To further explore the limits of communication on a diverse board, we assume for simplicity that the public signal is uninformative ($\gamma = \frac{1}{2}$) and that directors incur no private cost for disregarding information ($D = 0$). Then there exists a unique threshold level $\bar{m}$ that separates two regimes with different levels of trust. If the equilibrium effort levels exceed the threshold level, a director always follows her co-director's recommendation. We refer to this case as *complete trust*. If the equilibrium effort levels fall below the threshold, then trust is limited: an uninformed director follows her co-director's recommendation only if it goes against the co-director's own bias. Otherwise, she ignores the co-director's recommendation. We refer to this case as *limited trust*.

The threshold level $\bar{m}$ is derived as follows. Suppose that director A is uninformed. Moreover, suppose that director B's recommendation runs counter to director A's bias. Director A's posterior belief that director B's recommendation is correct (given that the recommendation coincides with β_B) equals $\frac{m_B\frac{1}{2}+(1-m_B)\frac{1}{2}}{m_B\frac{1}{2}+(1-m_B)} = \frac{1}{2-m_B}$. Hence, director A votes against her bias and in line with her co-director's recommendation if and only if

$$\frac{1}{2-m_B}\pi > \frac{1-m_B}{2-m_B}\pi + B \Leftrightarrow m_B > \bar{m} \equiv \frac{2B}{\pi+B}. \tag{12}$$

The threshold level $\bar{m}$ increases in the private benefit B.[26] The greater is B, the more reluctant an uninformed director is to vote against her own bias and the more convinced she needs to be that the co-director's recommendation is based on successful monitoring. Proposition 6 presents the different types of equilibria.

Proposition 6. *Suppose the board is diverse. If $B < \underline{B}$, the unique monitoring equilibrium involves complete trust. If $B > \bar{B}$, the unique monitoring equilibrium involves limited trust. If $\underline{B} < B < \bar{B}$, the two monitoring equilibria coexist.*

Before discussing the three regimes of Proposition 6, we first characterize the complete trust and limited trust equilibria in detail.

Complete Trust. In the complete trust equilibrium, an uninformed director always follows the recommendation of her co-director. Hence, the equilibrium behavior of a diverse board with complete trust is equivalent to that of the diverse board without any communication problems considered in Section 4. The board's strategy choice is then given by Proposition 2. By Assumption 1, biases are intermediate. Hence, the board takes a fully informed decision if at least one director monitors successfully. Accordingly, the equilibrium monitoring efforts, denoted by m^{*CT}, equal those in equation (9), with D set equal to zero:

$$m_A^{*CT} = m_B^{*CT} = m^{*CT} = \frac{\frac{1}{2}\pi}{c+\frac{1}{2}\pi}. \tag{13}$$

Limited Trust. When trust is limited, an uninformed director ignores her co-director's recommendation. Three information structures need to be distinguished when determining the ex post strategy

[26] Assumption 1 implies that $\bar{m}$ is smaller than one.

choice:

- If both directors monitor successfully, the board chooses the ex post efficient strategy, which equals $\sigma_A^M = \sigma_B^M = \theta$.
- If neither director monitors successfully, the board is deadlocked and implements either strategy with probability $\frac{1}{2}$.
- If only one director monitors successfully, two cases arise. If the signal differs from the bias ($\beta_d \neq \sigma_d^M$), the informed director's recommendation is credible and the board chooses the efficient strategy. If $\beta_d = \sigma_d^M$, the board is deadlocked due to a lack of credibility.

Joint monitoring success eliminates any communication problem and enables an efficient strategy choice. If only one director monitors successfully, the board may fail to act on perfect information.

6.4 Ex Ante Monitoring Choices With Limited Communication

Given her expectation of director B's effort, director A chooses her optimal monitoring effort m_A^{*LT} as follows:

$$\begin{aligned}\max_{m_A} E[U_A] =& (m_A m_B)\left[\pi + \frac{1}{2}B\right] + m_A(1-m_B)\left[\frac{1}{2}\pi + \frac{1}{2}\left(\frac{1}{2}\pi + \frac{1}{2}B\right)\right] \\ &+ m_B(1-m_A)\left[\frac{1}{2}(\pi + B) + \frac{1}{2}\left(\frac{1}{2}\pi + \frac{1}{2}B\right)\right] \\ &+ (1-m_A)(1-m_B)\left[\frac{1}{2}\pi + \frac{1}{2}B\right] - \frac{1}{2}cm_A^2.\end{aligned} \tag{14}$$

With probability $m_A(1-m_B)$, only director A monitors successfully. She then receives an expected payoff of $\left[\frac{1}{2}\pi + \frac{1}{2}(\frac{1}{2}\pi + \frac{1}{2}B)\right]$, which is derived as follows. With probability $\frac{1}{2}$, director A's bias differs from the observed state θ. She can then credibly communicate her information to director B, which implies a firm value of π and no private benefit for director A. With probability $\frac{1}{2}$, her bias coincides with her signal, which renders her noncredible. The board is deadlocked, which implies the same expected payoff, $(\frac{1}{2}\pi + \frac{1}{2}B)$, as in the case of joint monitoring failure. The following first-order condition must hold in an interior Nash equilibrium:

$$\frac{\partial E[U_A]}{\partial m_A} = 0 \Leftrightarrow \frac{1}{4}(\pi - B) - cm_A = 0. \tag{15}$$

The first-order condition for director A is independent of the co-director's effort. Directors' monitoring efforts no longer interact strategically. Previously, efforts were strategic substitutes: without impediments to information sharing, closer monitoring by one director reduces the other director's incentive to monitor because directors can free-ride on each other's efforts. Success by one director always suffices to take an informed decision. When monitoring outcomes are unobservable, free-riding is only possible if the informed director is credible (because her bias runs counter to the observed signal). Otherwise, communication breaks down and monitoring information is only acted upon if both directors monitor successfully. Hence, lack of trust due to incongruent preferences limits free-riding and creates strategic complementarity in monitoring efforts. The two modes of strategic interaction are ex ante equally likely and hence cancel out, leading to a game without strategic interaction.

Lemma 4. *With limited trust on a diverse board, the equilibrium monitoring efforts are equal to*

$$m_A^{*LT} = m_B^{*LT} = m^{*LT} = \frac{(\pi - B)}{4c}. \tag{16}$$

The equilibrium monitoring efforts with limited trust are strictly lower than the equilibrium efforts with complete trust in equation (13). Intuitively, directors on a diverse board perceive a lower marginal benefit from gathering information when they cannot share their signal credibly with their co-director. The inability to share information makes monitoring less decision-relevant and hence less valuable.

6.5 Discussion

According to Proposition 6, the complete and limited trust equilibria may coexist or there may be a unique equilibrium, depending on the parameter B. The intuition for the three regimes in the proposition is as follows.

If biases are small ($B < \underline{B}$), the unique equilibrium involves complete trust. The threshold level $\bar{m}$ above which directors trust each other's recommendations is so low that directors' efforts always exceed it. Even if directors expect their recommendation to be ignored by the other director, the incentives to gather information, and hence equilibrium efforts, are still sufficiently large that directors will trust each other's recommendation.

If biases are strong ($\bar{B} < B$), the threshold level $\bar{m}$ is so high that the unique monitoring

equilibrium involves limited trust. Even if directors expect their recommendation to be followed by the other director, the incentives to gather information, and hence equilibrium efforts, are so low that directors do not trust each other's recommendation.

If $\underline{B} < B < \bar{B}$, the limited and complete trust equilibria coexist. Directors' beliefs are self-fulfilling. If directors expect to be trusted, they will exert greater effort in equilibrium (because their information is more likely to be decision relevant), which in turn sustains trust. Conversely, if directors do not expect to be trusted, they will exert less effort in equilibrium, which in turn undermines trust.

6.6 Optimal Board Composition With Limited Communication

It can easily be checked that the equilibrium efforts with limited trust in equation (16) are always lower than the equilibrium efforts on a homogeneous board.[27] (Recall that a homogeneous board is not plagued by communication problems and equilibrium efforts therefore are given in equation (11).) Intuitively, directors on a diverse board perceive a lower marginal benefit from gathering information when they cannot communicate their signal credibly to their co-director.

Proposition 7. *A homogeneous board dominates a diverse board with limited trust.*

Limited trust on a diverse board makes a homogeneous board more attractive for two related reasons. Ex post, a given information set I is used more efficiently on a homogeneous board than on a diverse board with limited trust. Indeed, with limited trust, the board only takes an informed decision if both directors monitor successfully, whereas monitoring success by a single director suffices on a homogeneous board. Moreover, directors exert less effort to gather information ex ante when trust is limited compared to a homogeneous board.

In the absence of communication problems, shareholders are always better off with a diverse board than with a homogeneous one (Proposition 5). The threat of deadlock strengthens directors' monitoring incentives and thus raises expected firm value compared to a homogeneous board. In contrast, when monitoring outcomes are unobservable, a homogeneous board may be more desirable than a diverse one (Proposition 7). If director's opposing personal biases are sufficiently strong

[27] The equilibrium effort on a homogeneous board equals $m^{*Hom} = \frac{\frac{1}{2}\pi - \frac{1}{2}B}{c + \frac{1}{2}\pi - \frac{1}{2}B}$, which is greater than $\hat{m}^{*LT}$ if $c - \frac{1}{2}(\pi - B) > 0$. The latter inequality is implied by the stability conditions.

($\bar{B} < B$), communication on a diverse board partly breaks down. Limited trust prevents information sharing and therefore reduces incentives to gather information ex ante.

7 Conclusion

We ask when and how a diverse board can benefit shareholders. Diversity commits the board to a high information standard because directors with opposing agendas are deadlocked unless they have overwhelming information in support of the optimal course of action. The commitment to a high information standard can be valuable because it raises directors' efforts to gather information. In contrast, a board with unbiased directors cannot credibly commit to a high information standard. Hence, shareholders may be better off with biased than with unbiased directors. Specifically, we find that board diversity is more likely to be desirable if the firm's information environment is poor and if directors' opposing personal agendas are accompanied by sufficiently strong incentives for shareholder value maximization.

Like a diverse board, a homogeneous board only responds to strong information. However, when their monitoring efforts fail, directors on a homogeneous board are unanimous in acting on their shared personal biases and pursue private benefits, rather than being deadlocked. Pursuit of private benefits on a homogeneous board weakens monitoring incentives ex ante. Hence, a diverse board may dominate a homogeneous board. In contrast, in the presence of communication frictions, a homogeneous may be desirable because congruent personal agendas facilitate information sharing among directors.

Board diversity is commonly viewed as desirable because a greater range of skills, viewpoints and backgrounds may result in more efficient decision making. At the same time, deadlock is viewed as a possible downside of diversity. Our analysis sheds new light on this commonly considered tradeoff. We argue that diversity is desirable from shareholders' perspective because it creates (the threat of) deadlock, not in spite of it. One normative implication of our theory is that optimal design of corporate charters or governance regulation should allow for the possibility of "strategic deadlock," not seek to eliminate it. A central objection raised against stakeholder-oriented governance structures and shared control over corporations is that they lead to deadlock.[28] Our analysis suggests that, on the contrary, such structures may strengthen incentives to maximize shareholder value.

[28]For a textbook treatment of the costs and benefits of stakeholder orientation, see Chapter 1 in Tirole (2005).

Appendix A. Proofs

Proof of Proposition 1. Expected firm value under a high information standard ($\tau = 1$) exceeds expected firm value under the ex post efficient rule ($\tau = 0$) if and only if

$$E[\Pi|\tau = 1] > E[\Pi|\tau = 0] \Leftrightarrow \pi - (1 - m^{*c})^2 \frac{1}{2}\pi > \pi - (1 - m^*)^2(1 - \gamma)\pi, \tag{17}$$

which is equivalent to

$$(1 - \gamma)D\left[c + \frac{1}{4}(2\pi + D)\right] > \left(\gamma - \frac{1}{2}\right)\left[c^2 - \frac{1}{2}(1 - \gamma)\pi^2\right]. \tag{18}$$

The left-hand side is increasing in D while the right-hand side is independent of D. The left-hand side is decreasing in γ while the right-hand side is increasing in γ. By assumption, $\gamma \in \left[\frac{1}{2}, 1\right]$ and $D \in [0, 2c - \pi]$, where $2c-\pi$ is implied by the stability condition for the equilibrium given in equation (6). The stability condition for the equilibrium in equation (15) implies $2c - \pi > 0$.

Proof of Proposition 6. With complete trust, the equilibrium monitoring efforts equal those in equation (9) in Section 4. Given the assumptions that $D = 0$ and $\gamma = \frac{1}{2}$, the equilibrium effort levels with complete trust are

$$m_A^{*CT} = m_B^{*CT} = m^{*CT} = \frac{\frac{1}{2}\pi}{c + \frac{1}{2}\pi}. \tag{19}$$

The threshold level $\bar{B}$ is determined by the condition $m^{*CT} = \bar{m}$. While m^{*CT} is independent of B, the threshold $\bar{m}$ is linearly increasing in B. Hence, if $B > \bar{B}$, then $m^{*LT} < m^{*CT} < \bar{m}$ and there exists a unique monitoring equilibrium with limited trust. The condition $m^{*CT} = \bar{m}$ implies that

$$\bar{B} \equiv \frac{\frac{1}{2}\pi^2}{\frac{1}{2}\pi + 2c}. \tag{20}$$

It can easily be checked that $\bar{B} < \pi$.

The threshold level $\underline{B}$ is determined by the condition $m^{*LT} = \bar{m}$. While m^{*LT} is decreasing in B, the threshold $\bar{m}$ is increasing in B. Hence, if $B < \underline{B}$, then $\underline{m} < m^{*LT} < m^{*CT}$ and there exists a unique monitoring equilibrium with complete trust. The condition $m^{*LT} = \bar{m}$ implies that

$$\underline{B} \equiv \sqrt{(4c)^2 + \pi^2} - 4c. \tag{21}$$

References

Adams, Renée, and Daniel Ferreira, 2007, "A theory of friendly boards," Journal of Finance 62: 217-250.

Almazan, Andres, and Javier Suarez, 2003, "Entrenchment and severance pay in optimal governance structures," Journal of Finance 58: 519-547.

Anderson, Ronald, David Reeb, Arun Upadhyay, and Wanli Zhao, 2011, "The economics of director heterogeneity," Financial Management 40: 5-38.

Bolton, Patrick, Tao Li, Enrichetta Ravina, and Howard Rosenthal, 2019, "Investor ideology," Journal of Financial Economics, forthcoming.

Burkart, Mike, Denis Gromb, and Fausto Panunzi, 1997, "Large shareholders, monitoring, and the value of the firm," Quarterly Journal of Economics 112: 693-728.

Chemmanur, Thomas, and Viktar Fedaseyeu, 2018, "A theory of corporate boards and forced CEO turnover," Management Science 64: 4798-4817.

Crawford, Vincent, and Joel Sobel, 1982, "Strategic information transmission," Econometrica 50: 1431-1451.

Donaldson, Jason Roderick, Nadya Malenko, and Giorgia Piacentino, 2020, "Deadlock on the board," Review of Financial Studies, forthcoming.

Ferreira, Daniel, 2010,"Board diversity," in H. Kent Baker and Ronald Anderson (eds.), *Corporate governance: A synthesis of theory, research, and practice*, John Wiley & Sons.

Ferreira, Daniel, Miguel Ferreira, and Clara Raposo, 2011, "Board structure and price informative-

ness," Journal of Financial Economics 99: 523-545.

Giannetti, Mariassunta, and Mengxin Zhao, 2019, "Board ancestral diversity and firm-performance volatility," Journal of Financial and Quantitative Analysis 54: 1117-1155.

Harris, Milton, and Artur Raviv, 2008, "A theory of board control and size," Review of Financial Studies 21: 1797-1832.

Levit, Doron, and Nadya Malenko, 2016, "The labor market for directors and externalities in corporate governance," Journal of Finance 71: 775-808.

Li, Hao, 2001, "A theory of conservatism," Journal of Political Economy 109: 617-636.

Ljungqvist, Alexander, and Konrad Raff, 2018, "Board monitoring vs. external monitoring: Complements or substitutes?," Working paper, Stockholm School of Economics and Norwegian School of Economics.

Malenko, Nadya, 2014, "Communication and decision-making in corporate boards," Review of Financial Studies 27: 1486-1532.

Tirole, Jean, 2006, *The theory of corporate finance*, Princeton University Press.