The Commitment Role of Board Staggering

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Abstract

“The Commitment Role of Board Staggering”

This paper contributes to the debate of board staggering by abstracting from takeover considerations and focusing on a purely managerial perspective. Specifically, we study how staggering affects the efficiency of CEO/board communication and decision making. Equating staggering with greater commitment power on the part of the board, staggering improves the communication efficiency between the CEO and the board for given board composition and incentives. However, board composition and incentives are endogenous constructs. This endogeneity in board bias may result in a non-staggered, but friendly, board communicating more efficiency with the CEO than a staggered board that is antagonistic (to the CEO). Besides communicating with the CEO, another channel for the board to learn about the environment is through information gathering effort. While board staggering improves communication, all else equal, it depresses the board’s effort incentives. With high initial information asymmetry (the CEO is endowed with a precise private signal), staggering improves shareholder value as the communication benefit outweighs the forgone board effort. If the CEO’s information endowment is noisy, in contrast, the shareholders turn the communication handicap of non-staggered boards to their advantage as a cost-effective way to elicit board effort. Our analytical results shed light on recent empirical findings that board staggering tends to add value in settings of significant information asymmetry.
1 Introduction

Staggered boards have long been viewed as a value-destroying takeover defense and a conduit for entrenchment, e.g., Bebchuk and Cohen (2005). Recently, a more nuanced view has emerged with studies showing staggered (classified) boards may promote long-term value creation by protecting boards from short-termist shareholder and market pressures.\(^1\) While the immediate effect of staggering is to commit shareholders to longer director terms, staggering also confers greater commitment power to boards in dealing with management or other constituencies simply due to a longer time horizon on the part of the board as a collective—the “bonding” effect.\(^2\) We contribute to this discussion by modeling the interplay between shareholders, the board, and the CEO of a firm in an investment setting. Taking staggering to confer greater commitment power to the board (“going concern”) in dealing with the CEO, we study its effect on CEO/board communication and on shareholder value, treating board composition and incentives as endogenous constructs chosen by the shareholders.

The recent literature suggests a tradeoff between market-of-control costs versus managerial benefits of staggering. Abstracting from takeover considerations, however, we show that even from a purely managerial perspective, staggering is not always beneficial. While staggering always improves the information flow between the CEO and the board for given board composition and incentives, such improved communication does not necessarily translate into added shareholder value for two reasons: (i) it may reduce the board’s incentive to gather decision-

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\(^1\) E.g., Cremers, et al. (2016, 2017), Daines et al. (2016), Ge et al. (2016). For event studies centered on legal changes, see Larcker et al. (2011), Amihud and Stoyanov (2017). See also the discussion in Amihud et al. (2017) and http://clsbluesky.law.columbia.edu/2017/07/06/the-classified-board-duels/. Ge et al. (2016, p.811) find that firms that have destaggered invest less in longer-term projects such as R&D.

\(^2\) Cremers and Sepe (2016, p.74): “A governance model with empowered boards that can resist the threat of short-term shareholder and market pressures helps to mitigate those distortions. It does so by enabling the board to credibly commit the shareholders, as a collective, to longer-term engagements vis-a-vis directors, managers, and stakeholders, thereby increasing shareholder wealth.”
useful information not known even to the CEO, and (ii) the shareholders and the board may not be perfectly aligned in their preferences.

We study the role of board commitment in a setting where a pending investment decision should be tailored to the state of the world. The board holds the decision rights. At the outset, only the CEO has some noisy information about the state, but he is an empire builder. Through costly information acquisition (“effort”), the board may learn, and even improve upon, the CEO’s signal. If its effort to discover the state fails, the board can still engage in (strategic) communication with the CEO. It is at the communication stage where the issue of board commitment comes into play.

To capture the managerial aspects of staggering in a parsimonious manner, we take a staggered board as one that can precommit to a menu of investment levels for the CEO to choose from—i.e., a form of constrained delegation. A non-staggered board (i.e., noncommitment), in contrast, can only react in a sequentially rational manner to a “cheap-talk” report made by the CEO. The cheap talk case was studied in Baldenius et al. (2018, henceforth BMQ). Contrasting their results with those in this paper isolates the commitment effect of board staggering on board composition and incentives, communication, and ultimately shareholder value.

When assembling the board, we assume that the shareholders determine the board’s equity incentives and its non-pecuniary preferences (“board bias”) over the investment level. For instance, stacking the board with insiders or directors socially connected to the CEO tends to result in a friendly board whose preferences are (partially) aligned with the CEO. On the other hand, former accounting partners or regulators serving on boards may be overly concerned with avoiding high-visibility failures and hence may be antagonistic to the (empire-builder)

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3 At a technical level, we assume the staggered board faces a mechanism design problem without monetary transfers. The role of long interaction horizons (and low discount rates) for shaping commitment power has been developed by Macaulay (1963), Malcomson (2008), among others. Especially, Alonso and Matouschek (2007) study how constrained delegation of the kind we study arises endogenously in dynamic settings.
CEO. Similar issues may arise with boards dominated by debtholders.

We show that the optimal board with commitment is always weakly antagonistic (Proposition 1). Starting from an unbiased board, introducing a small antagonistic bias stimulates board effort and comes at only second-order costs in terms of investment bias and coarsened communication with the CEO, because the information flow changes continuously. Cheap talk, in contrast, may call for a weakly friendly optimal board, because communication tends to break down rather quickly as CEO/board becomes less aligned. The endogeneity in board bias may overturn the association between board staggering and the efficiency of CEO/board communication. For given board bias, staggering unambiguously improves the communication between the CEO and the board. However, with endogenous board bias, for CEOs with precise private information, a non-staggered (but friendly) board may communicate more efficiently with the CEO than a staggered (but antagonistic) one.

We then ask whether board commitment benefits the shareholders—what is the value of commitment? While commitment power on the part of the board vis-a-vis the CEO always makes the board weakly better off, all else equal, it does not necessarily benefit shareholders in our three-player corporate governance setting. Yet, with shareholders controlling the board’s preferences—through equity and non-pecuniary incentives (board bias)—one might expect the value of commitment to be positive. As we show, this logic is incomplete. For the special case where the only learning channel for the board is communication (i.e., information gathering is prohibitively costly), a replication result obtains (Proposition 2): a board that has to rely on a cheap-talk report, but is assigned the optimal weakly friendly bias to compensate for its inherent communication handicap, yields the same expected shareholder value as a board that has commitment.

\[^4\]Deloitte’s survey of Australian CEOs (2015, p.13): “The increased scrutiny has reduced the risk appetites of many companies. ‘There is an element of overgovernance,’ one CEO said. ‘The board has taken a risk-averse view and management are reporting to it.’ ... One CEO commented that a very good reason for boards to focus on risk was to avoid the stigma of becoming high-profile failures.”
power. Put differently, the endogenous board bias precisely substitutes for lack of commitment in this special case.

The potential for information gathering breaks this replication result (Proposition 3). We identify cases of high information asymmetry (the CEO’s signal is precise) where the value of commitment is positive, and cases of mild information asymmetry where it is negative. To illustrate the role of information asymmetry, recall that while commitment improves communication, all else equal, it depresses the board’s effort incentives. With precise CEO signals, the communication benefit of board commitment outweighs the foregone board effort. With noisy CEO signals, in contrast, the shareholders turn the communication handicap of non-commitment to their advantage: nominating an antagonistic board causes a steep drop in the information flow through cheap talk, and a corresponding boost to board effort. At the same time, communicating with an imprecisely informed CEO is of limited value, even with commitment. Therefore, board commitment can harm the shareholders even if they can control the board’s preferences.

Our results identify novel benefits and costs of board staggering based entirely on within-firm processes. They are consistent with the recent empirical evidence cited above that staggering tends to add value in settings of (i) significant scope for (relationship-specific) investments made by managers or shareholders and (ii) significant information asymmetry.\(^5\) Given the market-for-control concerns highlighted in the earlier literature (and absent from our model), (i) appears to be a necessary condition for staggering to be potentially beneficial. By linking the value of commitment to the CEO’s information endowment, our Proposition 3 presents a plausible mechanisms underlying (ii). This mechanism highlights once more the importance of endogeneity in studies of corporate boards.

The takeover defense view of staggering is emphasized by Bebchuk and Co-

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\(^5\)Cremers and Sepe (2016, p.128) use intangible assets as a proxy for asymmetric information: “...firms engaged in investments that imply more asymmetric information benefit more from having a staggered board.”
Building on Koppes et al. (1999), recent empirical studies have shifted the focus to managerial aspects to paint a more favorable view of staggering, especially in settings of significant scope for investment and information asymmetry; e.g., Johnson et al. (2015), Cremers and Sepe (2016), Cremers et al. (2016, 2017), Daines et al. (2016), Ge et al. (2016). Our analytical results demonstrate managerial benefits to staggering in cases that are consistent with these studies. More broadly speaking, it seems important to reexamine which of the commonly-cited takeover defense instruments may yield other (managerial) benefits, and which are unlikely to do so, e.g., poison pills. A better understanding of such potential benefits may yield a more complete picture of “best practices” in corporate governance.

At a technical level, our model is related to Holmstrom (1984), Melumad and Shibano (1991), and Alonso and Matouschek (2007) for communication with commitment on the part of the receiver. While these papers allow for more general information structures than we do, the simpler binary state space allows us to nest the board/CEO interaction in a larger contracting framework where a third party—the shareholders—chooses the board’s incentives; these incentives set the stage for the communication and investment subgame. A binary state space also renders trivial the issue of delegation of decision rights, as the board in our setting always wants to retain control. Alonso and Matouschek (2007) show how such commitment can be sustained in going-concern relationships.

Prior literature has looked at board bias and board communication from different angles. Kumar and Sivaramakrishnan (2008) study a hierarchical agency

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7Closely related, Amihud and Stoyanov (2017) show that the effect of staggered board on firm value is context-specific, thus there should not be a one-size-fits-all regulations.

8We compare our findings with board commitment to those derived in BMQ for cheap talk. The related cheap talk literature comprises, among others, Crawford and Sobel (1982), Desschin (2002), Harris and Raviv (2005, 2008, 2010), Adams and Ferreira (2007), Baldenius et al. (2014), and Chakraborty and Yilmaz (2017). Much of that literature has focused on the allocation of decision rights.
model with exogenous board bias. Building on Drymiotes’s (2007) idea of board monitoring reducing the noise in CEOs’ performance measures, Drymiotes and Sivaramakrishnan (2012) demonstrate how short-term incentives for boards serve to motivate such monitoring. In Levit (2012), a CEO can acquire information and disclose it voluntarily; an antagonistic board then strengthens the CEO’s effort incentives. In contrast, we consider the effect of board bias on the board’s own effort incentives. Chakraborty and Yilmaz (2017) study the optimal board bias and allocation of decision rights, but their board does not engage in costly information gathering activities. Drymiotes and Sivaramakrishnan (2018) examine individual directors’ voting behavior. We treat the board as one decision-maker and focus on the communication between the CEO and the board.

Closest to our paper is BMQ who consider a similar setting but confine attention to cheap talk. By allowing for board commitment, we derive predictions for the effect of staggering on board composition and compensation, communication, and shareholder value. While commitment is the main application we have in mind, our analysis applies equally to other firm-level factors that may affect a board’s commitment power, such as the degree of verifiability of typical investment decisions, e.g., PP&E-heavy vs. intangible-heavy firms.

The remainder of the paper is organized as follows. Section 2 lays out the model. Section 3 briefly reviews the equilibrium under board noncommitment. Section 4 solves for the equilibrium under board commitment. Section 5 compares the outcomes across the two communication modes and discusses the value of board commitment power to the shareholders. Section 6 concludes.

9 Other agency models address the issue of manipulation as a byproduct of CEO incentive pay; e.g., Laux and Laux (2009), Friedman (2014, 2016), Marinovic and Varas (2015), Marinovic and Povel (2017).

10 The interplay between corporate governance—specifically, reporting quality—and the takeover market is addressed in Li et al. (2018).
2 Model

The basic technology, preferences, and information endowment are as in Balde- nius et al. (2018, henceforth BMQ). The main difference is that in BMQ com- munication between the CEO and the board takes the form of cheap talk—i.e., the board acts sequentially rationally to any report received from the CEO— whereas this paper studies the consequences of the board having commitment power when dealing with the CEO, possibly as a result of staggering. To keep the analysis simple, we will adopt a static, reduced-form approach by assuming that a staggered board has commitment power, rather than derive a relational contract that sustains such commitment in a dynamic setting. For indefinite horizons and small enough discount rates, the type of communication protocol assumed below becomes feasible (Alonso and Matouschek, 2007).

2.1 The Setting

A firm faces an investment decision. The model entails three risk-neutral players: shareholders, the CEO, and the board of directors. The CEO is endowed with information regarding the efficient scale of the investment. The shareholders are passive; their role is confined to assembling the board and setting its compensation contract. The board holds the decision rights and aims to learn about the environment. For given economic state, $\omega$, and scale of the investment, $y$, the realized firm value is

$$\pi(y, \omega) \equiv \omega y - \frac{y^2}{2},$$

which we refer to as the NPV. The NPV-maximizing investment is $y^*(\omega) = \omega$.

At the outset, the shareholders and the board only know that the state $\omega$ is either low or high, i.e., $\omega \in \{L, H\}$, $H > L > 0$, with each state equally likely. Let

$$\Lambda_0 \equiv Var(\omega) = \frac{(H - L)^2}{4}$$
denote the unconditional variance, or prior information loss. The CEO privately learns a signal $s$ about $\omega$. We normalize the signal space to coincide with the state space, $s \in \{L, H\}$. The signal is correct with probability $Pr(s = \omega) = q \in (\frac{1}{2}, 1]$. We label $q$ the CEO’s precision and write $Q \equiv q(1-q) \in [0, \frac{1}{4}]$. Then

$$\Lambda_s \equiv \mathbb{E}_s[Var(\omega \mid s)] = Q(H - L)^2$$

is the expected posterior variance conditional on the signal $s$ being available, or the expected posterior information loss. Also, denote by

$$\Delta \equiv \mathbb{E}[\omega \mid s = H] - \mathbb{E}[\omega \mid s = L] = (2q - 1)(H - L)$$

(1)

the updating impact of the CEO’s signal.

The board can engage in information gathering effort, $e \in [0, 1]$ at cost $C(e) = \frac{c e^2}{2}$, $c > 0$, where we normalize $e$ to equal the probability the board perfectly discovers the state $\omega$. This model feature aims to capture the dual nature of information gathering by the board: to uncover what the CEO knows already (a form of monitoring) and to improve on the collectively available information (value-adding activity) by removing the residual uncertainty in the CEO’s information endowment. The CEO’s signal precision, $q$, thus is an ex-ante measure of both the information asymmetry and the relative importance of board monitoring (relative to value-adding activities).

To focus on optimal incentive provision for the board, we suppress any explicit agency problems and compensation issues at the CEO level and instead assume, in reduced form, that the CEO is an empire builder who aims to maximize

$$U_C \propto \pi(y, \omega) + by = \frac{1}{2}(\omega + b)^2 - \frac{1}{2}(y - \omega - b)^2.$$  

(2)

Throughout the paper we re-state the players’ preferences in terms of quadratic loss functions. We refer to $b$ as CEO bias and assume $b > 0$.\footnote{It is without loss of generality to assume positive $b$. All results would go through qualitatively, with suitably flipped interpretations, if $b < 0$.}
The shareholders compensate the board with a fixed payment $F$ and an equity stake $\alpha \in [0, 1]$, so the shareholders’ payoff reads

$$U_S = (1 - \alpha)\pi - F = (1 - \alpha)\left[\frac{1}{2}\omega^2 - \frac{1}{2}(y - \omega)^2\right] - F.$$  

(3)

In line with compensation practice, we assume throughout that $\alpha \in [0, 1]$ and $F \geq 0$.\footnote{A non-negative salary $F$ would emerge endogenously, if the board were protected by limited liability and the realized firm value were subject to some random shock, $\tilde{\epsilon}$, i.e., $\tilde{\pi} = (\omega y - \omega^2)\tilde{\epsilon}$, where $\tilde{\epsilon} \in [0, \bar{\epsilon}]$ is realized after all actions were chosen.}

Aside from compensation incentives, the board also derives non-pecuniary utility of $\bar{\beta} \in \mathbb{R}$ per unit of the investment, so its payoff reads

$$U_B = \alpha \pi + \bar{\beta}y + F - C(e) = \alpha \left[\frac{1}{2}(\omega + \bar{\beta})^2 - \frac{1}{2}(y - \omega - \bar{\beta})^2\right] + F - \frac{ce^2}{2}, \quad \text{for } \beta \equiv \frac{\bar{\beta}}{\alpha}. \quad (4)$$

It is notationally convenient to work with the scaled bias term $\beta \equiv \bar{\beta}/\alpha$, henceforth simply referred to as board bias. By individual rationality, the board’s expected utility has to exceed its reservation utility normalized to zero.\footnote{As we show below, the board’s individual rationality constraint is always slack at the optimal solution. Hence, there are no “money pump” issues in our setting, i.e., the shareholders cannot extract, at the margin, any non-pecuniary benefits they endow the board with.}

Given any available information, $\Omega \in \{\emptyset, r, s, \omega\}$, the players’ preferred investment levels are, respectively:

$$y_S(\Omega) = E[\omega \mid \Omega] \text{ for the shareholders;}$$

$$y_C(\Omega) =$$

\footnote{It is a standard assumption in the literature that the owner of the firm can control some key preference parameters of the board—more generally, of some intermediary—when dealing with management, e.g., Dessein (2002), Drymiotes (2007), Chakraborty and Yilmaz (2017).}

\footnote{We treat the board as one decision-maker rather than modeling explicitly the aggregation of individual directors’ preferences or efforts (Li, 2001; Harris and Raviv, 2008).}
$\mathbb{E}[\omega \mid \Omega] + b$ for the CEO; and $y_B(\Omega) = \mathbb{E}[\omega \mid \Omega] + \beta$ for the board. If the board successfully uncovers $\omega$, it will choose $y_B(\omega) = \omega + \beta$ and thus realize its bliss point. If information gathering fails, the board chooses investment level $\bar{y}$, which may depend nontrivially on the communication game played with the CEO.

The timeline is given in Figure 1: At Date 0 the shareholders pick $(\alpha, F, \beta)$. At Date 1 the board chooses information gathering effort, $e$. At Date 2 the board chooses the investment $y$. If information gathering was successful, the board will choose its preferred investment, $y_B(\omega)$; otherwise, it will choose $\bar{y}$ based on a report by the CEO—specifically, with commitment the uninformed board precommits to a menu of investment levels, and the CEO picks an entry from the menu by issuing a report.

2.2 The Shareholders’ Problem

Because our goal is to isolate the effects of board commitment on the equilibrium outcome, we begin by describing the contracting problem faced by the shareholders generically, i.e., for either communication mode, using the super-
script $k \in \{c, nc\}$ as shorthand for “commitment” and “noncommitment” (cheap talk), and subscript $j \in \{S, B, C\}$ for “shareholders,” “board,” and “CEO,” respectively. Let

$$\bar{\ell}_j^k(\beta, b) = \frac{1}{2} \sum_{s, \omega} \Pr(s, \omega) \left( \bar{y}^k(r^k(s)) - \omega - x^c_j \right)^2,$$

where $x^c_j = \begin{cases} 0, & \text{for } j = S \\ \beta, & \text{for } j = B \\ b, & \text{for } j = C \end{cases}$ (5)

denote player $j$’s expected loss for communication mode $k$ conditional on unsuccessful information gathering by the board, where $r^k(s)$ denote the CEO’s equilibrium reporting strategy, as described below. Denote by $\ell_j(\beta, b)$ the corresponding expected loss conditional on successful information gathering, which equals the term in (5) with $y_B(\omega)$ substituted for $\bar{y}^k(r^k(s))$: having learned the state $\omega$, the board chooses its bliss point $y_B(\omega) = \omega + \beta$, resulting in losses of $\ell_B = 0$ for itself, $\ell_S = \frac{\beta^2}{2}$ for the shareholders, and $\ell_C = \frac{(b-\beta)^2}{2}$ for the CEO, respectively.

At Date 1 the board chooses its information gathering effort $e$ to maximize its expected payoff as per Date 1, which by (4) reads:

$$EU^k_B(e | \alpha, \beta, F) = \alpha \left( \frac{1}{2} \mathbb{E}_\omega [(\omega + \beta)^2] - (1 - e)\bar{\ell}_B^k(\beta, b) \right) + F - \frac{ce^2}{2}. \quad (6)$$

Thus the board’s optimal effort $e^k(\alpha, \beta)$ is determined by the first-order condition, for any $k$,

$$e^k(\alpha, \beta) = \frac{\alpha}{c} \bar{\ell}_B^k(\beta, b). \quad (7)$$

The induced effort is increasing in the board’s equity stake, $\alpha$, and its “cost of ignorance,” $\bar{\ell}_B^k(\cdot)$. Moreover, the incentive constraint (7) displays complementarity: the greater the board’s cost of ignorance, the more effectively an increase in $\alpha$ elicits board effort, at the margin. Let $EU^k_B(\alpha, \beta, F) \equiv EU^k_B(e^k(\alpha, \beta) | \alpha, \beta, F)$ denote the board’s value function under communication mode $k$.

At the outset the shareholders assemble and contract with the board. Anticipating the board’s effort choice and the communication game if the board
remains uninformed, for any CEO bias \( b \), the shareholders choose \((\alpha, \beta, F)\) to maximize their expected Date-0 utility, which by (3) reads:

\[
\text{EU}_S^k(\alpha, \beta, F) = (1 - \alpha) \left( \frac{1}{2} \mathbb{E}_\omega[\omega^2] - e^k(\alpha, \beta) \ell_S(\beta) - [1 - e^k(\alpha, \beta)] \bar{\ell}_S(\beta, b) \right) - F. \tag{8}
\]

At Date 0, for communication mode \( k \in \{c, nc\} \), the shareholders solve the program:

\[
\mathcal{P}^k : \max_{\alpha \in [0, 1], \beta \in \mathbb{R}, F \in \mathbb{R}^+} \text{EU}_S^k(\alpha, \beta, F),
\]

subject to:

\[
\text{EU}_B^k(\alpha, \beta, F) \geq 0, \tag{IR}
\]

We denote the solution to Program \( \mathcal{P}^k \) by \((\alpha^k, \beta^k, F^k)\). To ensure interior board efforts and equity shares, we assume \( q < \bar{q} \), for some \( \bar{q} \in (\frac{1}{2}, 1) \), and \( c \in (c_1, c_2) \).

(See Appendix B for closed-form expressions for all these bounds.)

3 Benchmark: Cheap-Talk Reporting Game

The typical treatment of strategic communication in board settings is to assume no commitment power at the communication stage and to invoke techniques first developed by Crawford and Sobel (1982) for cheap-talk communication games.

The cheap-talk case was studied by BMQ; we simply borrow their characterization of the outcome. First, \( \beta \leq b \) holds, i.e., in equilibrium the CEO always prefers a larger investment than does the board. Second, with a binary signal privately known to the CEO, cheap talk communication is “bang-bang” in nature: if the preferences of the CEO and board regarding the investment level are sufficiently aligned, specifically, if

\[
b - \beta \leq \frac{\Delta}{2}, \tag{9}
\]

then the CEO reports truthfully \( r = s \), and the board invests according to \( \bar{y}^{mc}(r) = \mathbb{E}[\omega \mid r] + \beta \). We label this outcome perfect communication (PC), because the board realizes its preferred investment scale given the CEO’s signal.
On the other hand, if $b - \beta > \frac{\Delta}{2}$, babbling is the unique equilibrium, and the board invests according to its prior: $\bar{y}^{nc}(r) = \mathbb{E}[\omega] + \beta$. By (9), the more significant the CEO’s information advantage, the greater the scope for cheap talk communication. We refer to

$$\beta_{PC}(b) \equiv b - \frac{\Delta}{2}$$

as the critical board bias level at which perfect communication becomes feasible under cheap talk.

**Proposition 0 (BMQ—the solution to Program $P^{nc}$)** With cheap talk communication (non-commitment), the optimal fixed wage is $F^{nc} = 0$, and there exists a unique CEO precision level $q_o$ such that:

(a) **High-$q$:** For $q > q_o$, there exists a CEO bias level $b_o(q) \in \left(\frac{\Delta}{2}, \Delta\right)$, such that:

(i) The optimal board bias $\beta^{nc}(b)$ is discontinuous at $b_o(q)$, non-monotonic, and weakly friendly:

* For $b \leq b_o(q)$, $\beta^{nc}(b) = 0$, implementing perfect communication;
* For $b \in \left(\frac{\Delta}{2}, b_o(q)\right)$, $\beta^{nc}(b) = \beta_{PC}(b) > 0$, implementing perfect communication;
* For $b \geq b_o(q)$, $\beta^{nc}(b) = 0$, implementing babbling.

(ii) The optimal equity stake $\alpha^{nc}(b)$ is monotonically non-decreasing with a discrete jump up at $b_o(q)$.

(b) **Low-$q$:** For $q < q_o$, there exists a CEO bias level $b_o(q) < \frac{\Delta}{2}$, such that:

(i) The optimal board bias $\beta^{nc}(b)$ is discontinuous at $b_o(q)$, non-monotonic, and weakly antagonistic:

* For $b \leq b_o(q)$, $\beta^{nc}(b) = 0$, implementing perfect communication;
* For $b \in \left(b_o(q), \frac{\Delta}{2}\right)$, $\beta^{nc}(b) = \beta_{PC}(b) < 0$, implementing babbling;
* For $b \geq \Delta / 2$, $\beta^{nc}(b) = 0$, implementing babbling.

(ii) The board’s equity stake $\alpha^{nc}(b)$ is non-decreasing for any $b \notin (b_o(q), \Delta / 2)$, with a discrete jump up at $b_o(q)$, but strictly decreasing for any $b \in (b_o(q), \Delta / 2)$.

The shareholders use the indifference condition (9) to “toggle” between inducing perfect communication and babbling. For severe CEO agency problems, $b > \Delta / 2$, babbling obtains if the board is unbiased, but the shareholders can induce perfect communication by setting $\beta^{nc} = \beta_{PC}(b) > 0$. Likewise, for mild CEO agency problems, $b < \Delta / 2$, perfect communication obtains for $\beta = 0$, but setting $\beta^{nc} = \beta_{PC}(b) - \varepsilon < 0$ would block communication (throughout the paper we suppress $\varepsilon$). In either case, the optimal board bias is either zero or the critical threshold $\beta_{PC}(b)$, which is just sufficient to induce the desired communication case. To assess which of these board bias levels is optimal requires trading off: (i) the decision bias cost (minimized at $\beta = 0$), (ii) the board’s effort incentives (calling for a lower $\beta$-value), and (iii) communication efficiency (calling for a higher $\beta$-value). For precise CEO signals ($q > q_o$) communication is valuable, resulting in a weakly friendly board; conversely, for $q < q_o$ the optimal board is weakly antagonistic to foster information gathering. See BMQ for details.

4 Board Commitment

4.1 Effect of Board Commitment on Date-2 Subgame

By extending the interaction horizon between the board and management, staggering permits relational contracting and thus confers commitment power to the board (Alonso and Matouschek, 2007). The idea is that, because a staggered board is a going concern, it can credibly (albeit implicitly) promise to the CEO that it will take his interests into consideration when making decisions. In return, the CEO may be more willing to share his private information. This reasoning is in line with the recent empirical literature on the benefits of board staggering.
As a reduced-form approach, we equate staggering with board commitment. A staggered board precommits to a report-contingent investment schedule (“menu”) before eliciting a report from the CEO. This is equivalent to delegating the decision to the CEO subject to the constraint that the CEO pick an investment level from the menu. Incentive compatibility is ensured by the truthtelling constraints in the board’s sub-program at Date 2: for given \((\beta, b)\),

\[
\mathcal{SP}^c : \min_{(y(H), y(L))} \sum_{s \in \{H, L\}, \omega \in \{H, L\}} Pr(s, \omega) (y(s) - \omega - \beta)^2 ,
\]

s.t.:

\[
\begin{align*}
\mathbb{E}_\omega [(y(H) - \omega - b)^2 | s = H] &\leq \mathbb{E}_\omega [(y(L) - \omega - b)^2 | s = H], \quad (TT_H) \\
\mathbb{E}_\omega [(y(L) - \omega - b)^2 | s = L] &\leq \mathbb{E}_\omega [(y(H) - \omega - b)^2 | s = L]. \quad (TT_L)
\end{align*}
\]

Constraint \((TT_s)\), ensures that the CEO truthfully reports his private signal \(s = H, L\). If the CEO prefers a larger investment level than the board, i.e., \(\beta < b\), the potentially binding truthtelling constraint is \(TT_L\), which disciplines the CEO’s reporting behavior when he has observed a low signal. To simplify the exposition, for now, we assume that \(\beta \leq b\). We will show later (Proposition 1) that this ranking of bias levels indeed obtains in equilibrium.

**Lemma 1 (Commitment)** At Date 2, for given \(\beta \leq b\), suppose the board is uninformed about \(\omega\) but can precommit to a report-contingent decision rule. Then:

(a) If \(b - \beta \leq \frac{\Delta}{2}\), then \(\bar{y}^c(r) = \beta + \mathbb{E}[\omega | r]\), and the CEO’s report fully reveals \(s\), implementing perfect communication.

(b) If \(b - \beta \in \left(\frac{\Delta}{2}, \Delta\right]\), then \(\bar{y}^c(r = L) = b + \mathbb{E}[\omega | L] - \frac{\Delta}{2}\) and \(\bar{y}^c(r = H) = b + \mathbb{E}[\omega | L] + \frac{\Delta}{2}\), and the CEO’s report fully reveals \(s\), implementing constrained communication \((CC)\).

(c) If \(b - \beta > \Delta\), then the board commits to ignoring any CEO report and invests according to its prior, \(\bar{y}^c(r) = \mathbb{E}[\omega] + \beta\), implementing babbling.
Endowed with commitment power, the board can always induce the CEO to report obediently. Their preference alignment determines the cost of ensuring truthtelling. Figure 2 depicts the loss functions of the board (red, solid) and the CEO (blue, dashed) to illustrate the communication outcome for decreasing board bias levels $\beta_1$ through $\beta_3$. In analogy with (10), we define

$$\beta_{CC}(b) \equiv b - \Delta$$

as the critical board bias level at which constrained communication becomes feasible with commitment. A board that is closely aligned with the CEO ($\beta_1$ in Fig.2a) achieves perfect communication simply by committing to its preferred investment levels: having observed a low signal, the CEO strictly prefers $y_B(s = L)$ to $y_B(s = H)$. As the board bias decreases to $\beta_{PC}(b)$, the CEO becomes indifferent between these investments, i.e., $TT_L$ becomes binding (Fig.2b). As $\beta$ decreases further to $\beta_2 \in (\beta_{CC}(b), \beta_{PC}(b))$, the board commits to investment levels $\{\bar{y}(r)\}$ that deviate from its bliss points by an amount $\varepsilon$ so as to keep the CEO indifferent upon observing a low signal—the constrained communication (CC) case, Lemma 1b (Fig.2c). For very low board bias, $\beta_3 < \beta_{CC}(b)$ (Fig.2d), the distortions at these incentive-compatible investment levels outweigh the value of the CEO’s signal: the board is better off investing according to its prior, i.e., $\bar{y} = \beta + E[\omega]$, resulting in babbling.

All else equal, by revealed preference, commitment on the part of the receiver weakly improves information transmission—but when is this improvement strict? Contrasting Lemma 1 with the indifference condition under cheap talk in (9), we find that for extreme levels of relative preference divergence the outcome is insensitive to the board’s commitment power: babbling obtains for poor alignment ($b - \beta > \Delta$); perfect communication, for close alignment ($b - \beta \leq \frac{\Delta}{2}$). Commitment power on the part of the board affects the outcome only for intermediate levels of alignment, $b - \beta \in \left(\frac{\Delta}{2}, \Delta\right]$: cheap talk then results in babbling, while board commitment facilitates constrained communication. Fig. 3a,c illustrates
Fig. 2a: Perfect communication between board (red) and CEO (dashed-blue) for large $\beta_1$

$y_L(L|\beta_1) = \bar{y}(r=L)$
$y_H(H|\beta_1) = \bar{y}(r=H)$

Fig. 2b: Knife-edge case: $TT_L$ becomes binding ($\beta = \beta_{PC}(b)$)

$y_L(L|\beta_{PC}(b)) = \bar{y}(r=L)$
$y_H(H|\beta_{PC}(b)) = \bar{y}(r=H)$

Fig. 2c: Constrained communication for intermediate alignment ($\beta_2 \in (\beta_{CC}(b), \beta_{PC}(b))$)

$y_L(L|\beta_2) \beta + \mathbb{E} [\omega] \bar{y}(r=L)$
$y_H(H|\beta_2) \bar{y}(r=H)$

Fig. 2d: Babbling for small $\beta_3$, because constrained communication too costly

Fig. 2: Loss terms: deterioration of communication as $\beta$ decreases for given $b$
this communication improvement, using the same $\beta$-levels as in Fig. 2. Having observed a low signal, the CEO would like to invest $y_C(s = L)$. For $\beta < \beta_{PC}(b)$, cheap talk collapses; e.g., at $\beta_2$, the CEO prefers $y_B(s = H)$ to $y_B(s = L)$, as expressed by $AC < CB$. Commitment in contrast permits constrained communication, making the investment schedule in Fig. 3c continuous for $\beta \in (\beta_{CC}(b), b]$. The attendant investment distortion cost to the board, measured by $\varepsilon$, is small for $\beta$ close to $\beta_{PC}(b)$, but increases for smaller board bias (greater preference divergence). At $\beta_{CC}(b)$, the distortions $(DF, EG)$ equal the value of the CEO’s signal $(EF, EG)$. As $\beta$ decreases further, say to $\beta_3$, the investment schedule with commitment therefore collapses to the babbling one, as under cheap talk.

Tables 1 and 2 summarize the investment decisions and the players’ loss terms with commitment and cheap talk, respectively. For both perfect communication and babbling, the players’ loss terms differ only by the bias term, $\frac{\beta^2}{2}$, because the board and shareholders equally internalize any remaining information loss, $\frac{\Lambda_l}{2}$, $l = \emptyset, s$. Constrained communication can obtain only with commitment, in which case the shareholder’s loss is independent of the board bias $\beta$, as the investment decision $\bar{y}^C(\cdot)$ is dictated fully by the CEO’s binding truth-telling constraint. By avoiding the discontinuous jump from perfect to no communication at $\beta_{PC}(b)$ and instead replacing it with a gradual increase in bias cost to the board as the CEO/board alignment deteriorates, commitment leaves the board strictly better off for $\beta \in (\beta_{CC}(b), \beta_{PC}(b)]$.  

4.2 The Overall Equilibrium with Commitment

We now turn to the shareholders’ decision problem at Date 0, when assembling and contracting with the board. Before solving $P^c$, it is helpful to gain some intuition for the tradeoffs involved. The board bias $\beta$ affects the shareholders’ expected payoff through three channels: (a) directly through the investment choice made by a fully informed board, $y = \omega + \beta$; (b) through the board’s investment choice upon failed information gathering, $\bar{y}^c$, by way of mediating the
Fig. 3a: Noncommitment: Investments

\[ y_c(L) = b + \mathbb{E}[\omega|L] \]

\[ y_B(L) = \beta + \mathbb{E}[\omega|L] \]

Fig. 3b: Noncommitment: Board loss

\[ y_B(H) = \beta + \mathbb{E}[\omega|H] \]

\[ y_B(\emptyset) = \beta + \mathbb{E}[\omega] \]

Fig. 3c: Commitment: Investments

\[ y_c(L) = b + \mathbb{E}[\omega|L] \]

\[ y_c(L) = b + \mathbb{E}[\omega|L] \]

\[ y_c(H) = b + \mathbb{E}[\omega|H] \]

\[ y_B(H) = \beta + \mathbb{E}[\omega|H] \]

\[ y_B(\emptyset) = \beta + \mathbb{E}[\omega] \]

Fig. 3d: Commitment: Board loss

\[ y_B(H) = \beta + \mathbb{E}[\omega|H] \]

\[ y_B(\emptyset) = \beta + \mathbb{E}[\omega] \]

Fig. 3: The Effect of Board Commitment on Communication Outcome
If monitoring unsuccessful:

<table>
<thead>
<tr>
<th></th>
<th>PC</th>
<th>CC</th>
<th>Babbling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Perfect Communication)</td>
<td>(Constrained Communication)</td>
<td></td>
</tr>
<tr>
<td>Investment, $\bar{y}^c(r^*=s)$</td>
<td>$b - \beta \in [0, \Delta]$</td>
<td>$b - \beta \in (\Delta, \bar{\Delta})$</td>
<td>$b - \beta &gt; \Delta$</td>
</tr>
<tr>
<td>Board’s loss, $\bar{\ell}_B^c$</td>
<td>$\frac{1}{2} \Lambda_s$</td>
<td>$\frac{1}{2} \left[ \Lambda_s + (b - \beta - \frac{\Delta}{2})^2 \right]$</td>
<td>$\frac{1}{2} \Lambda_\emptyset$</td>
</tr>
<tr>
<td>Shareholders’ loss, $\bar{\ell}_S^c$</td>
<td>$\frac{1}{2} (\Lambda_s + \beta^2)$</td>
<td>$\frac{1}{2} \left[ \Lambda_s + (b - \frac{\Delta}{2})^2 \right]$</td>
<td>$\frac{1}{2} (\Lambda_\emptyset + \beta^2)$</td>
</tr>
</tbody>
</table>

Table 1: Outcome Given Unsuccessful Information Gathering: Commitment

<table>
<thead>
<tr>
<th></th>
<th>PC</th>
<th>Babbling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b - \beta \in [0, \Delta]$</td>
<td>$b - \beta &gt; \Delta$</td>
</tr>
<tr>
<td>Investment, $\bar{y}^{nc}(r)$</td>
<td>$\mathbb{E}[\omega</td>
<td>r=s] + \beta$</td>
</tr>
<tr>
<td>Board’s loss, $\bar{\ell}_B^{nc}$</td>
<td>$\frac{1}{2} \Lambda_s$</td>
<td>$\frac{1}{2} \Lambda_\emptyset$</td>
</tr>
<tr>
<td>Shareholders’ loss, $\bar{\ell}_S^{nc}$</td>
<td>$\frac{1}{2} (\Lambda_s + \beta^2)$</td>
<td>$\frac{1}{2} (\Lambda_\emptyset + \beta^2)$</td>
</tr>
</tbody>
</table>

Table 2: Outcome Given Unsuccessful Inform. Gathering: Noncommitment

communication game as per Lemma[1] and (c) through the board’s information gathering effort, $e^c(\alpha, \beta)$, which in turn determines the relative weights on (a) and (b). Put differently, on the one hand, lowering the absolute board bias $|\beta|$ minimizes the shareholders’ loss holding constant the board’s information. This follows from the fact that the loss terms $\ell_S = \frac{\beta^2}{2}$ (information gathering has succeeded) and $\bar{\ell}_S$ (information gathering has failed) in Table 1 are reaching their respective minima at $\beta = 0$. On the other hand, biasing the board may improve the board’s information: lowering $\beta$ elicits greater information gathering effort, whereas raising $\beta$ may improve CEO/board communication. That is, the direction of any deviation from $\beta = 0$ trades off information gathering and communication benefits.

Our next result describes the solution to Program $\mathcal{P}^c$:
Proposition 1 (Commitment) If the board can commit to a report-contingent investment rule, then the optimal fixed wage $F^c = 0$ and:

(a) The optimal board bias $\beta^c(b)$ is continuous, single-troughed, and weakly antagonistic:

- For $b \leq \frac{\Delta}{2}$, $\beta^c(b) = 0$, implementing perfect communication;
- For $b \in (\frac{\Delta}{2}, \tilde{b})$, $\beta^c(b) = \beta^{\text{int}}(b) < 0$, with $\beta^{\text{int}}(b)$ uniquely determined by

$$
\left( b - \frac{\Delta}{2} - \beta^{\text{int}}(b) \right)^2 \left( b - \frac{\Delta}{2} + 2\beta^{\text{int}}(b) \right) = - \left( b - \frac{\Delta}{2} \right) \Lambda_s, \quad (12)
$$

and $\tilde{b}$ uniquely determined by $\beta^{\text{int}}(\tilde{b}) = \beta^{\text{CC}}(\tilde{b})$, implementing constrained communication;
- For $b \in (\tilde{b}, \Delta)$, $\beta^c(b) = \beta^{\text{CC}}(b) < 0$, implementing constrained communication;
- For $b \geq \Delta$, $\beta^c(b) = 0$, implementing babbling.

(b) The optimal equity stake $\alpha^c(b)$ is continuous and monotonically non-decreasing.

Why is the optimal board bias with commitment always weakly antagonistic? First, we show in the proof that the shareholders never want to “jump” across the communication cases given in Table 1. The (absolute) board bias level required to induce such a discrete jump in the communication game between the CEO and the board would be so high that any benefits from enhanced communication or information gathering are outweighed by the attendant bias cost. Thus, we only need to consider “local” (within-case) changes in $\beta$. Recall from the incentive constraint (7) that the board exerts greater information gathering effort, the greater its cost of ignorance, $\bar{\ell}_B^{\text{CC}}(\beta, b)$. For sufficiently small or large CEO biases ($b \leq \frac{\Delta}{2}$ or $b > \Delta$), introducing a small board bias has no impact on communication or the board’s effort, as $\bar{\ell}_B^{\text{CC}}(\beta, b)$ then is independent of $\beta$ (Table
1), but it would increase the shareholders’ bias cost. Hence, the board should be unbiased.

For intermediate CEO bias, $b \in (\frac{\Delta}{2}, \Delta]$, first note that it is never optimal to appoint a friendly board: Setting $\beta > 0$ would impede information gathering and introduce a decision bias without any offsetting benefits, as $\bar{\ell}_S$ is independent of $\beta$ with constrained communication, $CC$. On the other hand, introducing a small antagonistic bias, $\beta < 0$, exposes the shareholders to merely a second-order bias cost if the board becomes informed, while generating a first-order benefit through greater board effort. An antagonistic board is therefore optimal for intermediate CEO bias levels. Specifically, the interior solution to the shareholders’ optimization problem under constrained communication trades off the above effects. As the CEO bias reaches some threshold $\tilde{b}$, however, this interior solution would result in a preference divergence $b - \beta^{\text{int}}(b)$ exceeding $\Delta$, resulting in babbling. For $b \in (\tilde{b}, \Delta)$, thus, the shareholders select the knife-edge board bias, $\beta^c(b) = \beta_{CC}(b)$, that just ensures constrained communication, $CC$.

To understand why the optimal fixed wage $F^c$ is zero, note that the board could secure a non-negative expected payoff by simply choosing zero effort; i.e., the board’s individual rationality constraint is slack at $F = 0$. Therefore, the board’s optimal equity stake trades off effort incentives and dilution concerns. Both forces push toward a positive relation between CEO agency problems and $\alpha^c$ (Proposition 1b): More severe agency problems at the CEO level (i) dampen the shareholders’ dilution cost and (ii) increase the board’s cost of ignorance. The latter in turn makes equity a more powerful incentive instrument because of the complementarity of $\alpha$ and $\bar{\ell}_B$ in eliciting board effort, by (7).

5 Discussion and the Value of Commitment

This section summarizes the key implications of our results, with an eye to the issue of endogeneity in empirical analyses of boards. To that end, we first com-
pare the equilibria that obtain under the respective communication modes and then evaluate the value of board commitment to the shareholders. This generates predictions as to the effect of staggering on the internal governance of firms.

5.1 The Effect of Commitment on the Equilibrium

We present three corollaries that compare the main endogenous constructs across the two communication modes. Corollaries [1] and [2] relate to the equilibrium board bias levels and induced communication cases. They follow directly from the preceding propositions and require no proof:

**Corollary 1 (Equilibrium board bias levels)**

(a) **High q**: For \( q \geq q_o \), we have \( \beta^c(b) \leq 0 \leq \beta^{nc}(b) \) for any \( b \); hence, the board is always weakly friendlier with cheap talk than with commitment.

(b) **Low q**: For \( q < q_o \), the ranking of the equilibrium board bias levels depends on the CEO bias, \( b \):

(i) For any \( b \in \left( b_o(q), \frac{\Delta}{2} \right) \), we have \( \beta^c(b) = 0 > \beta^{nc}(b) \).

(ii) For any \( b \in \left( \frac{\Delta}{2}, \Delta \right) \), we have \( \beta^c(b) < 0 = \beta^{nc}(b) \).

The optimal board bias is always weakly antagonistic with commitment; with cheap talk, its direction depends on the precision of the CEO’s signal. As discussed in connection with Propositions [0] and [1] with cheap talk the shareholders face a stark (discrete) tradeoff between communication (between the CEO and board) and board information gathering effort, whereas commitment makes this tradeoff continuous. Under cheap talk either learning channel may be given priority—for sufficiently precise CEO signals the shareholders opt to facilitate communication by means of a friendly board. With commitment, in contrast, the only first-order effect of introducing a small antagonistic bias is an increase in board effort, which is beneficial to the shareholders.
We now turn to the equilibrium equity stakes and induced board effort levels. As noted in connection with the effort incentive constraint in (7), the board will exert greater effort, the higher are its equity stake and its cost of ignorance—with the two factors being complements. With that in mind, how does commitment power on the part of the board affect board effort, in equilibrium? A reasonable working hypothesis may be that commitment power should reduce the board’s effort incentives because, all else equal, communication (free) and information gathering (costly) are imperfect substitutes as channels for learning about the state—and commitment fosters communication (Tables 1 and 2; Fig. 3). However, this hypothesis overlooks the endogenous nature of board bias.

To predict the relation between board commitment power and information gathering effort, it is therefore important to understand how commitment affects the efficiency of communication between the CEO and the board, in equilibrium, i.e., factoring in the optimal board bias. On a technical level, this boils down to a comparison of the board’s cost of ignorance terms, $\bar{\ell}_k(\beta^k(b), b)$, resulting under the two modes of communication, $k = c, nc$:

**Corollary 2 (Communication efficiency)**

(a) **High $q$:** For $q \geq q_o$, board commitment power may improve or hamper communication, depending on the exogenous CEO bias:

(i) For $b \in (\Delta_2, b_o(q))$, commitment yields constrained communication, whereas cheap talk yields perfect communication; hence, $\bar{\ell}_c^c(\beta^c(b), b) > \bar{\ell}_c^nc(\beta^nc(b), b)$.

(ii) For $b \in (b_o(q), \Delta)$, commitment yields constrained communication, whereas cheap talk yields babbling; hence, $\bar{\ell}_c^c(\beta^c(b), b) < \bar{\ell}_c^nc(\beta^nc(b), b)$.

(b) **Low $q$:** For $q < q_o$, commitment always weakly improves the efficiency of communication, i.e., $\bar{\ell}_c^c(\beta^c(b), b) \leq \bar{\ell}_c^nc(\beta^nc(b), b)$, for any $b$, and strictly
so for \( b \in (b_o(q), \Delta) \) where cheap talk yields babbling, whereas commitment yields either perfect or constrained communication.

For CEOs with low-precision signals, commitment indeed always results in weakly more efficient communication. Under cheap talk the shareholders would only ever install a biased board as a way to forestall (not foster) communication. For high \( q \), however, the endogenous board bias may overturn the above intuition for intermediate CEO bias levels: an antagonistic board with commitment power finds itself at a communication disadvantage compared with a friendly board that has to rely on cheap talk. Put differently, if the CEO has a significant information advantage at the outset, the endogenous board bias more than compensates for the lack of commitment power in terms of facilitating communication.

To rank the equilibrium equity incentives of the board and the resultant effort choices, recall that the shareholders trade off board effort and dilution costs when choosing \( \alpha \). Corollary 2 speaks to one determinant of this tradeoff: by (7), greater cost of ignorance to the board (less efficient communication) makes equity a more effective instrument, at the margin. The dilution cost however centers on expected firm value, and thus on the shareholders’ (rather than the board’s) loss function.

**Corollary 3 (Equilibrium equity stakes and effort levels)**

(a) **High** \( q \): For \( q \geq q_o \):

(i) If \( b \in \left( \frac{\Delta}{2}, b_o(q) \right) \), then \( \alpha^c(b) > \alpha^{nc}(b) \) and \( e^c(b) > e^{nc}(b) \);

(ii) If \( b \in (b_o(q), \Delta) \), then \( \alpha^c(b) < \alpha^{nc}(b) \) and \( e^c(b) < e^{nc}(b) \).

(b) **Low** \( q \): For \( q < q_o \), \( \alpha^c(b) \leq \alpha^{nc}(b) \) and \( e^c(b) \leq e^{nc}(b) \), for any \( b \).

The key takeaway from Corollary 3 is that the board’s equilibrium equity stake and information gathering effort are fully determined in a one-to-one fashion by the communication case that obtains in equilibrium, as per Corollary 2.
That is, the incentive effect of the discord between the players regarding the desired investment level outweighs any dilution concerns. For instance, for CEOs with high-precision signals and $b \in \left( \frac{\Delta}{2}, b_0(q) \right)$, board commitment can be shown to increase firm value for given $\alpha$, thus aggravating the dilution concerns, yet the (antagonistic) board receives a greater equity stake because of the incentive effect. This illustrates the importance of the complementarity between cost of ignorance and equity incentives in eliciting board effort.

Coming back to the theme of endogeneity with which we started this section: all else equal, a board that has commitment power indeed has weaker effort incentives. In equilibrium, however, the endogenous nature of board bias may flip this prediction—an antagonistic board with commitment power may have stronger incentives to gather information than a friendly board that has to rely on cheap talk as the mode of communication.\(^{16}\) Table 3 summarizes the effects of board commitment on the key endogenous constructs, and Fig. 4 provides an illustration using a numerical example:

<table>
<thead>
<tr>
<th>Corollary 1 (Board bias)</th>
<th>Corollary 2 (Communication)</th>
<th>Corollary 3 (Equity stakes, efforts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High $q$: $b \in \left( \frac{\Delta}{2}, b_0(q) \right)$</td>
<td>$\beta^c &lt; 0 &lt; \beta^{nc}$</td>
<td>$\bar{\ell}^c_B (CC) &gt; \bar{\ell}^{nc}_B (PC)$</td>
</tr>
<tr>
<td>$b \in (b_0(q), \Delta)$</td>
<td>$\beta^c &lt; 0 = \beta^{nc}$</td>
<td>$\bar{\ell}^c_B (CC) \leq \bar{\ell}^{nc}_B (Babbling)$</td>
</tr>
<tr>
<td>Low $q$: $b \in \left( b_0(q), \frac{\Delta}{2} \right)$</td>
<td>$\beta^c = 0 &gt; \beta^{nc}$</td>
<td>$\bar{\ell}^c_B (PC) &lt; \bar{\ell}^{nc}_B (Babbling)$</td>
</tr>
<tr>
<td>$b \in \left( \frac{\Delta}{2}, \Delta \right)$</td>
<td>$\beta^c &lt; 0 = \beta^{nc}$</td>
<td>$\bar{\ell}^c_B (CC) \leq \bar{\ell}^{nc}_B (Babbling)$</td>
</tr>
</tbody>
</table>

**Table 3:** Effect of Board Commitment on Key Endogenous Constructs

\(^{16}\)Faleye (2007) finds staggered boards to be associated with lax monitoring. Taking board effort, $e^k(\cdot)$, as a proxy for board monitoring, our results suggest that sharper empirical results may be obtained by conditioning tests on the link between staggering and monitoring intensity on measures of information asymmetry at the firm level.
5.2 The Value of (Board) Commitment

We now ask whether the shareholders ultimately benefit from commitment power on the part of the board. All else equal, of course, endowing any party with commitment power makes that party weakly better off under quite general conditions. The matter is more complicated in our a three-player setting, because we are primarily concerned with the expected payoff to the shareholders, but it is the board that may or may not have commitment power. At the same time, the fact that
the shareholders can control the preferences of the board may suggest that the shareholders should be able to benefit from the board’s commitment power. To show that this logic does not always hold, we proceed in two steps: We begin by assuming information gathering is ineffective \((c \to \infty)\) to focus solely on the communication subgame, and then assess the effect of board commitment on shareholder value in the full-fledged model.

5.2.1 Value of Commitment if Board Effort is Ineffective

Consider for illustration first the case in which the board cannot effectively gather information because \(c \to \infty\). If the board is unbiased, for some exogenous reason, then by comparison of Tables 1 and 2, the shareholders are better off with a board that has commitment power. But what if the shareholders can choose \(\beta\) in their best interest?

If the board can commit to a report-contingent investment pair, but cannot engage in information gathering, then at Date 2 the shareholders are best served by an unbiased board \((\beta^e = 0)\) that fully internalizes their objective. For noncommitment, adapting the arguments in Dessein (2002), BMQ show that

\[
\beta^{nc}(b) = \begin{cases} 
0, & \text{for } b \notin \left(\Delta^2, \Delta \right), \\
\beta_{PC}(b), & \text{for } b \in \left(\Delta^2, \Delta \right). 
\end{cases}
\]

(13)

The optimal board bias under cheap talk now is always weakly positive: the communication benefit outweighs the attendant bias cost, which is of second order for small levels of \(\beta\). In our binary state model, the communication benefit of facilitating perfect communication is \(\frac{1}{2}(\Lambda_\theta - \Lambda_\sigma)\); the attendant bias cost to the shareholders is \(\frac{1}{2}\beta^2\) where \(\beta = \beta_{PC}(b)\) (Tables 1 and 2). Equating the cost and benefit yields a cutoff for the CEO bias equal to \(\Delta\), beyond which the shareholders give up on communication.

To what extent can a carefully calibrated board bias, as in (13), substitute for lack of commitment? The following result requires no proof (simply plugging
the optimal board bias levels $\beta^c(b) \equiv 0$ and $\beta^{nc}(b)$ as in (13) into the loss terms in Tables 1 and 2):

**Proposition 2 (Replication result)** Suppose information gathering is ineffective ($c \to \infty$). Then, given the optimal board bias levels ($\beta^c(b) \equiv 0$ and $\beta^{nc}(b)$ as in (13)), the resulting loss to the shareholders is the same across commitment scenarios: $\bar{\ell}^{nc}(\beta^{nc}(b), b) = \bar{\ell}^c(\beta^c(b) = 0, b)$.

Proposition 2 is a striking result: commitment is of no value to the shareholders if information gathering by the board is infeasible and the board bias can be chosen endogenously. By assembling a suitably friendly board, the shareholders can replicate their expected payoff from the commitment setting. This replication result is surprising insofar as the board bias is a rather blunt instrument: it is chosen *ex ante* and cannot be conditioned on $s$. By contrast, the investment menu set by the (unbiased) board under commitment has two entries, one for each signal the CEO may observe—i.e., the board perfectly internalizes the shareholders’ preferences over the decision and has two instruments at its disposal. However, given the symmetric prior distribution (both states are equally likely), the distortions built into the investment menu by a board with commitment power are the same for each signal, and they equal the bias cost resulting from a friendly board without commitment power.\(^\text{17}\)

5.2.2 Value of Commitment with Information Gathering

We now return to the full-fledged model to explore the role of board bias in conjunction with equity incentives in motivating board effort. The goal is to study how, if at all, the replication result from the preceding subsection needs to be modified by the potential for the board to gather information.

---

\(^\text{17}\)The symmetry of the prior distribution is important for this argument. If the two states were not equally likely to occur, program $S\mathcal{P}^c$ would entail minimizing the probability-weighted distortions (no longer equally weighted) across the two signals. The optimal board bias under noncommitment (commitment) would again be weakly positive (zero), but the replication result in Proposition 2 would generally break down.
The corollaries in Section 5.1 provide some insight into a possible tradeoff: in general, commitment results in superior communication efficiency except for $q \geq q_o$ and $b \in \left( \frac{A}{2}, b_o(q) \right)$ (Corollary 2). On the other hand, cheap talk often elicits greater board effort in equilibrium precisely because of its communication handicap (Corollary 3). Greater board effort combined with the fact that, at the margin, the shareholders do not have to reimburse the board for the incremental effort cost (because the participation constraint is slack and $F^k = 0$), suggests an upside to lack of commitment. To formally address this tradeoff, define

$$VoC(b) \equiv EU^c_S(\alpha^c(b), \beta^c(b), F^c | b) - EU^{nc}_S(\alpha^{nc}(b), \beta^{nc}(b), F^{nc} | b)$$

as the value of board commitment (to the shareholders). Our last result presents sufficient conditions for predicting the sign of $VoC$:

**Proposition 3 (Value to shareholders of board commitment power)**

(a) **High $q$**: If $q \geq q_o$, then $VoC(b) > 0$ for any $b \in \left( \frac{A}{2}, b_o(q) \right)$.

(b) **Low $q$**: If $q < q_o$, then $VoC(b) < 0$ for any $b \in \left( b_o(q), \frac{A}{2} \right)$.

By improving communication, commitment power reduces the board’s effort incentives, all else equal. How significant is this opportunity cost of commitment? The answer depends on the information advantage enjoyed by the CEO as captured by his signal precision. For high $q$, the opportunity cost is limited because board effort plays only a monitoring role and generates little decision-useful information not already known to the CEO. Hence, $VoC(b) > 0$ for those intermediate CEO bias values (Proposition 3a). This result is consistent with the recent empirical findings that staggering tends to increase value in settings of high information asymmetry (here, high $q$), e.g., Cremers and Sepe (2016) and Daines et al. (2016), and it sheds light on the underlying mechanism.

Perhaps more surprisingly, the shareholders can be worse off with a board that has commitment power, even if they can select the board’s bias optimally.
(Proposition 3b). The lower is $q$, the greater is the opportunity cost of commitment as board effort serves the dual role of monitoring and generating additional decision-useful information. As a result, $\text{VoC}(b) < 0$ for moderate levels of CEO bias. The shareholders compound the communication handicap under cheap talk by strategically creating discord between the board and the CEO as a way to foster board effort.\[\footnote{Both parts of Proposition 3 can be illustrated by simple revealed preference arguments. For the high-$q$ case, suppose the shareholders nominate a (suboptimal) unbiased board, $\beta^c = 0$ for $b \in (\frac{q}{2}, b_o(q))$. This would leave them better off than under noncommitment with $\beta^{nc} = \beta_{PC}(b)$ because they: (i) avoid any loss conditional on successful information gathering; (ii) incur the same loss as under noncommitment conditional on unsuccessful information gathering (the replication result, Proposition 2); and (iii) benefit from greater board effort, holding fixed $\alpha$ at $\alpha^{nc}(b)$. The proof of Proposition 3 employs a slightly different replication argument. On the other hand, for $q < q_o$ and $b \in (b_o(q), \frac{q}{2})$, the shareholders under noncommitment could set $\beta = 0$ (rather than the optimal $\beta^{nc} < 0$) and $\alpha = \alpha^c(b)$ to replicate the commitment outcome. In either case of Proposition 3, establishing strict preference for the respective commitment regime is a straightforward but tedious matter.}

Contrary to our informal conjecture at the opening of this subsection, board commitment therefore does not necessarily benefit the shareholders even if they can control the board’s preferences over the investment decision, and even if one abstracts from takeover defense arguments. That is, a less “empowered” (in terms of commitment power) board may be optimal even with endogenous $\beta$. In a recent study, Chakraborty and Yilmaz (2017) show that the optimal allocation of decision rights between the CEO and the board is ambiguous—and determined by their respective information—if the board bias is exogenous; but if it is endogenous, decision rights should always rest with the board. That is, in Chakraborty and Yilmaz’s setting the board should always be more “empowered” (in terms of holding decision rights) if its preferences are under the control of shareholders. This points to the importance of distinguishing between alternative concepts of board “empowerment”—allocation of decision rights, communication protocols (e.g., commitment power), etc.
5.3 The Optimal Unscaled Board Bias

We close with an important robustness check. For analytical convenience, the results for the optimal board bias presented above were cast in terms of $\beta$, the board’s non-pecuniary benefits per unit of investment, scaled by its equity stake.

The primitive measure empirical researchers would aim to collect, however, is the unscaled (or “raw”) board bias, $\tilde{\beta}^k(b) \equiv \alpha^k(b) \cdot \beta^k(b)$. Having characterized both $\alpha^k(\cdot)$ and $\beta^k(\cdot)$, we can show that our results carry over qualitatively.

Because $\alpha^k(b) \in (0, 1)$ for any $b$, $\tilde{\beta}^k(b) = 0$ if and only if $\beta^k(b) = 0$ for either communication mode $k$. Moreover:

**Corollary 4 (Unscaled board bias)**

(a) With noncommitment:

(i) If $q > q_o$, $\tilde{\beta}^{nc}(b)$ is positive and strictly increasing, for any $b \in \left(\frac{\Delta}{2}, b_o(q)\right)$.

(ii) If $q < q_o$, $\tilde{\beta}^{nc}(b)$ is negative and strictly increasing, for any $b \in \left(b_o(q), \frac{\Delta}{2}\right)$.

(b) With commitment, $\tilde{\beta}^c(b)$ is weakly negative, continuous and single-troughed in $b$.

Clearly, scaling the equilibrium board bias by a strictly positive equity stake leaves unchanged its direction and therefore also the ranking across the commitment regimes. (Recall that whenever the $\beta^k(b)$, $k = c, nc$, are both nonzero, they are of opposite sign.) As for the change in the board bias as $b$ changes, the effects of $b$ on $\alpha^k$ and $\beta^k$ in general reinforce each other.\(^{19}\) Hence, all results for the scaled board bias carry over qualitatively to the raw board bias.

\(^{19}\) The only case in which the effects of $b$ on $\alpha^k$ and $\beta^k$ are countervailing is under commitment for $b \in [\tilde{b}, \Delta]$. Then, $\beta^c(\tilde{b}) = \beta_{cc}^c(b) < 0$, to keep the board indifferent between constrained communication and babbling; at the same time, $d\beta^c/db > 0$ and $d\alpha^c/db > 0$. But as we show in the proof of Corollary 4, the function $\tilde{\beta}^c(b) \equiv \alpha^c(b)(b - \Delta)$ is convex in $b$ on $[\tilde{b}, \Delta]$ and hence single-troughed.
6 Conclusion

This paper revisits the issue of board staggering from an internal governance perspective rather than a market-for-control one. We take a staggered board to be one that is endowed with commitment power in its dealings with the CEO. Comparing the outcome with that under cheap talk communication, as studied in BMQ, isolates the effects of staggering (more generally, of institutional factors facilitating board commitment) on the board’s composition and incentives, its information gathering effort, and shareholder value, in equilibrium. We establish qualitatively different predictions across the commitment scenarios when to expect boards to be friendly or antagonistic, and we show that shareholders may be harmed by board commitment power even if they control the board’s financial and non-pecuniary incentives: if the CEO’s information advantage is limited, having the board handicapped at the communication stage by lack of commitment—e.g., by destaggering—may be an effective incentive device to foster board effort.

From a modeling point of view, we feel that our reduced-form approach of equating staggering with board commitment is justified as such commitment power (constrained delegation) can arise endogenously for sufficiently low discount rates in an infinite-horizon model along the lines of Alonso and Matouschek (2007). On the other hand, there are other empirical measures available that might proxy for a board’s commitment power. For instance, investments in brick and mortar assets or PP&E may lend themselves more readily to a mechanism design approach, as in our commitment setting, than do investments in intangibles. From the viewpoint of stimulating empirical work, it would be useful to develop a taxonomy of institutional factors that facilitate, or retard, commitment power in corporate governance settings.

Our model focuses exclusively on the internal governance of firms; we do not dispute in any way that staggered boards may indeed deter welfare-enhancing
takeovers. Staggering features prominently in the influential Entrenchment Index of Bebchuk et al. (2009). However, given the arguments advanced in this paper, and in the related empirical studies by Johnson et al. (2015), Cremers and Sepe (2016), Cremers et al. (2016, 2017), Daines et al. (2016), and Ge et al. (2016), it seems important to reexamine which of the commonly-cited takeover defense instruments may yield other (say, managerial) benefits, and which are unlikely to do so. Our paper has highlighted potential benefits of staggering due to an extended interaction horizon between the board and management; it is difficult to conceive of similar benefits associated with, say, poison pills. A better understanding of such potential benefits may yield a more complete picture of “best practices” in corporate governance.
Appendix A: Proofs

Proof of Lemma 1. In the proof, we relax the constraint imposed in the main text that $\beta < b$; instead we allow for $\beta \in \mathbb{R}$. With commitment, the uninformed board minimizes its expected loss subject to the CEO’s truth-telling constraints.

\[
SP^c : \min_{\{y(H), y(L)\}} \frac{1}{2} q (y(H) - H - \beta)^2 + \frac{1}{2} (1 - q) (y(H) - L - \beta)^2 \\
+ \frac{1}{2} q (y(L) - L - \beta)^2 + \frac{1}{2} (1 - q) (y(L) - H - \beta)^2,
\]

subject to:

\[
Pr(\omega = H \mid s = H) (y(H) - H - b)^2 + Pr(\omega = L \mid s = H) (y(H) - L - b)^2 \\
\leq Pr(\omega = H \mid s = H) (y(L) - H - b)^2 + Pr(\omega = L \mid s = H) (y(L) - L - b)^2, \quad (TT_H)
\]

\[
Pr(\omega = L \mid s = L) (y(L) - L - b)^2 + Pr(\omega = H \mid s = L) (y(L) - H - b)^2 \\
\leq Pr(\omega = L \mid s = L) (y(H) - L - b)^2 + Pr(\omega = H \mid s = L) (y(H) - H - b)^2. \quad (TT_L)
\]

We solve the optimization problem in three steps: First, we characterize the optimal separating solution where $y(H) \neq y(L)$; then, the optimal pooling solution where $y(H) = y(L)$; lastly, by comparing the two, we find the global optimum.

Optimal separating solution. Without loss of generality, assume $y(H) > y(L)$. Then $(TT_H)$ and $(TT_L)$ can be reduced to:

\[
y(H) + y(L) - 2b - 2E(\omega \mid s = H) \leq 0, \quad (TT'_H)
\]

\[
y(H) + y(L) - 2b - 2E(\omega \mid s = L) \geq 0, \quad (TT'_L)
\]

respectively. Clearly, it cannot be the case that $(TT'_H)$ and $(TT'_L)$ are both binding. Let $\lambda_s$ represent the lagrangian multiplier for constraint $(TT'_s)$, then
the Lagrangian reads as follows:

\[ \mathcal{L} = \frac{1}{2} q (y(H) - H - \beta)^2 + \frac{1}{2} (1 - q) (y(H) - L - \beta)^2 + \frac{1}{2} q (y(L) - L - \beta)^2 + \frac{1}{2} (1 - q) (y(L) - H - \beta)^2 + \lambda_H (y(H) + y(L) - 2b - 2E(\omega \mid s = H)) + \lambda_L [2b - y(H) - y(L) + 2E(\omega \mid s = L)]. \]

The first-order conditions are:

\[ \frac{\partial \mathcal{L}}{\partial y(H)} = q(y(H) - H - \beta) + (1 - q)(y(H) - L - \beta) + \lambda_H - \lambda_L = 0, \quad (14) \]
\[ \frac{\partial \mathcal{L}}{\partial y(L)} = q(y(L) - L - \beta) + (1 - q)(y(L) - H - \beta) + \lambda_H - \lambda_L = 0. \quad (15) \]

By (14) and (15), we get \( y(H) - y(L) = (2q - 1)(H - L) = \Delta. \) To characterize the optimal separating solution, we prove the following three claims:

**Claim 1:** \((TT'_H)\) is always slack for \(b \geq \beta\), and \((TT'_L)\) is always slack for \(b < \beta\).

Proof by contradiction. Suppose \((TT'_H)\) is binding for \(b \geq \beta\). Because \((TT'_H)\) and \((TT'_L)\) cannot be binding simultaneously, \((TT'_L)\) must be slack, which, by complementary slackness, implies that \(\lambda_L = 0\). Then by the binding \((TT'_H)\) constraint, (14), (15) and \(\lambda_L = 0\), we have:

\[ \begin{cases} 
  y(H) = b + E[\omega \mid s = H] + \frac{\Delta}{2}, \\
  y(L) = b + E[\omega \mid s = H] - \frac{\Delta}{2}, \\
  \lambda_H = -(b - \beta + \frac{\Delta}{2}).
\end{cases} \quad (16) \]

For \(b \geq \beta\), \(\lambda_H = -(b - \beta + \frac{\Delta}{2}) < 0\), a contradiction. Therefore, for \(b \geq \beta\), \((TT'_H)\) has to be slack.

Similarly, if \((TT'_L)\) is binding, then \((TT'_H)\) must be slack and \(\lambda_H = 0\). Then, by the binding \((TT'_L)\) constraint, (14), (15) and \(\lambda_L = 0\), we have:

\[ \begin{cases} 
  y(H) = b + E[\omega \mid s = L] + \frac{\Delta}{2}, \\
  y(L) = b + E[\omega \mid s = L] - \frac{\Delta}{2}, \\
  \lambda_L = (b - \beta - \frac{\Delta}{2}).
\end{cases} \quad (17) \]
Similar arguments prove that \((TT'_L)\) has to be slack for \(b < \beta\).

**Claim 2:** If \(|b - \beta| \leq \Delta\), then both \((TT'_H)\) and \((TT'_L)\) are slack. To prove this claim, it suffices to solve a relaxed program that has \((TT_L)\) and \((TT_H)\) removed from \(SP^c\). It is easy to verify that the solution to the relaxed program satisfies both truth telling constraints for \(|b - \beta| \leq \Delta\).

**Claim 3:** If \(b - \beta > \frac{\Delta}{2}\), then \((TT'_L)\) is binding; if \(b - \beta < -\frac{\Delta}{2}\), then \((TT'_H)\) is binding. Suppose that \((TT'_L)\) were slack for \(b - \beta > \frac{\Delta}{2}\). Then, by complementary slackness, \(\lambda_L = 0\). At the same time, by Claim 1, for \(b - \beta > \frac{\Delta}{2}\), \((TT'_H)\) is also slack, which implies \(\lambda_H = 0\). Then, by \((14)\) and \((15)\), we get \(y(H) = \beta + E[\omega|s = H]\) and \(y(L) = \beta + E[\omega|s = L]\). Therefore:

\[
y(H) + y(L) = 2\beta + E[\omega|s = H] + E[\omega|s = L] < 2b + 2E[\omega|s = L],
\]

where the inequality uses the fact that \(b - \beta > \frac{\Delta}{2}\). Inequality \((18)\) however contradicts \((TT'_L)\). Hence, \((TT'_L)\) is binding for \(b - \beta > \frac{\Delta}{2}\), calling for investment amounts as in \((17)\). Similar arguments show that \((TT'_H)\) is binding for \(b - \beta < -\frac{\Delta}{2}\), calling for investment amounts as in \((16)\).

To summarize, the optimal separating solution is characterized as follows. Denote by \(\ell'^{sep}_B\) the board’s value function for \(y(H) \neq y(L)\). For \(|b - \beta| \leq \frac{\Delta}{2}\), \(y(r) = \beta + E[\omega|s = r]\) and \(\ell'^{sep}_B = \frac{1}{2}A_s\). On the other hand, for \(|b - \beta| > \frac{\Delta}{2}\), by \((16)\) and \((17)\):

- \(y(H) = b + E[\omega|s = L] + \frac{\Delta}{2}\), \(y(L) = b + E[\omega|s = L] - \frac{\Delta}{2}\) when \(b \geq \beta\) and \(y(H) = b + E[\omega|s = H] + \frac{\Delta}{2}\), \(y(L) = b + E[\omega|s = H] - \frac{\Delta}{2}\) when \(b < \beta\). The board’s loss term is \(\ell'^{sep}_B = \frac{1}{2}A_s + \frac{1}{2}(|b - \beta| - \frac{\Delta}{2})^2\).

**Optimal pooling solution.** Under pooling the board will invest on its prior, i.e., choose \(y = E(\omega) = H + L = \beta\), resulting in a loss the board of \(\ell^\text{pool}_B = \frac{1}{2}A_\emptyset\).

**Compare separating solution and pooling solution.** For \(|b - \beta| \leq \frac{\Delta}{2}\), clearly \(\ell'^{sep}_B < \ell^\text{pool}_B\). For \(|b - \beta| > \frac{\Delta}{2}\), in contrast:

\[
\ell'^{sep}_B - \ell^\text{pool}_B = \frac{1}{2}A_s + \frac{1}{2}(|b - \beta| - \frac{\Delta}{2})^2 - \frac{1}{2}A_\emptyset \left\{ \begin{array}{l} < \\ > \end{array} \right\} 0, \text{ for } |b - \beta| \left\{ \begin{array}{l} \leq \\ > \end{array} \right\} \Delta.
\]

37
We are now ready to characterize the optimal solution for Program $SP_c$.
The optimal investment decision and the associated loss term for board and shareholders are listed in the following table:

| If monitoring unsuccessful: | Case (i): PC $|b - \beta| \in [0, \frac{A}{2}]$ | Case (ii): CC $|b - \beta| \in (\frac{A}{2}, \Delta]$ | Case (iii): Babbling $|b - \beta| > \Delta$ |
|-----------------------------|---------------------------------|---------------------------------|--------------------------|
| Board’s loss, $\bar{\ell}_B^c$ | $\frac{1}{2} \Lambda_s$ | $\frac{1}{2} \left( \Lambda_s + (|b - \beta| - \frac{A}{2})^2 \right)$ | $\frac{1}{2} \Lambda_\emptyset$ |
| Shareholders’ loss, $\bar{\ell}_S^c$ | $\frac{1}{2} (\Lambda_s + \beta^2) + \frac{1}{2} \left( \Lambda_s + (b - \frac{A}{2})^2 \right)$ + $1_{\beta > b} \cdot b \Delta$ | $\frac{1}{2} (\Lambda_\emptyset + \beta^2)$ |

Table 1': Outcome Given Unsuccessful Information Gathering: Commitment

Proof of Proposition [1] Our proof follows the following steps: (1) we argue that the board’s IR constraint is slack at $F = 0$ and hence the optimal $F^c = 0$; (2) we show that $\beta^c < b$; (3) we characterize the optimal $(\alpha^c, \beta^c)$.

Step 1: We first argue that the board’s IR constraint is slack at $F = 0$. Note that the board’s expected utility is:

$$EU_B^c(e^c) = F + \alpha \left[ \frac{1}{2} E_\omega[(\omega + \beta)^2] - (1 - e^c) \bar{\ell}_B^c(\beta, b) \right] - \frac{c e^c}{2}.$$ 

Even choosing zero effort would allow the board to break even:

$$EU_B^c(e^c) \geq EU_B^c(e = 0) = F + \alpha \left[ \frac{1}{2} E_\omega[(\omega + \beta)^2] - \bar{\ell}_B^c(\beta, b) \right]$$

$$= F + \alpha \left[ \frac{1}{2} \left( \left( \frac{1}{2} + \beta \right)^2 + \frac{(H - L)^2}{4} \right) - \bar{\ell}_B^c(\beta, b) \right],$$

which is positive by $\bar{\ell}_B^c(\beta, b) \leq \frac{(H - L)^2}{8} = \frac{1}{2} \Lambda_\emptyset$; thus the IR constraint is slack at $F = 0$. 38
Step 2: We then argue that the optimal board bias is bounded by the CEO bias: $\beta^c < b$. The reason is that only the relative preference divergence $|b - \beta|$ matters for the communication game and the board’s effort incentives (recall $\bar{t}_B$ is symmetric in $\beta$ around $b$), whereas any absolute board bias is costly to the shareholders due to distorted investment decisions by the board (See Table 1’). This allows us to rewrite the preference divergence between the CEO and the board simply as $b - \beta$.

Step 3: In this part, we characterize the optimal $(\alpha^c, \beta^c)$.

The shareholders’ value is given by [8] with $F^c = 0$. It is convenient to work with the value function

$$EU^c_S(\beta \mid b) \equiv EU^c_S(\alpha^c(\beta, b), \beta \mid b),$$

where $\alpha^c(\beta, b) \in \arg \max_{\alpha} EU^c_S(\alpha, \beta \mid b)$. The solution to Program $P^c$ entails $(\alpha^c(b), \beta^c(b))$ where $\alpha^c(b) = \alpha^c(\beta^c(b), b)$. Define $M_n$ as the set of $\beta$ to induce communication Case $n \in \{i, ii, iii\}$, as defined in Table 1’:

$$\begin{align*}
M_i &= [b - \Delta, b], \\
M_{ii} &= [b - \Delta, b - \Delta/2), \\
M_{iii} &= (-\infty, b - \Delta).
\end{align*}$$

With slight abuse of notation, define $\beta_n(b) \in \arg \max_{\beta \in M_n} EU^c_S(\beta \mid b)$.

The proof for Step 3 proceeds as follows: First we show, in Lemma [A1] that the shareholders never choose $\beta$ so as to “jump” across communication cases, i.e., for any $b$, if case $n$ occurs “naturally” (i.e., for $\beta = 0$), then it is never optimal to set $\beta$ to induce Case $l \neq n$. We then characterize the optimal solution.

Lemma A1 (No Jumping Cases) With commitment on the part of the board, the shareholders never choose $\beta$ so as to switch communication cases. That is:

- $\beta^c(b \leq \Delta/2) = \beta_i(b)$,

---

20To avoid clutter we suppress the functional argument $b$ in $M_n(b)$. 39
• \( \beta^c(\frac{\Delta}{2} < b < \Delta) = \beta_{ii}(b) \),

• \( \beta^c(b \geq \Delta) = \beta_{iii}(b) \).

We prove Lemma [A1] in the following steps: Step 1-4 show that if the shareholders were to choose \( \beta \) to “jump” communication cases, they would choose the adjacent boundary value of \( \beta \) that just suffices to induce such a jump. Formally, we show that if the shareholders want to jump from Case \( n \) to \( l \), then the optimal way to do so is by setting \( \beta = \sup M_l \) if \( l > n \), or by setting \( \beta = \inf M_l \) if \( l < n \).

In Steps 5-7 we argue that the shareholders never want to jump cases.

Taking derivative of (19), which is differentiable almost everywhere, and applying the Envelope Theorem:

\[
\frac{dE_U^c}{d\beta} = \frac{\partial E_U^c(\alpha^c(\beta, b), \beta \mid b)}{\partial \beta} = [1 - \alpha^c(\beta, b)] \left[ -e(\cdot) \frac{\partial \ell_S}{\partial \beta} - [1 - e(\cdot)] \frac{\partial \bar{\ell}_S}{\partial \beta} + \frac{\partial e(\cdot)}{\partial \beta} \left[ \bar{\ell}_S(\beta, b) - \ell_S(\beta) \right] \right] = [1 - \alpha^c(\beta, b)] \left[ -e(\cdot) \frac{\partial \ell_S}{\partial \beta} - [1 - e(\cdot)] \frac{\partial \bar{\ell}_S}{\partial \beta} + \frac{\alpha^c(\beta, b)}{c} \frac{\partial \bar{\ell}_c}{\partial \beta} \left[ \bar{\ell}_S(\beta, b) - \ell_S(\beta) \right] \right].
\]

**Step 1:** If \( b > \frac{\Delta}{2} \), then \( \beta_{ii}(b) = b - \frac{\Delta}{2} \).

To prove this claim, note that in Case (i) we have \( \frac{\partial \ell_S}{\partial \beta} = \beta \), \( \frac{\partial \bar{\ell}_S}{\partial \beta} = \beta \), and \( \frac{\partial \bar{\ell}_c}{\partial \beta} = 0 \). Hence:

\[
\frac{dE_U^c}{d\beta} \bigg|_{\beta \in M_i} = -[1 - \alpha^c(\beta, b)] \beta,
\]

which implies \( \text{sign} \left( \frac{dE_U^c}{d\beta} \bigg|_{\beta \in M_i} \right) = -\text{sign}(\beta) \). For any \( b > \frac{\Delta}{2} \) and \( \beta \in M_i \), we have \( \beta > 0 \). Therefore, \( \beta_{ii}(b > \frac{\Delta}{2}) = b - \frac{\Delta}{2} \).

**Step 2:** If \( b \leq \Delta \), then \( \beta_{iii}(b) = b - \Delta - \varepsilon \), where \( \varepsilon \to 0 \).

Similar arguments as in Step 1 show that \( \frac{dE_U^c}{d\beta} \bigg|_{\beta \in M_{iii}} = -[1 - \alpha^c(\beta, b)] \beta \). For any \( b \leq \Delta \) and \( \beta \in M_{iii} \), we have \( \beta < 0 \); hence, \( \beta_{iii}(b \leq \Delta) = b - \Delta - \varepsilon \).

**Step 3:** If \( b > \Delta \), then \( \beta_{ii}(b) = b - \Delta \).
To prove this claim, note that if the shareholders were to set $\beta$ to induce Case (ii), then $\beta \in M_{ii} = [b - \Delta, b - \frac{\Delta}{2})$. Also, $\frac{\partial e_S}{\partial \beta} = \beta$, $\frac{\partial c_S}{\partial \beta} = 0$, and $\frac{\partial c_B}{\partial \beta} = -(b - \beta - \frac{\Delta}{2}) < 0$. Hence:

$$
\left. \frac{dEU_S^c}{d\beta} \right|_{\beta \in M_{ii}} = [1 - \alpha^c(\beta, b)] \cdot [-e(\cdot)\beta + \frac{\partial e}{\partial \beta} (\bar{c}_S - \ell_S)].
$$

Note that in Case (ii), $\bar{c}_S - \ell_S = \frac{1}{2} [\Lambda_s + (b - \frac{\Delta}{2})^2 - \beta^2]$. For any $b > \Delta$ and $\beta \in M_{ii}$, we have $\beta \in (0, b - \frac{\Delta}{2})$. Hence $\bar{c}_S - \ell_S > 0$, and consequently, $\left. \frac{dEU_S^c}{d\beta} \right|_{\beta \in M_{ii}} < 0$. As a result, $\beta_{ii}(b > \Delta) = b - \Delta$.

**Step 4:** If $b \leq \frac{\Delta}{2}$, then $\beta_{ii}(b) = b - \frac{\Delta}{2} - \varepsilon < 0$.

Proceeding as in Step 3 shows:

$$
\left. \frac{dEU_S^c}{d\beta} \right|_{\beta \in M_{ii}} = [1 - \alpha^c(\beta, b)] \left[-e(\cdot)\beta + \frac{\partial e}{\partial \beta} (\bar{c}_S - \ell_S) \right]
$$

$$
= [1 - \alpha^c(\beta, b)] \left[ -\frac{\alpha^c(\beta, b)\bar{c}_B}{c} \beta + \frac{\alpha^c(\beta, b)}{c} \frac{\partial \bar{c}_B}{\partial \beta} (\bar{c}_S - \ell_S) \right]
$$

$$
= - \frac{\alpha^c(\beta, b)[1 - \alpha^c(\beta, b)]}{2c} \left( b - \beta - \frac{\Delta}{2} \right)^2 \frac{(b - \Delta/2 + 2\beta + \Lambda_s(b - \Delta/2))}{\equiv g(\beta | b)}
$$

The last equation uses the fact that in communication Case (ii), $\bar{c}_B = \frac{1}{2} [\Lambda_s + (b - \frac{\Delta}{2})^2 - \beta^2]$ and $\bar{c}_S - \ell_S = \frac{1}{2} [\Lambda_s + (b - \frac{\Delta}{2})^2 - \beta^2]$. For any $b \leq \frac{\Delta}{2}$ and $\beta \in M_{ii}$, we have $\beta < b - \frac{\Delta}{2} \leq 0$. Therefore, $g(\beta | b) < 0$ and $\left. \frac{dEU_S^c}{d\beta} \right|_{\beta \in M_{ii}} > 0$. As a result, $\beta_{ii} = b - \frac{\Delta}{2} - \varepsilon$. (We will use below the $g(\cdot)$ function defined here.)

**Step 5:** The shareholders will not jump between Cases (i) and (ii); that is, $\beta_i^c(\frac{\Delta}{2} < b < \Delta) \neq \beta_i(b)$ and $\beta_i^c(b \leq \frac{\Delta}{2}) \neq \beta_{ii}(b)$.

To prove this claim, it is readily verified that $EU_S^c(\cdot)$ is continuous at $\beta = b - \frac{\Delta}{2}$, because both $\bar{c}_S$ and $\bar{c}_B$ are continuous at $\beta = b - \frac{\Delta}{2}$. Given the continuity of $EU_S^c(\cdot)$ at $\beta = b - \frac{\Delta}{2}$, it is straightforward that the shareholders will not switch between cases $i$ and $ii$. As Steps 1 and 4 show, if the shareholders were to do so, they would choose $\beta = b - \frac{\Delta}{2}$, but then they can (at least) replicate such payoff by staying in the original communication case.
**Step 6:** The shareholders will not jump between Cases (ii) and (iii); that is, \( \beta^c(\frac{\Delta}{2} < b < \Delta) \neq \beta_{iii}(b) \) and \( \beta^c(b \geq \Delta) \neq \beta_{ii}(b) \).

It is readily verified that \( \bar{\ell}_S^c \) is continuous at \( \beta = b - \Delta \). Denote by \( \bar{\ell}_{S_n}^c \) the shareholders’ loss given Case \( n \):

\[
\bar{\ell}_{S_n}^c(\beta = b - \Delta, b) - \lim_{\varepsilon \to 0} \bar{\ell}_{S_n}^c(\beta = b - \Delta - \varepsilon, b) = \left( b - \frac{\Delta}{2} - \beta \right) \beta = \frac{\Delta}{2} (b - \Delta). \tag{21}
\]

If \( b \geq \Delta \), Case (iii) arises naturally, i.e., for \( \beta = 0 \). The shareholders could jump to Case (ii) by choosing \( \beta = b - \Delta \) (Step 3). But doing so would be suboptimal because the term in (21) is weakly positive for \( b \geq \Delta \). Similar arguments show that if \( \frac{\Delta}{2} < b < \Delta \), the shareholders will not jump from Case (ii) to (iii).

**Step 7:** The shareholders will not jump between Cases (i) and (iii); that is, \( \beta^c(b \geq \Delta) \neq \beta_{i}(b) \) and \( \beta^c(b \leq \frac{\Delta}{2}) \neq \beta_{iii}(b) \).

By Step 2, if the shareholders were to jump from Case (i) to (iii), they would choose \( \beta = b - \Delta - \varepsilon \). By (21), for \( b \leq \frac{\Delta}{2} \), jumping from Case (ii) to (iii) is suboptimal. Recall that step 5 shows that the shareholders will not jump from Case (i) to (ii), therefore the shareholders will not jump from Case (i) to (iii). Reverse arguments show that the shareholders prefer not to jump from Case (iii) to (i), completing the proof of Lemma [A1].

We now characterize the globally optimal solution. By Lemma [A1], for \( b \leq \frac{\Delta}{2} \), the shareholders will choose \( \beta^c(b \leq \frac{\Delta}{2}) = \beta_i(b \leq \frac{\Delta}{2}) = 0 \). The reason is that within Case (i) \( \beta \) does not affect \( e^c(\cdot) \) but only introduces bias cost. Similarly, \( \beta^c(b \geq \Delta) = \beta_{iii}(b \geq \Delta) = 0 \).

If \( b \in (\frac{\Delta}{2}, \Delta) \), communication Case (ii) arises “naturally” (for \( \beta = 0 \)). By Lemma [A1], \( \beta^c(\frac{\Delta}{2} < b < \Delta) = \beta_{ii}(\frac{\Delta}{2} < b < \Delta) \). Denote by \( \beta^{int} \) the interior solution that satisfies the necessary first-order condition conditional on Case (ii):

\[
\frac{d E U^\xi(c)}{d \beta} \bigg|_{\beta \in M_{int}} = 0.
\]
Using the $g(\cdot)$ function from (20), $\beta^{\text{int}}$ is given by (ignoring irrelevant scalars):

$$g(\beta^{\text{int}} \mid b) = \left( b - \frac{\Delta}{2} - \beta^{\text{int}} \right)^2 \left( b - \frac{\Delta}{2} + 2\beta^{\text{int}} \right) + \Lambda_s \left( b - \frac{\Delta}{2} \right) = 0. \tag{22}$$

By (20), if $b \in \left( \frac{\Delta}{2}, \Delta \right)$, $g(\beta \mid b) > 0$ for any $\beta \geq 0$; hence, $\beta^{\text{int}} < 0$ must hold.

The second derivative at this stationary point is:

$$\left. \frac{d^2 EU_S^c}{d\beta^2} \right|_{\beta = \beta^{\text{int}}} = \frac{3\alpha^c(\cdot)[1 - \alpha^c(\cdot)]}{\alpha^c(\cdot) c} \left( b - \beta^{\text{int}} - \frac{\Delta}{2} \right) \beta^{\text{int}} < 0, \quad \tag{23}$$

making $\beta^{\text{int}}$ a local maximum. This leaves one of two possibilities (see Fig. 5 for illustration): either (a) the (unique) local maximum given by $\beta^{\text{int}}(b)$ falls in the interval $\left( b - \Delta, b - \frac{\Delta}{2} \right)$ and thus is feasible so that $\beta_{ii}(b) = \beta^{\text{int}}(b)$, or (b) $\beta^{\text{int}}(b) < b - \Delta$ in which case the corner solution $\beta_{ii}(b) = b - \Delta$ obtains. Plugging the corner solution $\beta = b - \Delta$ into the $g(\cdot)$ function in (22) and setting it equal to zero yields the unique CEO bias level, $\tilde{b}$, at which the interior solution just becomes infeasible:

$$g \left( \beta = \tilde{b} - \Delta \mid \tilde{b} \right) = \frac{3}{4} \Delta^2 \left( \tilde{b} - \frac{5}{6} \Delta \right) + \left( \tilde{b} - \frac{\Delta}{2} \right) \Lambda_s = 0 \iff \tilde{b} = \frac{\Delta}{2} \left( 1 + \frac{2 - 8Q}{3 - 8Q} \right).$$

Now note that, as $\lim_{b \downarrow \frac{\Delta}{2}} \beta^{\text{int}}(b) = 0 > \lim_{b \uparrow \Delta} b - \Delta$, so the interior solution is feasible and hence optimal at the lower bound of the $b$-interval $\left( \frac{\Delta}{2}, \Delta \right)$. Together with uniqueness of $\tilde{b}$ this implies that $\beta_{ii}(b) = \beta^{\text{int}}$ (interior solution) for any $b \in \left( \frac{\Delta}{2}, \tilde{b} \right]$, and $\beta_{ii}(b) = b - \Delta$ (corner solution) for any $b \in (\tilde{b}, \Delta)$.

To summarize, the optimal board bias with commitment is:

1. For $b \leq \frac{\Delta}{2}$: $\beta^c(b) = 0$, implementing Case (i).

2. For $b \in \left( \frac{\Delta}{2}, \tilde{b} \right]$: $\beta^c(b) = \beta^{\text{int}}$, where $\tilde{b} = \frac{5\Delta^3 + 4\Delta \Lambda_s}{2(3\Delta^3 + 4\Lambda_s)}$ and $\beta^{\text{int}}$ is determined by (22). This is the interior solution for Case (ii).

3. For $b \in (\tilde{b}, \Delta)$: $\beta^c(b) = b - \Delta$. This is the corner solution for Case (ii).
(4) For \( b \geq \Delta \): \( \beta^c(b) = 0 \), implementing Case (iii).

Continuity of \( \beta^c(b) \) is straightforward. We will prove single-troughedness of \( \beta^c(b) \) below.

The optimal equity stake. Since in Cases (i) and (iii), \( \beta^c = 0 \) and \( \alpha^c \) is constant in \( b \), it remains to show that \( \alpha^c \) is monotonically increasing in \( b \) in Case (ii). We first show that \( \alpha^c \) is monotonically increasing in \( b \) for \( b \in [\frac{\Delta}{2}, \tilde{b}] \). In this region, the optimal solution \((\alpha^c, \beta^\text{int})\) is an interior one which satisfies the following first-order conditions:

\[
\left. \frac{\partial EU^c_S(\alpha, \beta | b)}{\partial \beta} \right|_{\beta^\text{int}} = 0 \quad \text{and} \quad \left. \frac{\partial EU^c_S(\alpha, \beta | b)}{\partial \alpha} \right|_{\alpha^c} = 0,
\]

which, when differentiated with respect to \( b \), yield:

\[
EU^c_{S_{\alpha\alpha}} \cdot \frac{d\alpha^c}{db} + EU^c_{S_{\alpha\beta}} \cdot \frac{d\beta^\text{int}}{db} + EU^c_{S_{ab}} = 0,
\]

\[
EU^c_{S_{\beta\beta}} \cdot \frac{d\beta^\text{int}}{db} + EU^c_{S_{\beta\alpha}} \cdot \frac{d\alpha^c}{db} + EU^c_{S_{\beta b}} = 0.
\]

Using Cramer’s rule,

\[
\frac{d\alpha^c}{db} = \frac{EU^c_{S_{\beta b}} EU^c_{S_{\alpha\alpha}} - EU^c_{S_{\alpha b}} EU^c_{S_{\beta\beta}}}{EU^c_{S_{\alpha\alpha}} EU^c_{S_{\beta\beta}} - (EU^c_{S_{\alpha\beta}})^2} \quad \text{and} \quad \frac{d\beta^\text{int}}{db} = -\frac{EU^c_{S_{\alpha\alpha}} EU^c_{S_{\beta b}} + EU^c_{S_{\alpha b}} EU^c_{S_{\beta\beta}}}{EU^c_{S_{\alpha\alpha}} EU^c_{S_{\beta\beta}} - (EU^c_{S_{\alpha\beta}})^2} (24)
\]

Fig. 5: Interior and Corner Solution for \( \beta_{ii} \)
Clearly,

\[ EU_{S\alpha}^c = -2 \left[ \bar{\ell}_S^c(\beta, b) - \ell_S(\beta) \right] \bar{\ell}_B^c(\beta, b) < 0, \]

\[ EU_{S\beta}^c = \frac{\alpha^c(1 - \alpha^c)}{c} \left[ \frac{b - \Delta}{2} \beta^{\text{int}} \left( \bar{\ell}_S^c(\beta, b) - \ell_S(\beta) \right) + (b - \frac{\Delta}{2}) \beta^{\text{int}} \right] < 0, \]

\[ EU_{S\alpha\beta}^c = \frac{(1 - 2\alpha^c)}{c} \left( \frac{\partial}{\partial \beta} \left[ \bar{\ell}_B^c(\beta, b) \left( \bar{\ell}_S^c(\beta, b) - \ell_S(\beta) \right) \right] \right) = 0. \]

The derivatives in (24) then reduce to

\[ \frac{d\alpha^c}{db} = -\frac{EU_{S\alpha\beta}^c}{EU_{S\alpha}^c}, \quad \text{and} \quad \frac{d\beta^{\text{int}}}{db} = -\frac{EU_{S\beta}^c}{EU_{S\beta\beta}^c}. \]

Now note:

\[ EU_{S\alpha\beta}^c = \left( b - \frac{\Delta}{2} \right) + \frac{1 - 2\alpha^c}{c} \left( \frac{\partial}{\partial b} \left[ \bar{\ell}_B^c(\beta, b) \left( \bar{\ell}_S^c(\beta, b) - \ell_S(\beta) \right) \right] \right) \]

\[ = \left( b - \frac{\Delta}{2} \right) + \frac{1 - 2\alpha^c}{c} \left\{ (b - \frac{\Delta}{2} - \beta^{\text{int}}) \left( \bar{\ell}_S^c(\beta, b) - \ell_S(\beta) \right) + (b - \frac{\Delta}{2}) \bar{\ell}_B^c(\beta, b) \right\} \]

\[ > 0. \]

Thus, \( \frac{d\alpha^c}{db} > 0 \) for any \( b \in (\frac{\Delta}{2}, \tilde{b}) \).

Now consider the case of \( b \in (\tilde{b}, \Delta) \), resulting in the corner solution \( \beta^c = b - \Delta \):

\[ \alpha^c = \frac{1}{2} - \frac{H^2 + L^2}{4} \frac{\ell_S(\beta, b)}{\bar{\ell}_S(\beta, b) - \ell_S(\beta)} \]  

\[ \frac{1}{2} \frac{\bar{\ell}_S(\beta, b) - \ell_S(\beta)}{2} \left[ \bar{\ell}_S(\beta, b) - \ell_S(\beta) \right] \frac{\ell_B(\beta, b)}{\ell_B(\beta, b)} \]

\[ = \frac{1}{2} - \frac{H^2 + L^2}{4} \frac{\ell_S(\beta, b)}{\bar{\ell}_S(\beta, b) - \ell_S(\beta)} \left[ \frac{1}{2} \left( \Lambda_s + b \Delta - \frac{3}{4} \Delta^2 \right) (H - L) \right]. \]

Therefore, given \( b \in (\tilde{b}, \Delta) \), \( \frac{d\alpha^c}{db} > 0 \).

It remains to verify the single-troughedness of \( \beta^c(b) \). A sufficient condition for this is that the interior solution \( \beta^{\text{int}}(b) \) is monotonically decreasing in \( b \) over
the relevant range:
\[
EU_{S_{fb}}^c = -\frac{\alpha(1-\alpha)}{c} \left\{ \bar{\ell}_S^c(\beta, b) - \ell_S(\beta) \right\} + (b - \frac{\Delta}{2} - \beta)(b - \frac{\Delta}{2} + \beta)
\]
\[
= -\frac{\alpha(1-\alpha)}{2c} \left[ \frac{3}{4} (b - \frac{\Delta}{2})^2 - \beta^2 \right] + \Lambda_s
\]

To show that \(H > 0\), we plug in \((b - \frac{\Delta}{2})\Lambda_s = -(b - \frac{\Delta}{2} - \beta)^2(b - \frac{\Delta}{2} + 2\beta)\) from the first-order condition (20):
\[
H = \frac{1}{b - \frac{\Delta}{2}} \left[ (b - \frac{\Delta}{2})\Lambda_s + 3(b - \frac{\Delta}{2})[(b - \frac{\Delta}{2})^2 - \beta^2] \right]
\]
\[
= \frac{1}{b - \frac{\Delta}{2}} \left[ -(b - \frac{\Delta}{2} - \beta)^2(b - \frac{\Delta}{2} + 2\beta) + 3(b - \frac{\Delta}{2})[(b - \frac{\Delta}{2})^2 - \beta^2] \right]
\]
\[
= \frac{2(b - \frac{\Delta}{2} - \beta)}{b - \frac{\Delta}{2}} \left[ \frac{1}{2} (b - \frac{\Delta}{2})^2 + \beta^2 + \frac{3}{4}(b - \frac{\Delta}{2})^2 \right]
\]
\[
> 0.
\]

Thus, \(EU_{S_{fb}}^c < 0\). It follows that \(\frac{d\beta^{int}}{db} < 0\), and \(\beta^c(b)\) is single-troughed.

**Proof of Corollary 3**

**Part (a), high \(q\).**

(i) For \(b \in (\frac{\Delta}{2}, b_o(q))\), by Propositions [] and [], \(\beta^{nc} = b - \frac{\Delta}{2}\) and perfect communication (Case i) obtains under non-commitment; \(\beta^c = \beta^{int}\) or \(\beta^c = b - \Delta\), and constrained communication (Case ii) obtains under commitment. Hence:
\[
\alpha^c(b) = \frac{1}{2} - \frac{H^2 + L^2}{4c} - \frac{1}{2} \left[ \Lambda_s + (b - \frac{\Delta}{2})^2 \right]
\]
\[
\alpha^{nc}(b) = \frac{1}{2} - \frac{H^2 + L^2}{4c} - \frac{1}{2} \left[ \Lambda_s + (b - \frac{\Delta}{2})^2 \right]
\]
Note that:
\[
\alpha^c(b) > \alpha^{nc}(b) \iff \left[ \frac{1}{2} \left( \Lambda_s + (b - \frac{\Delta}{2} - \beta^c)^2 \right) \right] \cdot \left[ \frac{1}{2} \left( \Lambda_s + (b - \frac{\Delta}{2})^2 - \beta^{c^2} \right) \right] > \left( \frac{\Lambda_s}{2} \right)^2
\]
\[
\iff \left( b - \frac{\Delta}{2} - \beta^c \right)^2 \left( b - \frac{\Delta}{2} + \beta^c \right) + 2(b - \frac{\Delta}{2})\Lambda_s > 0.
\]

Hence to prove \( \alpha^c(b) > \alpha^{nc}(b) \) it is necessary and sufficient to show that \( G(\beta^c) > 0 \). Depending on the ranking of \( b_o(q) \) and \( \bar{b}(q) \), \( \beta^c \) takes different values: \( \beta^c = b - \Delta \) for \( b \in [\bar{b}(q), b_o(q)) \) if \( b_o(q) > \bar{b}(q) \); and \( \beta^c = \beta^{int} \) otherwise. If \( \beta^c = \beta^{int} \), plugging in equation (22), we get:
\[
G(\beta^c = \beta^{int}) = (b - \frac{\Delta}{2} - \beta^{int})^2(b - \frac{\Delta}{2} + \beta^{int}) - 2(b - \frac{\Delta}{2} - \beta^{int})^2(b - \frac{\Delta}{2} + 2\beta^{int})
\]
\[
= -(b - \frac{\Delta}{2} - \beta^{int})^2(b - \frac{\Delta}{2} + 3\beta^{int})
\]
\[
= (b - \frac{\Delta}{2})\Lambda_s - (b - \frac{\Delta}{2} - \beta^{int})^2\beta^{int}
\]
\[
> 0.
\]

If \( \beta^c = b - \Delta \), then
\[
G(\beta^c = b - \Delta) = \frac{\Delta^2}{4}(2b - \frac{3}{2}\Delta) + 2(b - \frac{\Delta}{2})\Lambda_s,
\]
which is monotonically increasing in \( b \). Therefore for \( b \in [\bar{b}(q), b_o(q)) \),
\[
G(\beta^c = b - \Delta) \geq G(\beta^c = b - \Delta \mid b = \bar{b}(q)) = G(\beta^c = \beta^{int}) > 0.
\]

Combining the fact that \( \alpha^c(b) > \alpha^{nc}(b) \) with \( \bar{\ell}_B(b, \beta^c) = \frac{1}{2} \left[ (b - \frac{\Delta}{2} - \beta^c)^2 + \Lambda_s \right] > \frac{1}{2}\Lambda_s = \bar{\ell}_B^{nc}(b, \beta^{nc}) \) verifies that \( e^c(\cdot) > e^{nc}(\cdot) \) for \( b \in (\frac{\Delta}{2}, b_o(q)) \).

(ii) For \( b \in (b_o(q), \Delta) \), by Proposition 0, \( \beta^{nc} = 0 \) and babbling (Case iii) obtains under noncommitment. Therefore,
\[
\alpha^{nc}(b) = \frac{1}{2} - \frac{H^2 + L^2}{4} - \frac{\Lambda_s}{2}.
\]

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which equals $\alpha^c(b \mid b > \Delta)$. Recall that Proposition 3 shows that $\alpha^c(b)$ is monotonically increasing in $\beta$. Hence,

$$\alpha^{nc}(b \mid b \in (b_o(q), \Delta)) = \alpha^c(b \mid b > \Delta) > \alpha^c(b \mid b \in (b_o(q), \Delta)).$$

Combining with the fact that $\tilde{e}_B^{nc}(b, \beta^{nc}) = \frac{(H-L)^2}{8} = \frac{1}{2}\Lambda_0 \geq \tilde{e}_B(b, \beta^c)$, it is clear that $e^{nc}(\cdot) > e^c(\cdot)$ for $b \in (b_o(q), \Delta)$.

**Part (b), low $q$.** To rank $\alpha^k$ across commitment settings, first note that for $b \notin (b_o(q), \Delta)$, $\beta^k = 0$ under both commitment settings, and the same communication case is implemented across commitment settings. Hence $\alpha^c(b) = \alpha^{nc}(b)$ for $b \notin (b_o(q), \Delta)$. For $b \in (b_o(q), \Delta)$, $\beta^{nc} = 0$ or $\beta^{nc} = b - \frac{\Delta}{2}$. Case (iii) obtains under noncommitment. Therefore,

$$\alpha^{nc}(b \mid b \in (b_o(q), \Delta)) \geq \frac{1}{2} - \frac{H^2 + L^2}{4} \cdot \frac{\Lambda_0}{2c} \geq \alpha^c(b \mid b > \Delta) > \alpha^c(b \mid b \in (b_o(q), \Delta)).$$

The last inequality holds by monotonicity of $\alpha^c(b)$ as per Proposition 3. We just show that $\alpha^c(b) \leq \alpha^{nc}(b)$ for any $b$. Combined with the fact that $\tilde{e}_B(b, \beta^c) \leq \tilde{e}_B^{nc}(b, \beta^{nc})$, we have $e^c(\cdot) \leq e^{nc}(\cdot)$.

**Proof of Proposition 3.**

(a) **High $q$:** If $q \geq q_o$, then $b_o(q) \geq \frac{\Delta}{2}$. By revealed preference, $EU_S(\alpha^c(b), \beta^c(b) \mid b) \geq EU_S^{nc}(\alpha^{nc}(b), \beta^{nc}(b) \mid b)$. Next, we argue that for $b \in \left(\frac{\Delta}{2}, b_o(q)\right)$, $EU_S^{nc}(\alpha^{nc}(b), \beta^{nc}(b) \mid b) = EU_S(\alpha^{nc}(b), \beta^{nc}(b) \mid b)$. The reason is that, for any $b \in \left(\frac{\Delta}{2}, b_o(q)\right)$, $\beta^{nc}(b) = b - \frac{\Delta}{2}$, and for such $\beta^{nc}$ value, the communication between the CEO and the board is perfect communication, independent of the commitment scenarios. Therefore, $EU_S^{nc}(\alpha^c(b), \beta^c(b) \mid b) \geq EU_S(\alpha^{nc}(b), \beta^{nc}(b) \mid b)$. It remains to show that this inequality holds in a strict sense. For that purpose, note that for $b \in \left(\frac{\Delta}{2}, b_o(q)\right)$, $\beta^c(b) = \beta_{ii}(b) < b - \frac{\Delta}{2} = \beta^{nc}(b)$, and for the value function $EU_S(\beta \mid b) \equiv \max EU_S^{nc}(\alpha(b), \beta \mid b)$, by (20),

$$\frac{dEU_S^{nc}(\beta \in M_{ii})}{d\beta}_{\beta=b-\frac{\Delta}{2}} = \frac{\alpha^c(\cdot)[1 - \alpha^c(\cdot)]}{2c} \left[ \Lambda_s(b - \frac{\Delta}{2}) \right] < 0.$$
Therefore, VoC > 0 for any $b \in \left(\frac{A}{2}, b_o(q)\right)$, given $q \geq q_o$.

(b) Low $q$: If $q < q_o$, then $b_o(q) < \frac{A}{2}$. Hence, for any $b \in \left(b_o(q), \frac{A}{2}\right)$, revealed preference argument leads to $EU_S^{nc}(\alpha^{nc}(b), \beta^{nc}(b) \mid b) \geq EU_S^{nc}(\alpha^c(b), \beta^c(b) \mid b)$. It remains to show that this inequality holds in a strict sense. For that purpose, note that for $b \in \left(b_o(q), \frac{A}{2}\right)$, $\beta^{nc}(b) = b - \frac{A}{2} < 0$ and $\beta^c(b) = 0$. Hence $EU_S^{nc}(\alpha^{nc}(b), \beta^{nc}(b) \mid b) = EU_S^{nc}(b)$ and $EU_S^{nc}(\alpha^c(b), \beta^c(b) \mid b) = EU_S^{nc}(b)$. By Proposition 0, for $b > b_o(q)$, $EU_S^{nc}(b) > EU_S^{nc}(b)$. Finally, for any $b \in \left(b_o(q), \frac{A}{2}\right)$, if $\beta = \beta^c(b) = 0$, the communication between the CEO and the board is Case (i), where the commitment power does not make a difference. That is, $EU_S^{nc}(\alpha^c(b), \beta^c(b) \mid b) = EU_S^{nc}(\alpha^c(b), \beta^c(b) \mid b)$. Therefore, VoC < 0 for any $b \in \left(b_o(q), \frac{A}{2}\right)$, given $q < q_o$.

Proof of Corollary 4.

With noncommitment (part (a)), by Proposition 0, for high-$q$, both $\beta^{nc}(b)$ and $\alpha^{nc}(b)$ are positive and strictly increasing for any $b \in \left(\frac{A}{2}, b_o(q)\right)$. Therefore, $\beta^{nc}(b) = \alpha^{nc}(b) \cdot \beta^{nc}(b)$ is positive and strictly increasing. In the low-$q$ case, for $b \in \left(b_o(q), \frac{A}{2}\right)$, $\beta^{nc}(b)$ is negative and strictly increasing but $\alpha^{nc}(b)$ is positive and strictly decreasing. Therefore, $\beta^{nc}(b)$ is negative and strictly increasing.

With commitment (part (b)), by Proposition 1, for $b \in \left(\frac{A}{2}, \Delta\right)$, $\beta^c(b)$ is negative and continuous and $\alpha^c(b)$ is positive and continuous, therefore $\beta^c(b) = \alpha^c(b) \cdot \beta^c(b)$ is negative and continuous. Now we prove the single-troughedness property of $\beta^c(b)$. Note that, for $b \in \left(\frac{A}{2}, \bar{b}\right)$, $\beta^c(b) = \beta^{int}$ is negative and decreasing (the proof of Proposition 1), whereas $\alpha^c(b)$ is positive and increasing, hence $\beta^c(b)$ is negative and decreasing for $b \in \left(\frac{A}{2}, \bar{b}\right)$. For $b \in \left(\bar{b}, \Delta\right)$, $\beta^c(b) = b - \Delta$ and $\alpha^c(b)$ is as in (25), therefore

$$\beta^c(b) = \alpha^c(b) \cdot \beta^c(b) = \alpha^c(b) (b - \Delta) = \left(\frac{1}{2} - \frac{H^2 + L^2}{4} - \frac{1}{2} \left[\Lambda_s \beta + (b - \frac{A}{2})^2\right]\right) (b - \Delta).$$
Take the third derivative of $\bar{\beta}^c$ with respect to $b$,

$$\frac{d^3\bar{\beta}^c}{db^3} = -\frac{96c[(H - L)^4 - 8(H^2 + L^2)\Delta^2]}{(4b\Delta - 3\Delta^2 + 4\Lambda_s)^4}.$$ 

That is, $\frac{d^3\bar{\beta}^c}{db^3}$ is monotonic in $b$ for $b \in (\tilde{b}, \Delta)$. Moreover, it is readily verified that

$$\frac{d^2\bar{\beta}^c}{db^2}\bigg|_{b=\tilde{b}} = \frac{H^2 + L^2}{(H - L)^4} 64c\Delta > 0,$$

$$\frac{d^2\bar{\beta}^c}{db^2}\bigg|_{b=\Delta} = \frac{16c\Delta [4(H^2 + L^2)(3\Delta^2 + 4\Lambda_s)^3 - (H - L)^4(13\Delta^4 + 48\Delta^2\Lambda_s + 48\Lambda_s^2)]}{(H - L)^{12}} > 0.$$ 

Therefore $\frac{d^2\bar{\beta}^c}{db^2} > 0$ for $b \in (\tilde{b}, \Delta)$. Combining with the fact that $\bar{\beta}^c(b)$ is continuous for the entire $b$ region and decreasing for $b \in (\frac{\Delta}{2}, \tilde{b})$, it is then verified that $\bar{\beta}^c$ is single-troughed in $b$. 

\textbf{Appendix B: Feasible Parameter Range for} $(c, q)$

To ensure an interior optimal $\alpha$ and $e$, we need to impose the joint parameter restrictions on $c$ and $q$. We first bound $c$ from above to ensure $\alpha^k(\cdot) > 0$. From Table 3 and Fig 4, the minimal $\alpha^k(\cdot)$, denoted by $\underline{\alpha}(\cdot)$, is achieved for sufficiently small $b$:

$$\underline{\alpha}(\cdot) = \frac{1}{2} - \frac{H^2 + L^2}{4} - \frac{\Delta}{4} - \frac{\Lambda_s}{2}.$$ 

Therefore, for $c < \frac{Q^2(H-L)^4}{(1-2Q)(H^2+L^2)+4HLQ} \equiv c_2$, $\alpha^k(\cdot)$ is always positive.

We now bound $c$ from below to ensure $e^k(\cdot) \leq 1$. Again, by Table 3 and Fig 4, equilibrium board effort, $e^k(\cdot)$, achieves its maximum, denoted by $\bar{e}(\cdot)$, at $b = b_0(\cdot)$, hence

$$\bar{e}(\cdot) = \left( \frac{1}{2} - \frac{H^2 + L^2}{4} - \frac{1}{2} \right) \frac{\Delta}{2} = -\frac{\Lambda_s}{2c}.$$ 

Plugging in $b_0(\cdot) = \frac{\Delta}{2} - \frac{\sqrt{2}}{8} \sqrt{\frac{(1-4Q)(Q(H-L)^4-4c(H^2+L^2))}{cQ}}$, and the identity $(\frac{\Delta}{2})^2 \equiv (\frac{1}{4} - Q)(H - L)^2$, we derive the lower bound $c_1 \equiv \frac{Q(1-2Q)(H-L)^4}{2(1+2Q)(H^2+L^2)-4HLQ}$ to ensure that $e^k(\cdot) < 1$ for $c > c_1$. 

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Lastly, we bound \( q \) from above, i.e., \( q < \bar{q} \), to ensure that the parameter range of \( c \) thus derived is nonempty:

\[
\begin{align*}
c_1 < c_2 & \iff \frac{Q(1 - 2Q)(H - L)^4}{2[(1 + 2Q)(H^2 + L^2) - 4HLQ]} < \frac{Q^2(H - L)^4}{(1 - 2Q)(H^2 + L^2) + 4HLQ} \\
& \iff Q > \frac{2[H^2 + L^2]}{2(2H^2 + 2L^2) + (H - L)^2} \\
& \iff q < \frac{1}{2} + \frac{H - L}{2\sqrt{2(H^2 + L^2) + (H - L)^2}} \equiv \bar{q}.
\end{align*}
\]

Hence the joint parameter restrictions are \( c_1 \leq c \leq c_2 \) and \( q < \bar{q} \).
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