Support, Oppose or Rubberstamp?

A Theory of Collective Decisionmaking of Corporate Boards

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Abstract

This paper presents a model of collective decision making by corporate boards in which directors gather information, consider alternatives and vote in favor or against proposals under consideration. We derive incentives for directors that induce optimal decision outcomes. We show that these incentive contracts condition on directors' tendencies to free-ride on each others' information and votes and their designs vary with firms' governance structures. We also show that while in many scenarios directors choose to rubberstamp the CEOs decision, with optimal compensation, the CEO, anticipating conformity, increases his own effort so that decision quality does not suffer.

Keywords: corporate boards, corporate governance, collective decision making, executive compensation, strategic voting, board independence, shareholder say-on-pay

JEL Classification: G34, L22

1 Introduction

In the aftermath of the recent financial crisis there is great skepticism about the ability of corporate boards to provide directions. While many CEOs were replaced, their boards typically remained intact[1] suggesting a growing disbelief among shareholders whether directors can provide effective oversight or a prevailing optimism that the standards set in Sarbanes and Oxley and elsewhere will eventually lead to improved board performance.

In an attempt to analyze why boards so often fail to provide effective oversight, we develop a model of board decision making. In keeping with the fiduciary duties of loyalty and care[2], we model how corporate directors expend (non-contractible) effort to evaluate strategic decisions for their firms, advise the CEO and vote to support or oppose proposals under consideration. The quality of directors' recommendations depends on expertise and effort which in turn depends on the incentives they face. Directors' recommendations are discussed and voted on by the board, requiring simple majority, supermajority or unanimity to pass.

Holmström (1982) established that an optimal compensation contract for a team to induce effort requires a share of the output and a penalty for non-achievement. Otherwise, there will be under-provision of effort as the cost of effort is borne by each member but the output is shared. While corporate boards are also teams, they are more complex, since each director makes at least two decisions: how much effort to expend to evaluate alternatives and whether to support or oppose the proposal under consideration. The more a director expects to learn from his fellow directors either by observing how they vote or through discussion before voting, the greater his willingness to free-ride and the lower his incentive to consider alternatives. Hence, when a director anticipates that she will not always rely on her own information when voting, she collects less information ex-ante. We find that this problem can become worse with pre-vote discussions since there is greater opportunity to free-ride as more information be revealed.[3] Thus the optimal contract needs to solve the effort choice problem while conditioning on tendencies to free ride on information and vote.

We derive incentive contracts under different voting rules and demonstrate that optimal incentive

[1] See "Wall Street Housecleaning May Bypass Boardroom", WSJ April 2, 2008.

[2] One of directors' fiduciary duties is the duty of care. The duty of care requires that "A director must exercise due diligence in making decisions. *He must discover as much information as possible on the questions at issue* and be able to show that, in reaching a decision he has considered all reasonable alternatives."(Gaughan, 2008)

[3] This suggests that information sharing which is usually viewed value enhancing, as in recent papers on boards by Raheja (2005), Adams and Ferreira (2007), Harris and Raviv (2008), on teams like Lazear (1989), Itoh (1991), and on strategic voting like Federsen and Pesendorfer (1998), Coughlan (2005) and Bond and Eraslan (2010), may potentially reduce value when effort is considered.

compensation contracts depend on voting rules and there is no "one size fits all". Since voting rules impact ex-ante incentives, incentive contracts are voting-rule-specific and the set of optimal contracts varies with corporate governance.[4] This implication is in line with Coles, Daniel and Naveen (2008) and Easterwood and Raheja (2007) who document that compensation contracts vary with board structures and board characteristics; Coles, Lemmon and Wang (2008) who quantifies this variation using a structural model; and Fahlenbrach (2009) who argues that compensation contracts and governance rules are substitutes and reports strong correlations between corporate governance characteristics and the structure of executive pay. Interestingly, free riding tendencies will not be eliminated even with optimal incentive contracts, because some directors voting along the rest of board may actually improve the quality of the collective decisions ex post. Hence, eliminating all free-riding tendencies would be very costly for shareholders.

When directors are equally capable of discovering information and/or identifying alternatives, we show that granting each board member a stake in the firm and penalizing him when his recommendations turn out to be wrong achieves shareholder value maximization. This combination of reward and penalty affects incentives more intensely with reward based on joint output and penalty on individual recommendations. Thus, even small penalties can be quite effective.[5]

Incentive contracts differ when a particular director is better at evaluating alternatives for a proposal under consideration than his fellow directors. We show that regardless of incentives or independence, the rest of the board will follow his recommendation[6] even against their own signals when voting is sequential and/or a discussion precedes the vote.[7] This conformity, however, does not necessarily results in less information being used to make decisions.[8] With the right incentives,

[4]An important insight of our paper is that with optimal incentive contracts, voting rules become irrelevant. However, since voting rules impact ex-ante incentives and the amount of free-riding, optimal compensation contracts are voting-rule-specific. This extends the insights of Persico (2004) by including optimal contracting and strategic voting.

[5]The threat that a director may be forced to resign with some probability if he repeatedly supports decisions that turn out to be negative NPV ex post is a good example of such penalty. The importance of individual penalties have been frequently highlighted in the financial press. As Morgensen writes in the New York Times: "the only way to force some directors to live up to their duties is for shareholders to keep them worried about an embarrassing vote."(See "Too Many 'No' Votes To Be Ignored", G. Morgensen, NYT, Sep 20, 2009, Business, Pages 1-2.)

[6]In line with this prediction Agrawal and Chadha (2005), Güner, Malmendier and Tate (2008) and Minton, Taillard and Williamson (2010) report that expert directors have a strong impact on corporate decisions.

[7]The fundamental tradeoff between inducing agents to tell the truth and inducing them to undertake effort is originally investigated in Pendergast (1993). There workers are rewarded on a subjective basis which results in conformity. In our model conformity occurs even if directors are compensated on objective and verifiable basis.

[8]This result runs counter to the perceived wisdom in most herding papers. See for instance Welch (1992) and Bipchandani, Hirshleifer and Welch (1992).

this director can be induced to optimally increase his own effort to compensate for the information loss from free riding by the rest of the directors.[9] We show that optimal decision outcome can be achieved by an incentive compensation contract that grants this director (call him the CEO, a lead director, or an expert director) a stake in the firm and imposes a penalty if the recommendation turns out wrong ex post. Interestingly, such compensation to the CEO and token payments to other directors was the corporate norm until some years ago.

We show that this high-powered compensation scheme is more costly for shareholders than incentivizing equally capable directors but, nevertheless, it translates into higher firm value and higher shareholder value for reasonable effort-cost-functions when the board is comprised of heterogenous directors.[10] This result is novel, since earlier theories in the governance literature proposing incentive pay for directors do not explicitly adjust for its impact on shareholder surplus. Our theory also implies that adding independent directors to the board, or aiming to incentivize them with stock-based compensation contracts may not result in shareholder value maximization. Evidence reported in Erkens, Hing and Matos (2010) on bank performance during the 2007-2008 financial crisis is consistent with this view.

One of the problems of directors setting pay, especially their own pay, is that "they are unlikely to declare their own and their CEO's performance below average".[11] Since our model shows that shareholder value maximizing incentive contracts vary with board characteristics and governance rules, it raises further concerns whether the design of incentives can be left to directors. Simply putting independent directors on the compensation committee may not be enough, especially if the directors are independent not only of the CEO but also of the shareholders which is exactly what the directors' incentive contracts are meant to correct. New rules recently passed by the SEC mandating advisory shareholder votes on companies' executive pay may help to improve incentives for directors. An opposing shareholder vote on executive compensation, as Protess (2011) writes[12], is an implicit threat for directors' re-election and a penalty component of incentive pay.

When the cost of acquiring information about the firm is low, our model predicts that independent

[9]The importance of optimal incentives for expert directors has been highlighted in Güner, Malmendier and Tate (2008) that documents an increase in external funding for firms with poor investment opportunities and a decline in acquisition quality after bankers join boards.

[10]Consistent with Adams, Almeida and Ferreira (2005), our theory implies that the interaction between executive characteristics and organizational variables have an impact on firm performance.

[11]*Roundtable on Corporate Boards*, CNBC, Feb 9, 2010.

[12]"Dissention among a majority of investors could embarrass the company. And if a company does not adjust its ways, directors may not get re-elected." *In split vote, SEC adopts rules on corporate pay*, by Ben Protess, New York Times, January 26, 2011.

directors can be incentivized to become informed and maximize shareholder value. We also show that when information cost is high, outside directors do not add value and granting them incentive compensation may destroy value. This prediction of our model is supported by empirical evidence provided in Duchin, Matsusaka and Ozbas (2010) that the effectiveness of outside directors depends on the cost of acquiring information about the firm and information asymmetry among directors. Using recent regulations on outside directors, the authors show that when the cost of acquiring information about the firm is low (high), firm performance increases (worsens) when outsiders are added to the board.

When the CEO's private benefits are high, the information the board receives from the CEO is less reliable and other board members may have more confidence in their own signals even if of lower quality. This implication of our model is in line with Gilette, Noe and Rebello (2003) who show that when insiders' agency problems are severe, an independent director can add value by preventing decisions that are obviously wrong. This prediction is also consistent with the empirical findings of Ferreira, Ferreira and Rapuso (2011) that document a positive correlation between price informativeness and board independence for firms where board monitoring is valuable. When stock prices become more informative, the information disadvantage of directors is reduced, they can intervene more often to improve decision quality and to counterweigh the CEO's conflict of interest. Nevertheless, if the CEO has a severe conflict of interest, it may be more efficient for a board to simply force him and appoint a successor whose recommendations they can confidently follow, rather than actively collect information and frequently intervene. Moreover, the CEO may not be the only director with substantial private benefits and severe conflict of interest as in Fich and Shivdasani (2006), Aggarwal and Nanda (2007) and Güner, Malmendier and Tate (2008). If other directors have severe conflict of interest, then their recommendations may be similarly biased (possibly in different directions) and unlikely to benefit shareholders.

Our paper is related to the small but growing theoretical literature on corporate boards such as Hermalin and Weisbach (1998), Raheja (2005), Adams and Ferreira (2007), Harris and Raviv (2008) and Kumar and Sivaramakrishnan (2008). Hermalin and Weisbach (1998) model the bargaining process between the board and the CEO and show that linking directors' pay to stock performance results in more monitoring and higher firm value. Our paper focuses on the voting process through which directors make decisions and show that optimal incentive contracts vary with the governance structure of the corporation. Adams and Ferreira (2007) present a model where friendly boards can dominate because of their dual role of monitoring and advising and they provide a rational for one-tier and two-tier boards. Raheja (2005) and Harris and Raviv (2008) develop novel theories about the optimal composition of boards between insiders and outsiders, and optimal board size. In Raheja (2005) insiders share their information with outsiders after a negative shock to firm performance because they wish to position themselves in the event of CEO turnover. In Harris and Raviv, insider controlled boards can be optimal if insiders' information is critical for the investment decision of the firm. While one of our conclusions also favors friendly boards, the reason is quite different. In Adams and Ferreira (2007) and Harris and Raviv (2008) friendly boards allow for better information sharing. In our model friendly boards emerge endogenously when directors choose to rubberstamp the CEO's recommendation. None of these studies explore the friction between information collection and information sharing, or the impact of optimal board compensation on firm and shareholder value which are the main focus of our paper.

In a related model, Kumar and Sivaramakrishnan (2008) compare monitoring and contracting with the CEO through a one-member board compensated by an equity contract, to direct shareholder monitoring and contracting with the CEO. Our model differs from KS's as we study a multi-member board. This allows us to highlight the role of free-riding in board decision making, in ex ante information collection and in ex post voting, and show how optimal board compensation depends on the governance rules of the corporation. We also demonstrate that in equilibrium directors endogenously decide whether to become active monitors or to rubberstamp.

Like Fulghieri and Lukinc (2001) we study endogenous information acquisition and optimal contract design. Our focus is on board decision making and optimal compensation, while theirs is on information acquisition by investors and optimal security issuance. Even though the focus of the models is very different, both predict that in equilibrium the degree of information asymmetry among agents is endogenously determined and the design of optimal contracts depends on the cost and precision of the information production technology.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 describes board decision making and optimal contracting for homogenous directors and Section 4 for heterogenous directors. Section 5 compares firm values, board compensation and shareholder surplus for optimal contracting under different governance rules and outcomes. Section 6 concludes.

2 The Model

We consider a firm that is facing a major decision. This can be any strategic decision where resolution of uncertainty about the future is valuable. For simplicity we call it an investment choice.

The future state θ can be H or L with equal probability. The firm's gross profit is 1 if H is realized, and 0 if L is realized. The cost of investing is $c \geq 0.5$, so investing without information about which state is more likely makes the project zero- or negative NPV. For convenience, assume the discount rate is zero.

The board of directors makes its decisions through a majority vote. In line with common corporate practice, we assume that the CEO is a voting member of the board. We further assume that shareholders and directors are risk-neutral and all directors are identical and have the same search technology, which we later relax.

In line with directors' fiduciary responsibilities of duty of care, each board member can obtain a signal about the quality of the firm's investment opportunity by exerting some effort. The precision of the signal depends on the amount of effort exerted. If a board member exerts effort, $q \in [0.5, 1]$, then she will receive a signal with precision q. The higher q is, the better forecast the board member obtains. If a board member exerts effort q and observes a signal H, then with probability $q \geq 0.5$ the investment opportunity is H, and with probability $(1 - q)$ the investment opportunity is L. If the signal is L, then the investment opportunity is L with probability q and H with probability $(1-q)$. The expected gross profit of the firm, $E(\pi)$, is therefore a function of the effort level or signal precision of each director, and the voting rules.

Let α denote a board member's expertise or ability to collect information. Following previous literature, we assume a convex effort cost function for the directors, $\alpha(q-.5)^2$, such that the marginal cost of effort increases with the precision of the information. Since we initially assume that no director has any advantage in information production, we omit the subscript on α and q.

Following Holmström (1982) and Khanna (1998), we represent a compensation contract as a combination of a "carrot" (incentive payment) and a "stick" (penalty). We will show later that such a contract induces optimal decision outcome for directors. Formally, a director's compensation is written as

$$w = \omega + \lambda\pi(*) - \gamma I \tag{1}$$

where π is the realized gross profit of the firm; ω is the director's fixed wage, λ is the director's stake in the firm, γ is the amount of penalty for making the wrong recommendation and I is an indicator variable that equals zero if no penalty is imposed and one otherwise. The term, $\lambda\pi$ constitutes the incentive payment or "carrot" if π is positive and reflects the pay for performance component or equivalently a stake in the firm. Since we do not impose limited liability, this portion can be negative ex-post, a joint penalty that is uniform across all directors, such as a loss on their equity stake due to a drop in the share price. The term γI represents an individual penalty or "stick". An example of such a penalty is that a director may be forced by shareholders to resign from the board with some probability if he repeatedly supported decisions that turned out negative net present value ex post, and/or voted for the firm to pass up valuable investment opportunities that competitors profitably exploited later. Similarly, an opposing shareholder vote on executive compensation may serve as an implicit threat to the reelection of members of the compensation committee of the board.[13]

For the rest of the paper we assume that directors are wealth constrained and feasible contracts are those with non-negative fixed wage component, that is,[14]

$$\omega \geq 0 \qquad\qquad \forall \lambda,\ \gamma. \tag{2}$$

First we will consider a corporate board with homogenous directors, then one with heterogenous directors. We identify equilibrium information collection and voting strategies for each director under an optimal incentive contract. We initially assume that directors are identical in their search technologies and hence, in equilibrium they are offered the same incentive contract and collect the same information of quality, q, ex ante. Then, we extend the analysis to the case of heterogenous directors. For simplicity, and without loss of generality, we consider a three-member board.

3 Board decisionmaking with homogenous directors

We start our analysis under the assumption of homogenous directors since a board of directors to be truly independent presupposes that directors possess similar quality of information (expertise), as otherwise they are more open to being persuaded by the CEO or other directors to vote along with them rather than take an independent stand.[15] Thus we first introduce a model where all directors (including the CEO) have similar costs of getting informed and derive optimal contracts that maximize shareholder surplus. Later we allow heterogenity among directors and show that the CEO or the director who is perceived to be more informed is able to persuade others to rubberstamp his recommendation. However, as mentioned before, with optimal contracting the informational loss from rubberstamping can be overcome, so shareholder surplus do not necessarily suffer.

We consider different voting procedures and governance rules. In the first case, board members vote simultanously with no pre-vote discussion. So a director cannot infer other's information. This

[13]Individual penalties are important not only because of their frequent use in implicit contracts in practice but as shown in Holmström (1982) and Khanna (1998), optimal contracts without individual penalties are often infeasible to implement.

[14]This assumption rules out contracts in which directors pay up front to become large shareholders.

[15]This would also likely apply to boards which have the chairman separate from the CEO.

is our base case where there is no leakage of information. However, since it is likely that even without pre-discussion some information will leak out during the voting process, we also consider the case where board members vote sequentially and each director can observe the votes of those who voted before him but not the votes of those who voted after him.[16] Thus, each director can infer some of the information of those voting before him and can potentially free ride on their effort. Finally we consider a board where directors expect to have a pre-vote discussion to influence each other's opinion or to jointly advise the CEO. Here there is even greater leakage as each director can infer some of the information of all other directors. The optimal contract for each case is different and derived below.

The optimal incentive compensation contract for directors maximizes shareholder surplus under the expected voting rule. When voting is simultanous, the dominant strategy of each director who receives a signal, $\theta = H$ is to vote in favor of investing (i.e., there is no free-riding on how others vote). Using the majority rule, the board approves the decision if the majority of directors vote in favor. In all other cases, the board rejects the investment.

There are eight possible signal realizations for the three-director board: (H, H, H); (H, H, L); (H, L, H); (L, H, H); (L, L, H); (L, H, L); (H, L, L); (L, L, L). In the first four cases the investment opportunity will be undertaken under a majority rule, in the last four cases the investment will be rejected. When the investment is rejected, firm value will be 0. When the investment is undertaken cost, c, is incurred and the expected value of the firm conditional on realized signals yields

$$\begin{aligned} E[\pi|HHH] &= \frac{0.5q^3}{0.5q^3 + 0.5(1-q)^3} - c \qquad (3) \\ E[\pi|HHL] &= E[\pi|HLH] = E[\pi|LHH] = \frac{0.5q^2(1-q)}{0.5q^2(1-q) + 0.5q(1-q)^2} - c \end{aligned}$$

The unconditional expected value of the firm (before directors receive signals) given that each director will reach her decision independently (i.e. based on her own signal only) and the board accepts investment on the basis of the majority rule becomes

$$\begin{aligned} E[\pi] = 0.5 * [&E[\pi|HHH] * Prob(HHH) + E[\pi|HHL] * Prob(HHL) \\ &+ E[\pi|HLH] * Prob(HLH) + E[\pi|LHH] * Prob(LHH) - c] \qquad (4) \end{aligned}$$

[16]This is of course only one way of modeling information leakage. However, this approach allows for closed form solutions allowing us to perform interesting comparative statics. We believe that the tradeoffs identified should hold for other models of information leakage as well.

Substituting for probabilities and expected values in (4) yields the first term in the bracket as q^3 and the second through the fourth term as $q^2(1-q)$ each. Computing the sum and simplifying the resulting expression obtains the expected gross firm value as

$$E[\pi] = 0.5[3q^2 - 2q^3 - c]. \tag{5}$$

Given this value, shareholders choose the effort level, q, for each director to maximize their residual after the board is compensated for its effort as:

$$\max_{q \in [0.5;1]} 0.5[3q^2 - 2q^3 - c] - 3\alpha(q - 0.5)^2 \tag{6}$$

Taking the first-order condition for $q \in [0.5, 1]$ gives

$$q^2 + (2\alpha - 1)q + \alpha = 0 \tag{7}$$

The choice of effort and signal precision that maximizes shareholder value obtains as

$$q^{B*} = \frac{1}{2} - \alpha + \sqrt{\frac{1}{4} + \alpha^2} \tag{8}$$

Note that $\frac{1}{2} - \alpha + \sqrt{\frac{1}{4} + \alpha^2} < 1 \;\; \forall \alpha > 0$. For the special case of $\alpha = 0$, $\frac{1}{2} - \alpha + \sqrt{\frac{1}{4} + \alpha^2} = 1$. Note, each director chooses the same level of effort in equilibrium as they are assumed to be homogeneous.

Next we identify optimal contracts that induce this desired effort choice from each director. To do so we use the symmetric Nash equilibrium concept. For that we first compute the optimal effort choice, q, of a director who takes the effort choice of each of the other directors as p. Each director's maximization problem then takes the form

$$\begin{aligned} &\max_{q \in [0.5,1]} \omega + .5\lambda(p^2 q + p^2(1-q) + 2pq(1-p) - c) \\ &-\gamma[\text{Probability of being wrong}] - \alpha(q - .5)^2 \end{aligned} \tag{9}$$

where the first term is the fixed wage, the second term is the director's share of the expected firm value, and the third term is the expected penalty he incurs if his vote turns out to be wrong ex post. The probability of being wrong depends on the director's effort to become informed and whether he votes according to his signal, or suppresses his signal and votes along with others (if they are in agreement), or does not collect any information and free rides on the fellow directors' votes. As before, the penalty for repeatedly supporting decisions that turn out to be bad for the firm ex post, is that the director may be forced to resign with some probability and lose his director's pay, perks and benefits.

We next discuss different voting mechanisms and corporate cultures: simultanous voting without pre-vote discussion, and non-simultanous voting with and without prior discussion, and identify contracts that maximize shareholder surplus for each mechanism.

3.1 Optimal contracting with no free-riding

For ease of clarity we start with the base case in which voting is conducted simultanously and no information is leaked prior to the vote either through pre-vote discussion or otherwise. In this case the probability of being wrong for each director is $1 - q$.

When each director arrives at his or her decision only on the basis of his own information and the board reaches its decision by majority rule, then (9) becomes

$$\begin{aligned}\max_{q\in[0.5,1]} \omega + .5\lambda(p^2q + p^2(1-q) + 2pq(1-p) - c) \\ -\gamma(1-q) - \alpha(q-.5)^2\end{aligned} \tag{10}$$

where q and p are as defined above.

Given p, the first-order condition with respect to q is

$$\lambda p(1-p) + \gamma - 2\alpha(q - 0.5) = 0 \tag{11}$$

When all directors are equally skilled and face the same effort costs, then, substituting q for p in a symmetric Nash equilibrium yields

$$\lambda q^2 - (\lambda - 2\alpha)q - (\gamma + \alpha) = 0 \tag{12}$$

Solving the first order condition for q determines each directors's signal precision as follows.

$$q^B = \frac{\lambda - 2\alpha + \sqrt{(2\alpha-\lambda)^2 + 4\lambda(\gamma+\alpha)}}{2\lambda} \tag{13}$$

or

$$q^B = \frac{1}{2} - \frac{\alpha}{\lambda} + \sqrt{\frac{1}{4} + \frac{\alpha^2}{\lambda^2} + \frac{\gamma}{\lambda}} \tag{14}$$

To obtain the effort level that maximizes shareholder surplus, the incentive compensation contract for directors must set q^B in (14) equal q^{B*} in (8). The following proposition describes the optimal incentive contract. The proof is straightforward from the derivations above and is omitted.

Proposition 1 *When each board member reaches his or her decision independently from each other and the majority rule is used to arrive at the investment decision, then the optimal compensation contract,* $(\omega^B, \lambda^B, \gamma^B)$ *must satisfy*

$$\frac{1}{2} - \alpha + \sqrt{\frac{1}{4} + \alpha^2} = \frac{1}{2} - \frac{\alpha}{\lambda} + \sqrt{\frac{1}{4} + \frac{\alpha^2}{\lambda^2} + \frac{\gamma}{\lambda}} \tag{15}$$

Condition (15) determines the properties of the optimal contract when each director makes his or her decision independently. We plot this condition on Figure 1 in α, λ, and γ space. As before, α captures directors skills or expertise, λ is their equity stake in the company as determined by the optimal compensation contract and γI the penalty for recommending (or rejecting) negative (positive) net present value projects.

3.2 Optimal contracting when some free-riding is possible

Preventing information leakage from one director to the next is likely to be difficult in practice. Even in the absence of pre-vote discussions some directors may intentionally or inadverently let some of their information known. The other directors can then aggregate this information before they themselves vote. We try to capture this kind of information leakage through sequential voting where those voting later benefit from how those who went before voted. Being able to aggregate others' information induces directors to collect less information ex ante and the contract $(\omega^B, \lambda^B, \gamma^B)$ becomes inefficient.

To model directors' decisionmaking when free-riding is possible, we consider first the case of directors voting sequentially with order of vote not pre-determined.[17] We show that the director voting last follows her private signal if her fellow directors disagree but ignores her information and votes with them if they agree.

Proposition 2 *If a director can observe her fellow directors' information or vote, then she ignores her own information and votes with others when they agree but follows her own signal when her fellow directors disagree. When a director can potentially rely on some of her fellow directors' recommendations prior to her vote, then the incentive compensation contract* $(\omega^B, \lambda^B, \gamma^B)$ *does not maximize shareholder value.*

Proof: in Appendix.

[17] This is the easiest case to handle since the contracts will be the same for each director. Main results are not affected if order is pre-determined, however. In that case the optimal contract will be different for each director depending on the predetermined order of vote. (See also discussion at the end of this section)

The tendency to vote strategically by free-riding on others' votes has been shown to be potentially value-increasing in models in the strategic voting literature in political elections and juries by Austen-Smith and Banks (1996), Feddersen and Pesendorfer (1996, 1997), Dekel and Piccione (2000), Persico (2004), among others. More recently, Maug and Rydqvist (2009) show that under supermajority and unanimity rules strategic voting creates more value than 'sincere voting' while they perform equally under the majority rule. These models differ from ours by assuming that agents are endowed with private information and no effort is required from those agents to acquire (further) information. Under this assumption strategic voting unambigously increases value. However, when agents endogenously collect information, then strategic voting has a feedback effect on effort, and may become detrimental, as our analysis shows. To overcome this problem optimal incentive compensation contract must condition on the possibility of such free-riding.

To derive the optimal contract that conditions on this kind of potential free-riding by directors, we proceed by backward induction focusing on the decision of the director who votes last. Note that if the rest of the board is in agreement, then this director's decision will have no impact on the investment choice under majority rule. It follows from Proposition 2 that this director will suppress her signal (if different) and follow her fellow directors when they agree, and vote according to his own signal otherwise. Therefore, her problem takes the following form:

$$\max_q \omega + .5\lambda(p^2q + p^2(1-q) + 2pq(1-p) - c) - \gamma(1-p)(1+p-2pq) - \alpha(q-.5)^2 \tag{16}$$

where $(1-p)(1+p-2pq)$ is the probability of a director being wrong when she votes with her fellow directors if they agree and follows her own signal if they disagree.

In contrast to the director who votes last, the second to last director does not gain by ignoring his own signal, since the probability of being wrong is the same for both strategies. Therefore, the this director's problem will be the same as in (10).

When the order of voting is random, each director recognizes ex ante that if he is called upon to vote third (which has a one-third probability) and the other two board members before him agree, he may suppress his signal. Hence each director's problem becomes

$$\begin{aligned} &\max_q \omega + .5\lambda(p^2q + p^2(1-q) + 2pq(1-p) - c) \\ &-\gamma[\frac{2}{3}(1-q) + \frac{1}{3}(1-p^2-2pq+2p^2q)] - \alpha(q-.5)^2 \end{aligned} \tag{17}$$

This objective function takes into account that a director will vote independently when he votes first or second (which happens with probability two-third) but he will follow others when he votes last and those before him agree.

The first-order condition of (17) in q yields

$$-p^2(3\lambda + 2\gamma) + p(3\lambda + 2\gamma) + (3\lambda + 2\gamma) - 2\alpha q = 0 \tag{18}$$

Substituting back for $p = q$ in the first-order condition as

$$q^2(3\lambda + 2\gamma) + q(6\alpha - 3\lambda - 2\gamma) - (3\alpha + 2\gamma) = 0 \tag{19}$$

yields the director's effort choice as

$$q^{BC} = \frac{-(6\alpha - 3\lambda - 2\gamma) + \sqrt{(6\alpha - 3\lambda - 2\gamma)^2 + 4(3\lambda + 2\gamma)(2\gamma + 3\alpha)}}{6\lambda + 4\gamma} \tag{20}$$

Simplifying expression (20) gives

$$q^{BC} = \frac{1}{2} - \frac{\alpha}{\lambda + \frac{2}{3}\gamma} + \frac{\sqrt{4(\alpha + \frac{2}{3}\gamma)^2 - \frac{8}{3}\alpha\gamma + (\lambda + \frac{2}{3}\gamma)^2}}{2(\lambda + \frac{2}{3}\gamma)} \tag{21}$$

The optimal contract equates q^{BC} and q^{B*} and induces directors who have an opportunity to free ride on each others' effort and vote to exert the effort shareholders desire. Proposition 3 below characterizes the terms of the optimal incentive compensation contract for free-riding directors.

Proposition 3 *When directors potentially free ride on the votes of those going before them, a compensation contract (ω^{BC}, λ^{BC}, γ^{BC}) maximizes shareholder value if and only if it satisfies (2) and*

$$\frac{1}{2} - \alpha + \sqrt{\frac{1}{4} + \alpha^2} = \frac{1}{2} - \frac{\alpha}{\lambda + \frac{2}{3}\gamma} + \frac{\sqrt{4(\alpha + \frac{2}{3}\gamma)^2 - \frac{8}{3}\alpha\gamma + (\lambda + \frac{2}{3}\gamma)^2}}{2(\lambda + \frac{2}{3}\gamma)} \tag{22}$$

The proof is straightforward from the formal arguments above and is therefore omitted.

Note this contract sets q^{BC} equal to q^{B*}, the shareholder value maximizing effort choice. However it comes with more powerful incentives to control directors' free-riding tendencies ex ante than the one in Section 3.1. The fixed wage component gets reduced accordingly, so in equilibrium, each director is compensated only to the extent of his effort cost. Figure 2 illustrates this contract. Note that for a given α, these contracts exhibit higher λs and γs than in the simultanous voting case.

As the corollary below states, the terms of the optimal contract will vary with α.

Corollary 1 *There does not exist any optimal contract that would induce board members to exert value maximizing effort independent of α.*

Proof: in Appendix.

Expression (22) yields $\lambda = 1$ and $\gamma = 0$ as the only optimal contract independent of α. This contract is of course infeasible, since shareholders cannot give the whole firm to each of the directors. Setting $\gamma = 0$ would remove the incentives to free-ride on other's effort but it would be prohibitively costly to implement. The remaining α-dependent contracts characterized by $\gamma > 0$ induce directors to exert more effort ex ante but at the expense of potential free-riding.

With optimal efforts, firm value becomes

$$\frac{1}{4} + 4\alpha^3 + (\frac{1}{2} - 4\alpha^2)\sqrt{\frac{1}{4} + \alpha^2} - 0.5c \tag{23}$$

The aggregate board compensation is set at

$$\frac{3\alpha}{4} + 6\alpha^3 - 6\alpha^2\sqrt{\frac{1}{4} + \alpha^2} \tag{24}$$

and shareholder value is maximized at

$$-2\alpha^3 + (2\alpha^2 + \frac{1}{2})\sqrt{\frac{1}{4} + \alpha^2} - \frac{3\alpha}{4} + \frac{1}{4} - 0.5c \tag{25}$$

Note that a predetermined order of voting is not a special case of random voting order. When the order of vote is predetermined, then directors exert different effort ex ante depending on their order of vote. The directors who anticipate voting early will vote independently by maximizing (10) but the one who votes last will maximize (16). In this case the optimal compensation differs according to the order of voting. In case of secret ballot voting with no prior information sharing, voting is simultaneous. However, the optimal contract cannot penalize individual directors for making the wrong decision because secret ballots cannot identify which way a director voted. Thus, the penalty can only be contingent on the board's joint decision and the optimal contract requires a higher λ. This is similar to Milgrom (1982), and hence the optimal contracts become prohitively expensive and potentially not even feasible, making shareholders worse off.

3.3 Optimal Contracting with Pre-Vote Discussion

When a discussion precedes the vote and all directors are expected to participate, then there is more opportunity to free-ride on others' information, since even the director voting first can aggregate over all other directors' information. Anticipating this, each director will reduce ex ante effort accordingly.

When discussion precedes the vote, each director's probability of being wrong $(1-p)(1+p-2pq) < [\frac{2}{3}(1-q) + \frac{1}{3}(1-p^2-2pq+2p^2q)]$, the probability of being wrong in the no-discussion case. After taking the first-order condition of (16) in q, we get

$$\lambda p(1-p) + 2\gamma(1-p)p - 2\alpha(q - .5) = 0 \tag{26}$$

Given p, a director will choose lower ex ante effort when discussion precedes voting since the q that solves (26) is lower than the q that solves (18). Hence, with pre-vote discussions, decisions are also more likely to be reached by a unanimous vote because voting along with others will reduce each director's probability of being wrong the most. While unanimity will be achieved often, it will come at the expense of reducing the amount of information available.

Since directors have the same skills and effort costs, we look for the symmetric Nash equilibrium. Substituting q for p and simplifying expression (26) yields

$$(\lambda + 2\gamma)q^2 - (\lambda + 2\gamma - 2\alpha)q - \alpha = 0 \tag{27}$$

Hence if discussion precedes the vote, each board member would choose effort to attain signals of quality

$$q^D = \frac{\lambda + 2\gamma - 2\alpha + \sqrt{(\lambda + 2\gamma - 2\alpha)^2 + 4(\lambda + 2\gamma)\alpha}}{2(\lambda + 2\gamma)} \tag{28}$$

Simplifying expression (28) gives

$$q^D = \frac{1}{2} - \frac{\alpha}{\lambda + 2\gamma} + \sqrt{\frac{1}{4} + \frac{\alpha^2}{(\lambda + 2\gamma)^2}} \tag{29}$$

The optimal compensation contract $(\omega^D, \lambda^D, \gamma^D)$ induces directors to exert shareholder value maximizing effort by setting $q^{B*} = q^D$, that is,

$$-\alpha + \sqrt{\frac{1}{4} + \alpha^2} = -\frac{\alpha}{\lambda + 2\gamma} + \sqrt{\frac{1}{4} + \frac{\alpha^2}{(\lambda + 2\gamma)^2}} \tag{30}$$

It is straightforward to show that for every α there exists an optimal contract. Recall that without pre-vote discussion, α-independent contracts do not exist.

Proposition 4 *If*

$$\lambda + 2\gamma = \begin{cases} 1 & \text{if } \alpha > 0.5 \\ \\ \alpha & \text{otherwise} \end{cases} \tag{31}$$

then $q^{B*} = q^{D*}$ *is attained.*

Substituting $\gamma = \frac{1-\lambda}{2}$ into (29), the expected firm value

$$E[\pi(q^{BC})] = E[\pi(q^D)] = \frac{1}{4} + 4\alpha^3 + (\frac{1}{2} - 4\alpha^2)\sqrt{\frac{1}{4} + \alpha^2} - .5c \tag{32}$$

Note that effort and firm value is the same under $(\omega^D, \lambda^D, \gamma^D)$ and $(\omega^B, \lambda^B, \gamma^B)$. However, the compensation contracts are different. Proposition 5 states this result. The proof is straightforward from above and is omitted.

Proposition 5 *The optimal incentive contract depends on the governance structure of the corporation.*

Interestingly, optimal incentive contracts are voting rule specific.[18] However, once we derive the corresponding optimal incentive contracts, voting rules become irrelevant. Thus, optimal incentive contracts serve as substitutes for governance rules, consistent with the empirical findings Fahlenbrach (2009).

Since optimal compensation contracts depend on governance rules and board participation, Proposition 5 implies that their design cannot be left with directors. If shareholders do not have a significant say-on-pay, they are likely to lose all or part of their surplus to those who design the compensation contracts. Hence, we argue that directors' independence is necessary but not sufficient for shareholder value maximization: shareholder value maximization requires shareholders' say on director and CEO pay. Since boards have to be appropriately compensated to make the right decisions, they should not be in charge of designing their own compensation contracts.

4 Optimal contracting with heterogenous directors

Now, consider the case when the CEO or a director has an informational advantage, he volunteers to vote first, and this is known ex-ante.[19] Denote by $q > p$ the information precision of the CEO and by p the information precision of his fellow directors.[20] We next show that in this case other directors optimally choose to ignore their own signal and free-ride on the CEO's vote regardless of their compensation structure.

[18] For example, an optimal compensation contract that induces shareholder value maximization under sequential voting by directors with no prior discussion is strictly suboptimal when a discussion is expected to precede the vote.

[19] In practice, there are many organizations in which members speak in a set order. In some of these organizations the most junior, in others the most senior member speaks first. This order is not critical in our analysis. In most organizations there is no set order for discussion.

[20] It can be shown that if the CEO's information is superior, the optimal contract will require him to go first under the majority rule.

Suppose first that the CEO or the director with an informational advantage receives a signal L and recommends not to invest. Further suppose the director voting second receives a signal H. How will this director vote? Note that Proposition 2 still applies, i.e. the director voting last will go with the recommendation of his fellow directors if they agree.

After seeing his own signal, the director voting next can either follow his signal and accept the project, or ignore his signal and reject the project. If he rejects the project, then by Proposition 2, so will the director voting last. If he accepts the project, the director voting last will vote to either accept or reject depending on his own signal and the ratio of p to q.

Given that the CEO recommends against the project, and assuming that the director voting last follows his own signal if the others voting before him disagree, the second director will turn out to be wrong by voting for the project based on his own signal if either the signal sequence is LHH, the majority accepts and $\theta = L$, or the signal sequence is LHL, the majority rejects and $\theta = L$. Hence, the probability of the second director being wrong if he votes for the project given his signal H is:

$$\begin{aligned} &Pr(\theta = L|LHH) * Pr(LHH) \quad + \quad Prob(\theta = L|LHL) * Pr(LHL) \\ &= \ 0.5q(1-p)^2 + 0.5q(1-p)p \quad = \quad .5q(1-p) \end{aligned} \tag{33}$$

If he ignores his own signal and votes against the project, his probability of being wrong is

$$\begin{aligned} &Prob(\theta = H|LHH) * Prob(LHH) \quad + \quad Prob(\theta = H|LHL) * Prob(LHL) \\ &= \ 0.5p^2(1-q) + .5p(1-q)p \quad = \quad 0.5p(1-q) \end{aligned} \tag{34}$$

A comparison of these probabilities reveals that

$$.5q(1-p) > .5p(1-q) \qquad \text{for all } q > p, \tag{35}$$

that is, the second director will be better off ignoring his own signal and free-riding on the recommendation of the director voting first, i.e. the CEO. From Proposition 2, the director voting last also free-rides. We later show that in this case shareholders are better off not incentivizing other directors to collect information.

For $q > p$, the project will be accepted when signal sequence HHL, HLH, HHH, or HLL is observed. The expected firm value given a particular signal sequence is

$$\begin{aligned}
E[\pi|HHL] &= E[\pi|HLH] = 0.5qp(1-p) \\
E[\pi|HHH] &= 0.5qp^2 \\
E[\pi|HLL] &= 0.5q(1-p)^2
\end{aligned} \tag{36}$$

Hence,

$$E[\pi|s_1, s_2, s_3] = .5[2qp(1-p) + qp^2 + q(1-p)^2 - c] = .5[q-c] \tag{37}$$

Not unexpectedly, the expected firm value in (37) is independent of p, the quality of the other directors' signals. Hence, these directors' information does not contribute towards increasing firm value. Also, they ignore their own information while voting. Anticipating this, they will not collect information ex ante. Thus, they need not be offered incentive pay or a share in the company but at most a symbolic pay. Thus, the optimal compensation contract (ω^H, λ^H, γ^H) is to only induce the CEO to choose an effort level, q^{H*} that maximizes shareholder surplus (expected gross firm value less expected CEO compensation) subject to his participation constraint and given that other directors do not collect information. As we show later, with optimal contracting the CEO's effort choice is higher when he expects others to rubberstamp. Thus, the resulting decision is not necessarily made with less information. Formally,

$$\max_{q\in[.5,1]} E[\pi(q) - \omega - \lambda\pi(q) + \gamma I] \tag{38}$$
$$\text{subject to} \qquad E(\omega + \lambda\pi(q) - \gamma I) \geq \alpha(q - .5)^2.$$

Realizing that he cannot rely on his fellow directors for information the CEO maximizes his expected compensation minus the cost of his effort accordingly. Formally,

$$\max_{q\in[0.5,1]} E[\omega + \lambda\pi(q) - \gamma I] - \alpha(q - .5)^2 \tag{39}$$

Substituting in the market clearing condition for executive pay

$$E[\omega + \lambda\pi - \gamma I] = \alpha(q - 0.5)^2 \quad q \in [0.5, 1] \tag{40}$$

and expression (38) becomes

$$\max_{q\in[0.5,1]} E[\pi] - \alpha(q - 0.5)^2 \tag{41}$$

For a given signal precision q, a rational CEO will invest if he observes a signal H and not invest otherwise. Since the unconditional probability of the investment opportunity being good is 1/2,

$E[\pi(q)] = 0.5[q * 1 + (1 - q) * 0 - c]$. Investment will occur with probability 1/2, out of which the H signal will correctly predict the H state with probability q. Thus, expected firm value is a function of signal precision as

$$E[\pi(q)] = 0.5(q - c) \tag{42}$$

and the shareholder value maximizing q solves

$$\max_{q \in [0.5,1]} 0.5(q - c) - \alpha(q - 0.5)^2 \tag{43}$$

Taking the first-order condition for $q \in [0.5, 1]$ when $\alpha > 0$ yields

$$0.5 - 2\alpha(q - 0.5) = 0 \tag{44}$$

The choice of effort and signal precision that maximizes shareholder value is

$$q^{H*} = \begin{cases} \frac{\alpha+0.5}{2\alpha} & \text{if } \alpha > 0.5 \\ \\ 1 & \text{otherwise} \end{cases} \tag{45}$$

Given his compensation contract, the CEO will exert effort to

$$\max_{q \in [0.5,1]} \omega + 0.5\lambda(q - c) - \gamma(1 - q) - \alpha(q - 0.5)^2 \tag{46}$$

The first-order condition for $q \in [0.5, 1]$ takes the form of

$$0.5\lambda + \gamma - 2\alpha(q - 0.5) = 0 \tag{47}$$

and yields the CEO's choice of effort and signal precision as

$$q^M = \frac{0.5\lambda + \gamma + \alpha}{2\alpha} \tag{48}$$

Shareholders will choose $(\omega, \lambda, \gamma)$ to set q^M equal to q^{H*}. Formally,

$$\frac{0.5\lambda + \gamma + \alpha}{2\alpha} = \begin{cases} \frac{\alpha+0.5}{2\alpha} & \text{if } \alpha > 0.5 \\ \\ 1 & \text{otherwise} \end{cases} \tag{49}$$

Proposition 6 *For any α, the optimal effort choice for the CEO when other directors are expected to rubberstamp, q^{H*}, is strictly greater than his effort choice, q^{B*}, when directors vote on the basis of their private information.*

The first part of the proof is straightforward from comparing equations (8) and (45). The second part directly follows from the arguments above.

Given the optimal effort choice by the CEO, expected firm value becomes

$$\pi^{H*} = \begin{cases} \frac{\alpha+0.5}{4\alpha} - 0.5c & \text{if } \alpha > 0.5 \\ \\ \frac{1-c}{2} & \text{otherwise.} \end{cases} \tag{50}$$

The optimal contract sets total compensation at

$$\begin{cases} \frac{1}{16\alpha} & \text{if } \alpha > 0.5 \\ \\ \frac{\alpha}{4} & \text{otherwise.} \end{cases} \tag{51}$$

The difference between gross firm value and compensation is the shareholder value:

$$S^{H*} = \begin{cases} \frac{1}{4} + \frac{1}{16\alpha} - \frac{c}{2} & \text{if } \alpha > 0.5 \\ \\ \frac{1-c}{2} - \frac{\alpha}{4} & \text{otherwise.} \end{cases} \tag{52}$$

5 Firm values and shareholder surplus

5.1 Firm value under endogenously rubberstamping directors

In the previous section we established that when the CEO has an informational advantage, even independent directors will rubberstamp the CEO's decision regardless of whether such herding is ex post efficient or not. Interestingly, however, with optimal contracting, the CEO increases his own effort to counter this potential loss in firm value due to the expected rubber-stamping by his fellow directors.

Proposition 7 *When the CEO has an informational advantage and directors rubberstamp the CEO's decision, then in our model such herding increases firm value. This is because with optimal contracting the CEO, anticipating rubberstamping by other directors, counters by increasing his own effort ex ante to more than compensate for the information loss through rubberstamping.*

Proof: in Appendix.

With optimal contracting, the difference in firm values from (50) and (32) becomes:

$$DFV = \begin{cases} 32\alpha^4 - 32\alpha^3\sqrt{\alpha^2+1/4} + 4\alpha\sqrt{\alpha^2+1/4} - 1 & \text{if } \alpha > 0.5 \\ \\ 4\alpha^3 + (\frac{1}{2} - 4\alpha^2)\sqrt{\frac{1}{4}+\alpha^2} - \frac{1}{4} & \text{otherwise.} \end{cases} \quad (53)$$

We plot this difference against α, the parameter capturing the cost of individual effort. Figure 3 shows that for any $\alpha > 0$ this difference is always negative and asymptotes to zero from below. At $\alpha = 0$ the difference in firm value is zero, because when effort is costless, boards with homogenous and heterogenous directors are equivalent. For $\alpha > 0$ Figure 3 demonstrates that for any potential value loss due to herding by fellow directors, the CEO makes up for with increased effort and attains the efficient outcome. The extent to which the CEO or another director can make up for the value loss from fellow directors' free-riding and rubberstamping depends on their relative effort costs and the shape of the effort cost functions.

In Burkart, Gromb and Panunzi (1997) and Almazan and Suarez (2003) shareholders optimally choose less oversight because too much shareholder oversight can destroy firm value by reducing the manager's incentives to seek out new projects. In our paper directors' lack of oversight can potentially compromise decision quality, however, with optimal contracting and shareholder say-on-pay the CEO can counter the information loss due to his fellow directors free-riding with increased effort and achieve higher firm value.

Whether higher firm value also translates into higher shareholder surplus depends on both its effect on gross firm value and on the total amount of compensation and is shown in the next section.

5.2 Shareholder values under endogenously rubberstamping directors

Higher firm value does not necessarily imply higher shareholder value. Shareholder value is the residual: gross firm value net of board compensation. Whether shareholder surplus is higher or lower depends on how the aggregate board compensation optimally adjusts in anticipation of directors' rubberstamping. If aggregate compensation decreases, then it unambiguously results in higher shareholder value. If it increases, the effect on shareholder value is ambiguous and depends on the relative changes in aggregate compensation and gross firm value. The increase or decrease in aggregate compensation with rubberstamping is determined by the relative increase in the CEO's optimal compensation to induce additional effort compared to the relative decrease in the other directors' aggregate compensation due to their decreased effort.

Proposition 8 *When directors endogenously rubberstamp in our model, the optimal aggregate board compensation is higher.*

Proof: in Appendix.

Next we consider, the effect on shareholder value that depends on whether the increase in gross firm value offsets the increase in aggregate compensation. When directors are heterogeneous and expected to rubberstamp, shareholder value is as in (52). With homogenous directors who each exert the same amount of effort and then vote strategically, shareholder value is as in (25).

Taking the difference in shareholder values yields

$$DS = \begin{cases} -\frac{1}{16\alpha} - 2\alpha^3 + (2\alpha^2 + \frac{1}{2})\sqrt{\alpha^2 + \frac{1}{4}} - \frac{3\alpha}{4} & \text{if } \alpha > 0.5. \\ \\ -\frac{1}{4} - \frac{\alpha}{2} - 2\alpha^3 + (2\alpha^2 + \frac{1}{2})\sqrt{\alpha^2 + \frac{1}{4}} & \text{otherwise} \end{cases} \tag{54}$$

Interestingly, for any $\alpha > 0$ this difference is always negative.

Proposition 9 *In our model when directors endogenously choose to rubberstamp, shareholder value does not decline because the benefits from increased effort by the CEO dominate the increase in aggregate board compensation.*

Proof: in Appendix.

Figure 4 depicts the difference in shareholder values as a function of α. For any $\alpha > 0$, this difference is always negative. In the special case of $\alpha = 0$ the shareholder value difference is zero, because with costless effort, the two governance structures are equivalent. As the CEO overcomes the lack of information sharing/collection of fellow directors by increasing his own effort, with optimal contracting and shareholder say on pay both firm value and executive compensation rise as does shareholder value. Hence, for quadratic effort-cost functions, endogenous rubber-stamping by directors can be value-increasing for shareholders.[21] Thus, if in practice corporate boards are expected to rubberstamp, our theory explains why in a crisis only the CEO is being replaced, while directors keep their position and avoid most of the blame.

6 Conclusion

We study new aspects of the collective decision making process of boards. In our model directors make decisions collectively through pre-determined voting and governance rules. We identify incentive contracts that achieve the highest expected surplus for the shareholders and show that they depend on the governance rules and the extent of board participation and that there is no "one size fits

[21]While this result is robust to a wide range of effort cost function, with higher powered cost functions it may be prohibitively costly for the CEO to fully overcome the information loss.

all". For this reason, we argue that the design of optimal compensation contracts cannot be left to directors alone, but shareholders, as residual claimants, need to be involved. If they are not, they risk losing the surplus. Simply putting independent directors on the compensation committee is unlikely to be enough, especially if these directors are independent not only of the CEO but also of the shareholders.

A typical contract gives each board member a stake in the firm while penalizing her if her recommendation turns out to be wrong. However, while the penalty component allows for the effort choice problem to be solved, it creates a conformity problem during the voting. If a board member believes that her information is of inferior quality, she votes along with other directors even if their recommendations disagree with her information. Ordinarily, one would expect such free-riding to result in less informed and, thus, inferior decisions. However, with optimal contracts that solve the effort choice problem while conditioning on the free-riding problem, we show that to be not always true.

Anticipating to rubber-stamp in this fashion, directors have little incentive to become informed. However, if this is expected, then with optimal contracting the CEO can be induced to increase his own information quality to compensate for the expected information loss, so decision quality does not suffer. Thus, with optimal contracting and shareholders' say-on-pay directors' free-riding do not necessarily destroy value, especially when the marginal cost of collecting information for directors is relatively high. This may explain why in the current crises, CEOs of many banks and financial institutions have been dismissed while boards have by and large been spared the blame. This prediction of our model for when independent directors are more (less) effective in their monitoring and oversight functions is consistent with empirical evidence reported in Ferreira, Ferreira and Rapuso (2010) and in Duchin, Matsusaka and Ozbas (2010).

7 Appendix

Proof of Proposition 2:

(A) The third board member ignores his signal and votes with the board members who voted before him when those board members agreed with each other and follows his own signal otherwise, if by doing so, he can increase his payoff. This would happen if $(1-p)(1+p-2pq) < 1-q$ holds. Substituting in for $p = q$, we get $1 - 3q^2 + 2q^3 < 1 - q$. Simplifying the expression yields $2q^2 - 3q - 1 = 2(q - \frac{3}{4})^2 - \frac{1}{8} < 0$. The roots of this quadratic equation are 1/2 and 1, the minimum of the quadratic function obtains at $q = 3/4$. Hence $2q^2 - 3q - 1 < 0$ for $q \in [0.5, 1]$.

(B) Suppose that the Proposition holds true, that is, suppose that $q^{BC} < q^{CEO}$. Then,

$$1/2 - \alpha + \sqrt{\frac{1}{4} + \alpha^2} < \frac{1}{2} + \frac{1}{4\alpha} \tag{55}$$

must be true. Simplifying yields

$$\sqrt{4\alpha^2 + 16\alpha^4} < \sqrt{16\alpha^4 + 8\alpha^2 + 1} = 4\alpha^2 + 1 \tag{56}$$

which trivially holds. Thus, when directors can rely on each others' information, they will exert less efforts to monitor. **Qed**

Proof of Corollary 1:

To solve for the optimal contract we need to set $q^{B*} = q^{BC}$ as in (22). Simplifying the expression yields

$$\frac{1}{2} - \alpha + \sqrt{\frac{1}{4} + \alpha^2} = \frac{1}{2} - \frac{\alpha}{\lambda + \frac{2}{3}\gamma} + \frac{\sqrt{4\alpha^2 + \lambda^2 + \frac{20}{9}\gamma^2 4\gamma\lambda}}{2(\lambda + \frac{2}{3}\gamma)} \tag{57}$$

For this inequality to hold for every α independent of α it must be the case that (i) $\lambda + \frac{2}{3}\gamma = 1$ and (ii) $\lambda^2 + \frac{20}{9}\gamma^2 4\gamma\lambda = 1$. Substituting in the two conditions yields $(1 - \frac{2}{3}\gamma)^2 + \frac{20}{9}\gamma^2 + 4\gamma(1 - \frac{2}{3}\gamma) = 1$ which is only satisfied if $\gamma = 0$ and correspondingly $\lambda = 1$. This would require the shareholders to give 100 percent of the firm to *each* of the three board members which is obviously impossible. Hence there does not exist an optimal contract that would hold with the same terms for all α. **Qed**

Proof of Proposition 7:

We need to establish that $E[\pi^{BC}] < E[\pi^{H*}]$ or that $.5 * [3(q^{BC})^2 - 2(q^{BC})^3] < .5q^{H*}$. Plugging in q^{B*} for q^{BC} (8) and q^{H*} from (45), we get that

$$.5 * [3(q^{BC})^2 - 2(q^{BC})^3] = \frac{1}{4} + 4\alpha^3 + (\frac{1}{2} - 4\alpha^2)\sqrt{\frac{1}{4} + \alpha^2} \tag{58}$$

Comparing the above expression with $.5 * q^{H*} = \frac{1}{4} + \frac{1}{8\alpha}$ yields

$$.5 * [3(q^{BC})^2 - 2(q^{BC})^3] = \frac{1}{4} + 4\alpha^3 + (\frac{1}{2} - 4\alpha^2)\sqrt{\frac{1}{4} + \alpha^2}\ ?<?\ \frac{1}{4} + \frac{1}{8\alpha} \tag{59}$$

or

$$32\alpha^4 + 4\alpha\sqrt{\frac{1}{4} + \alpha^2} - 32\alpha^3\sqrt{\frac{1}{4} + \alpha^2} - 1 < 0 \tag{60}$$

which holds $\forall \alpha \geq 1/2$.

For $\alpha \in (0, 1/2]$ the comparison with $.5 * q^{H*} = 1/2$ yields

$$.5 * [3(q^{BC})^2 - 2(q^{BC})^3] = \frac{1}{4} + 4\alpha^3 + (\frac{1}{2} - 4\alpha^2)\sqrt{\frac{1}{4} + \alpha^2} < \frac{1}{2} \tag{61}$$

Since the LHS of (61) at $\alpha = 0$ equals 1/2 and the LHS of (61) is decreasing in α for $\alpha \in [0, 1/2]$, (61) holds $\alpha \in (0, 1/2]$ and it holds for equality for $\alpha = 0$. **Qed**

Proof of Proposition 8:

Suppose that this proposition holds true for $\alpha > 1/2$. Then it must be the case that

$$\frac{1}{4\alpha} > \sqrt{3}(\sqrt{.25 + \alpha^2} - \alpha). \tag{62}$$

Simplifying the expression yields

$$1 + 4\sqrt{3}\alpha^2 > 2\sqrt{3}\alpha\sqrt{4\alpha^2 + 1} \tag{63}$$

or

$$\sqrt{48\alpha^4 + 8\sqrt{3}\alpha^2 + 1} > \sqrt{48\alpha^4 + 12\alpha^2} \tag{64}$$

Since $8\sqrt{3}\alpha^2 + 1 = 13.856\alpha^2 + 1$ and $13.856\alpha^2 + 1 > 12\alpha^2$ trivially holds.

Next suppose that this proposition holds for $\alpha \in [0, 1/2]$. Then it must be the case that

$$1 > \sqrt{3}(\sqrt{.25 + \alpha^2} - \alpha) \tag{65}$$

or

$$\frac{1}{\sqrt{3}} + \alpha > \sqrt{.25 + \alpha^2} \tag{66}$$

or

$$\frac{1}{12} + \frac{2\alpha}{\sqrt{3}} > 0 \tag{67}$$

which trivially holds.**Qed**

Proof of Proposition 9:

(1) First we prove that for $\alpha \in [0, \frac{1}{2}]$

$$\frac{1}{4} + \frac{1}{2}\alpha + 2\alpha^3 - (2\alpha^2 + \frac{1}{2})\sqrt{\alpha^2 + \frac{1}{4}} \geq 0 \tag{68}$$

Let $f(x) = \sqrt{x}$. The tangent line to $f(x)$ at $x_0 = \frac{1}{4}$ is

$$y = f'(x_0)(x - x_0) + f(x_0) \tag{69}$$

or

$$y = \frac{1}{2\sqrt{x_0}}(x - x_0) + f(x_0) \tag{70}$$

Substituting in for $f(x)$

$$y = x + \frac{1}{4} \tag{71}$$

Since (71) is tangent to $\sqrt{x}$,

$$x + \frac{1}{4} \geq \sqrt{x} \tag{72}$$

Similarly, for $x = \alpha^2 + 1/4$,

$$\alpha^2 + \frac{1}{2} \geq \sqrt{\alpha^2 + \frac{1}{4}} \tag{73}$$

For (68) it implies that

$$\frac{1}{4} + \frac{1}{2}\alpha + 2\alpha^3 - (2\alpha^2 + \frac{1}{2})\sqrt{\alpha^2 + \frac{1}{4}} \geq \frac{1}{4} + \frac{\alpha}{2} + 2\alpha^3 - (2\alpha^2 + \frac{1}{2})(\alpha^2 + \frac{1}{2})$$

$$= \frac{\alpha}{2}(1 - 3\alpha + 4\alpha^2 - 4\alpha^3) \tag{74}$$

Let

$$g(\alpha) = 1 - 3\alpha + 4\alpha^2 - 4\alpha^3 \tag{75}$$

Then $g(0) = 1$ and $g(\frac{1}{2}) = 0$ and

$$g'(\alpha) = -3 + 8\alpha - 12\alpha^2 = -12[(\alpha - \frac{1}{3})^2 + \frac{5}{36}] < 0 \tag{76}$$

So $g(\alpha)$ is strictly decreasing for $\alpha \in [0; 1/2]$ and it is bounded from below by 0. This implies that for any $\alpha \in [0, \frac{1}{2}]$

$$\frac{1}{4} + \frac{1}{2}\alpha + 2\alpha^3 - (2\alpha^2 + \frac{1}{2})\sqrt{\alpha^2 + \frac{1}{4}} \geq 0 \tag{77}$$

(2) Second we prove that for any $\alpha \geq 0$

$$\frac{1}{16\alpha} + 2\alpha^3 - (2\alpha^2 + \frac{1}{2})\sqrt{\alpha^2 + \frac{1}{4}} + \frac{3\alpha}{4} \geq 0 \tag{78}$$

Let $f(t) = \sqrt{1 + t}$. The tangent line to $f(t)$ at $t = 0$ is

$$y = f'(0)(t) + f(0) = \frac{t}{2} + 1 \tag{79}$$

Since (79) is tangent to $\sqrt{x}$,

$$\frac{1}{2}t + 1 \geq \sqrt{1+t} \tag{80}$$

Since

$$\sqrt{\alpha^2 + \frac{1}{4}} = x\sqrt{1 + \frac{1}{4\alpha^2}} \tag{81}$$

This implies that

$$\frac{1}{8\alpha} + \alpha \geq \sqrt{\alpha^2 + \frac{1}{4}} \tag{82}$$

This implies that

$$\frac{1}{16\alpha} + 2\alpha^3 - (2\alpha^2 + \frac{1}{2})\sqrt{\alpha^2 + \frac{1}{4}} + \frac{3\alpha}{4} \geq \frac{1}{16\alpha} + 2\alpha^3 - (2\alpha^2 + \frac{1}{2})\sqrt{\frac{1}{8\alpha} + \alpha} + \frac{3\alpha}{4}$$

$$= \frac{1}{16\alpha} + 2\alpha^3 - \frac{\alpha}{4} - 2\alpha^3 - \frac{1}{16\alpha} - \frac{\alpha}{2} + \frac{3\alpha}{4} = 0 \tag{83}$$

Qed

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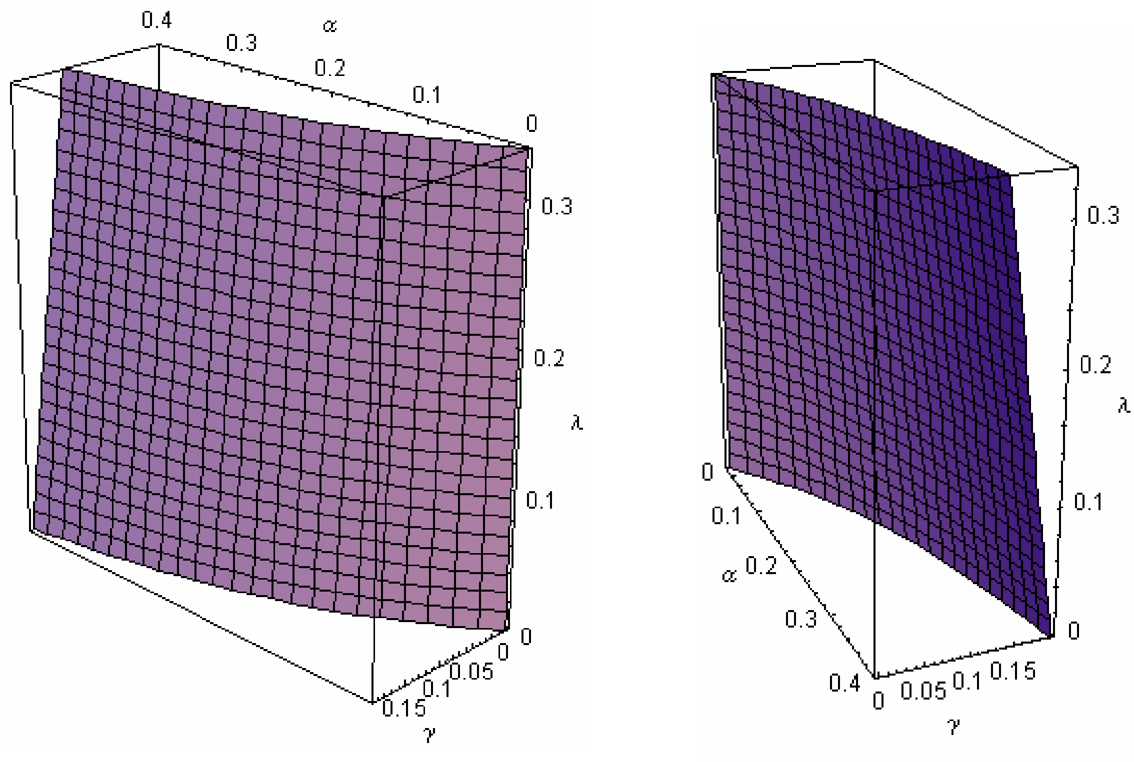

Figure 1: Optimal Board Compensation without Information Sharing (front and back view, respectively).

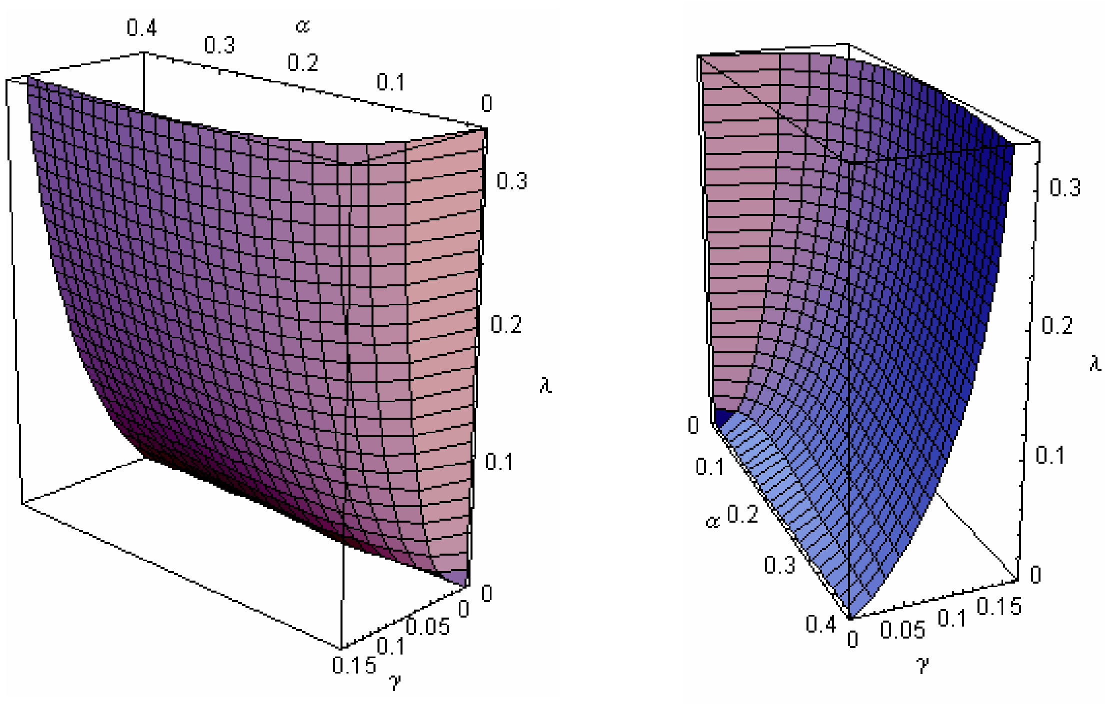

Figure 2: Optimal Board Compensation with Information Sharing (front and back view, respectively).

Figure 3

Difference in firm values of non-rubberstamping and rubberstamping boards as a function of effort cost (X = Effort Cost (Alpha); Y = Firm Value)

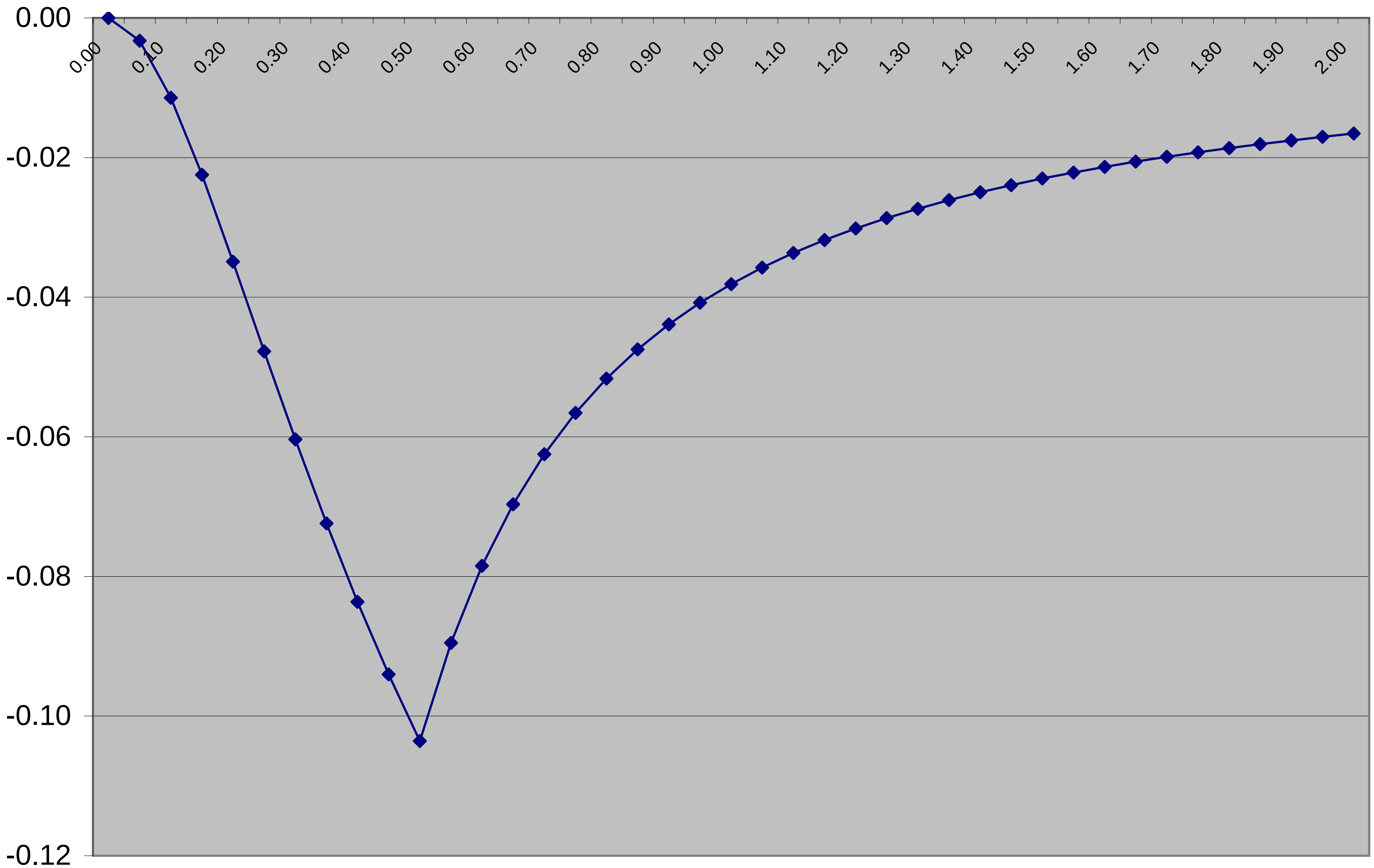

Figure 4
Difference in shareholder value of non-rubberstamping and rubberstamping boards as a function of effort cost
(X = Effort Cost (Alpha); Y = Shareholder Value)