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Social Networks and Corporate Governance

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Abstract

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We create a model that links corporate governance and firm values to governing boards' social networks and innovations in technology. Because agents create social networks with individuals with whom they share commonalities along the dimensions of social status and income, among other attributes, CEOs may participate in board members' social networks, which interferes with the quality of governance. At the same time, social connections with members of a board can allow for better evaluation of the members' abilities. Thus, in choosing whether to have board members with social ties to management, one must trade off the benefit of members successfully identifying high ability CEOs against the cost of inadequate monitoring due to social connections. Further, technologies like the Internet and electronic mail that reduce the extent of face-to-face networking cause agents to seek satisfaction of their social needs at the workplace, which exacerbates the impact of social networks. The predictions of our model are consistent with recent episodes that appear to signify inadequate monitoring of corporate disclosures as well as with high levels of executive compensation. Additionally, empirical tests support the model's key implication that there is better governance and lower executive compensation in firms where networks are less likely to form.

1 Introduction

Issues surrounding corporate governance, particularly disclosure policy as well as executive compensation, have recently received significant attention. Prominent episodes of misrepresentation, including the Enron, WorldCom, and Tyco debacles, have added to a concern that investors may lose confidence in financial markets, which may threaten the viability of such avenues as a source of capital. In the case of Enron, revelation of the fraud was accompanied by an erasure of as much as $1 billion in the retirement savings of investors.[1] Practices like misrepresenting the exercise date on options as well as backdating of options grants (Lie, 2005), and the apparent delinkage of compensation with financial performance, have also been in the spotlight.[2]

In general, the expectation of financial economists is that the market discipline imposed by public ownership should be able to curb managerial excesses. As Subrahmanyam (2005) indicates, however, much of the investing population is characterized by a limited understanding of financial markets and accounting standards and may, therefore, lack the sophistication required to control managerial excess.[3] Nonetheless, investors indirectly control governance through the board of directors, which, in the above cases, should have had both the incentive and the sophistication to prevent such events, but was apparently unable to limit misrepresentation.

We address why boards of directors may not be able to curb excesses even if they attach positive probabilities to the prevalence of corporate fraud. Our starting point

[1]See "Retirement Savings Reform Sought," *Financial Times*, February 11, 2002, available at http://specials.ft.com/enron/FT3NM3FQKXC.html.

[2]See, for example, "Cendant Chief's Compensation Soared in 2005," by Ryan Chittum, *Wall Street Journal*, March 2, 2006 or "At Visteon, Bonuses Defy Gravity," by Floyd Norris, *New York Times* April 14, 2006.

[3]Frieder and Subrahmanyam (2007) relate the sophistication of investor clientele to executive compensation levels. They show that investor naïveté can lead to inadequate monitoring of CEOs and excessive compensation. Subrahmanyam (2007) also argues that lack of investor sophistication can, in general, lead to poor governance.

is the observation that the number of members on the board of directors is small, so their human needs may have a substantial impact on the quality of governance.[4] More specifically, we focus on the proclivities of the individual to form interpersonal relationships and connections, which also has been well-established in the literature.[5] Additionally, we appeal to the evidence that social networks tend to be formed amongst agents with similar qualifications and social status (see McPherson, Smith-Lovin, and Cook, 2001, Laumann 1973, and Marsden, 1987).[6] Based on these dual notions, we argue that cross-memberships on corporate boards present a social barrier to effective governance. Since many of the board members tend to be within a CEO's social network, they are reluctant to investigate the CEO too deeply for fear of losing members within their social circle.[7] In equilibrium, a lack of adequate monitoring of CEOs reduces firm values by allowing managerial excess; CEOs, however, benefit because their social circles are preserved. We also show that social networks can reduce the precision of information collected and used by boards of directors in determining resource allocation policies.

A question that naturally arises in the context of our argument is why shareholders cannot replace directors who do not invest adequate effort in the company. Here we point to the well-known aspects of the governance mechanisms that encourage entrenchment and preclude board members from being replaced with the frequency

[4]While the optimal board size is not the focus of this paper, one could appeal to standard arguments such as prohibitively high coordination costs with large boards to argue why the size of the board must be limited for effective decision-making. The average board size in 2005 was 9.33 (information obtained from the IRRC database).

[5]Recall the famous quote of Donne (1975): "No [person] is an island." The need for interpersonal relationships has been justified in Maslow (1968), Bowlby (1969), and in a review article by Baumeister and Leary (1995). See Ainsworth (1989) and Hogan, Jones, and Cheek (1985) for an evolutionary rationale for such attachments derived from the idea that social ties would have survival benefits.

[6]Hong, Kubik, and Stein (2004) discuss how such social networks can facilitate participation in financial markets by way of a "word-of-mouth" mechanism.

[7]In an example of the connection between social networks and governance issues, see Belliveau, O'Reilly, and Wade (1996) for evidence on how social ties between the CEO and compensation committees influence CEO compensation levels.

necessary to punish poor performance. These aspects include voting procedures that do not permit shareholders to cast votes against board members in proxy proposals, but only to cast a "yes" vote or a vote of withholding of support. The full-fledged proxy fights required for putting up slates of investors' own choices for board members are often prohibitively costly.[8] In a sense, then, our work proposes an externality, in that the board members' need for social contact is not internalized by corporate governance mechanisms currently in place. We show that this phenomenon causes firm values to deteriorate by reducing oversight by boards of corporate management.

We also consider whether it is always optimal to have board members with the lowest level of social ties to prospective CEOs. We argue that while social ties are a barrier to effective monitoring, they may also have a benefit. Specifically, board members with social links to the pool of prospective CEOs may have better information about the ability of agents within the pool. If the incremental benefit to the firm of having a high-ability CEO is sufficiently large, a board with a strong social nexus to the prospective CEO pool actually may be optimal. The choice of members with strong social affinities towards prospective management thus trades off the benefit of having a high-ability CEO against the cost of inadequate monitoring should a board member with strong ties to management be appointed.

Our analysis also relates to how social networks have been affected by technological innovations such as Internet and electronic mail. In this regard, a substantial group of psychologists believe that the use of the Internet actually may reduce face-to-face interactions between agents, causing their personal social networks to deteriorate.[9] Thus, we propose that the advent of such technologies leads agents to seek satisfaction of their social needs within the workplace. This causes boards of directors to further

[8]See, for example, "Soviet-Style Proxies, Made in the U.S.A." and "Fair Game: Fresh Air For Board Elections?" (both articles by Gretchen Morgenson, *New York Times*, June 25 and October 15, 2006, respectively).

[9]Nie (2005) provides a comprehensive survey of the evidence.

reduce their monitoring of management in order to preserve their "social capital."

Other studies have focused on the interaction between boards of directors and management. For example, Hermalin and Weisbach (1998) focus on how the CEO's bargaining power with respect to boards depends on the CEO's perceived ability. Hirshleifer and Thakor (1998) analyze how the takeover market can provide an alternative to boards of directors in monitoring managers. Noe and Rebello (1996) focus on how factions of outside board members (as opposed to insiders) can promote good governance by blocking opportunistic managerial proposals.[10] While these papers provide important insights, they do not link the extent of monitoring and information production to social networks.

Finally, we perform basic empirical tests of the model's central implications. We find that firms are better governed and that executive compensation is lower when boards both consist of fewer members who also are CEOs and have greater non-Caucasian representation. Given that the vast majority of CEOs tend to be Caucasian,[11] evidence presented in this paper supports the notion that conditions in which networks are less likely to form lead to improved corporate governance.

This paper is organized as follows. Section 2 presents a simple model where monitoring is impeded by social ties. Section 3 presents an analysis of executive compensation. Section 4 considers information production through signals of varying precision. Section 5 presents some preliminary empirical tests. Section 6 concludes.

[10]Hermalin and Weisbach (1988) find that outsiders are more likely to be added to the board after poor firm performance, when shareholders are more likely to find external monitoring of managers desirable.

[11]According to the Bureau of Labor Statistics, 89.3% of CEOs in 2005 were neither African American, Hispanic, nor Asian American.

2 The Basic Model

A number of choices are possible for incorporating social networks into models of financial markets. Our initial modeling themes start with the assumption that CEOs of firms will, if left unmonitored, hurt firm values by consuming private benefits. We further argue that if Agents A and B are within each other's social networks then increased monitoring of Agent B (e.g., a CEO) by Agent A (e.g., a member of the firm's board of directors) causes the social relationship between A and B to deteriorate (i.e., monitoring "alienates" B). In turn, this causes Agent A to suffer disutility,[12] which, in equilibrium, tends to reduce monitoring levels.

We also consider how the need for social networks can lead to multiple board memberships, which may reduce the effort expended on governing each individual firm. We then model a scenario wherein agents require a minimum amount of "social capital" to sustain themselves (see, for example, Jacobs, 1961 or Coleman, 1988). This social capital may be satisfied either at the workplace or in the agents' private lives. We further discuss how the need for a threshold level of social capital can interfere with corporate governance and thereby affect firms' market values.[13] We begin this discussion by presenting some simple models of firms that are monitored by agents who are the firms' "board members." In Subsection 2.1, we first present a model of cross-membership where one CEO belongs to the board of the other firm; then, in Subsection 2.2, we consider how an agent determines the optimal number of board memberships. In Subsection 2.3, we present a model where the need for personal social capital conflicts with performing board member duties.

[12]This notion can be justified by the observation (e.g., Putnam, 1995) that social networks need mutual trust to be successful. From a purely social standpoint, monitoring another agent from the perspective of reducing their private benefits would be a clear violation of this trust.

[13]See Zerubavel (1979) on how professional and personal networks can overlap and affect professional duties.

2.1 Social Networks and Managerial Monitoring

Consider a simple model of two firms whose CEOs are members of each others' boards. For parsimony, each firm's board consists of exactly one decision-making board member, who is the CEO of the other firm.[14] The CEO of firm i can exert an effort e_i to monitor the CEO in firm j and the monetary benefit to firm j from this monitoring is Be_i (this benefit is internalized by the board member). The cost of exerting effort e_i is $0.5Ke_i^2$. There is also an interactive cost which implies that if the CEO of firm i exerts too much effort in monitoring firm j, then the social connection between the two CEOs will deteriorate such that the CEO of firm 2 will increase the monitoring of firm 1. For simplicity, the benefits and costs are assumed to be symmetric across the two firms. Therefore, increased monitoring reduces private benefits to the CEO of the relevant firm by $K_I e_i e_j$. The appendix develops the asymmetric case.

The above setting implies that the CEO of firm j maximizes

$$Be_i - 0.5Ke_i^2 - K_I e_i e_j.$$

In the Nash equilibrium, we then have

$$B = Ke_i + K_I e_j \tag{1}$$

for $i, j = 1, 2$. Solving this linear system implies that

$$e_1 = e_2 = \frac{B}{K + K_I}. \tag{2}$$

In Equation (2), the second term in the denominator represents the "social cost" of board membership.[15] The basic principle is that when a fellow board member alienates

[14] In practice, of course, boards consist of many members. Since the interplay between the members is not the focus of this paper, we will talk of a solitary board member, who can be construed as the only board member who is active in decision-making while the others passively accept any policy decision of this member.

[15] That the effort levels e_1 and e_2 are decreasing in K_I is sensitive to the assumption of symmetry across firms. See the appendix for the subtlety involved in the asymmetric case.

a CEO board-member, the alienated board member may increase his monitoring of the other board member's firm. We then have the following proposition.

Proposition 1 *Firm values are lower in equilibrium when each CEO belongs to the board of another firm, than when there is no such cross-membership.*

An alternative interpretation of the above analysis is that the same non-CEO agent is on the board of both firms. But, both CEOs are in the board member's social circle. The cost $0.5Ke_i^2$ represents the deleterious effect of "alienating" people within the board members's social circle; in our setting, the cost of alienation is convex in the effort put in to monitoring. There is also an interactive term $K_I e_i e_j$, however, which implies that the greater the effort put into one firm, the greater is the cost of alienating the CEO of the other. Thus, losing social capital with one CEO increases the cost of alienating another in the sense that, to have a steady social circle, alienating one member of the circle makes it more important that the other is not alienated. This alternative interpretation leads to the same expression for e_1 and e_2 as above, and a similar cost is imposed due to social networks interfering with corporate governance.

2.2 The Optimal Number of Board Memberships

In this section, we analyze how the concept of social networks can be used to determine the optimal number of boards to which an agent belongs. We consider the problem of a non-CEO board member who confers a governance benefit B_i per unit effort e_i by belonging to firm i. As in the previous subsection, the cost of expending e_i is $0.5Ke_i^2$. There are no interaction terms, as we choose to model social benefits differently in this subsection. Specifically, we postulate that each board member derives a social benefit of X_i from each board to which he belongs. The agent maximizes

$$\sum_{i=1}^{N}[B_i e_i - 0.5Ke_i^2 + NX_i].$$

The optimized benefit is $\sum_{i=1}^{N}[B_i^2/K]$.

Purely for convenience, we now assume that $B_i = B$ and $X_i = X\ \forall i$, and that N falls on a continuum, rather than being restricted to the set of natural numbers. We also account for the notion that distractions from belonging to many firms reduce the governance benefit *per firm*. Specifically, we assume that assume that $B = \beta - LN$, where β is a baseline benefit from monitoring and the reduction in the benefit to each firm per additional board to which an agent belongs is L.

In the dynamic setting, the board member first chooses the number of board memberships, and then decides the amount of effort to expend on each firm. The recursion involves choosing a level of effort, and then substituting that effort level into the objective function to determine the optimal N. This implies that the board member chooses N to maximize

$$\frac{N(\beta - LN)^2}{K} + XN.$$

The first order condition for the above problem is

$$(\beta - 3LN)(\beta - LN) + KX = 0$$

We now impose conditions to ensure a unique maximum for the objective function. Specifically, we impose an exogenous upper bound on the number of firms, which is denoted as N_m. To ensure that the quadratic function has a real solution and that N is positive, we also assume that β is large enough such that $\beta^2 > 3KX$ and $\beta > 3LN_m/2$. The appendix shows that the optimal number of board memberships under the preceding conditions is given by

$$N = \frac{1}{3L}\left[2\beta - \sqrt{\beta^2 - 3KX}\right]. \tag{3}$$

From (3) we have the following proposition.

Proposition 2 *The optimal number of board memberships is increasing in the social benefit per firm (X), and decreasing in the extent of the diffusion of governance benefits (L) due to multiple memberships.*

The above proposition indicates that board members who derive greater social benefits from board memberships will belong to many boards. Further, the greater the reduction in governance benefits per firm due to multiple memberships, the smaller the optimal number of memberships, which is intuitive.

2.3 Non-Professional Social Networks and Corporate Governance

In this subsection, we revert to the case where the number of boards to which an agent belongs is exogenous, and explicitly model how personal social networks can interfere with corporate governance activities. We assume that the agent has personal social needs that are essential for his sustenance. Specifically, we assume that an agent requires a total "social capital" of α (this quantity may be viewed as the extent of the individual's social connections). We assume that an agent (who is not a CEO) is on the board of N firms and the convex monitoring costs for each of the firms are viewed as social costs of alienating the CEO of each firm. The agent then has a personal social capital (i.e., personal friends and acquaintances) that provide him with a monetary-equivalent utility of G, and prior to monitoring, a professional social capital of A.

The agent maximizes

$$\sum_{i=1}^{N}[B_i e_i - 0.5K_i e_i^2]$$

subject to the constraint that

$$A + G - \sum_{i=1}^{N} 0.5K_i e_i^2 \leq \alpha.$$

The unconstrained optimum for e_i (a purely mathematical construct) is

$$e_i = \frac{B_i}{K_i}.$$

This level of effort implies a total monetary benefit of B_i^2/K_i for corporation i.

Now, suppose that

$$A + G - \sum_{i=1}^{N} 0.5 B_i^2/K_i \leq \alpha.$$

In this case, the unconstrained optimum will also represent the equilibrium allocation of effort by the agent. If the above inequality is not satisfied, however, then we assume that the board member will invest effort up to the point where the social capital constraint just binds. The equilibrium allocation of effort will then be given by the solution to the equation

$$\sum_{i=1}^{N} 0.5 K_i e_i^2 = A + G - \alpha.$$

In order to avoid multiple solutions, we now assume symmetry across firms with $K_i = K$ and $B_i = B \ \forall \ i$. Then, we have that the effort e per firm is given by

$$e = \sqrt{\frac{2(A + G - \alpha)}{NK}}. \tag{4}$$

Note that the optimal effort is decreasing in N not because of diffusion of effort. Rather, with larger N, the aggregate loss of social capital per unit effort is greater. Hence the board member scales down e. This implication is consistent with the evidence of Fich and Shivdasani (2006) that the quality of governance is negatively associated with the number of boards to which each outside director belongs.

Also observe from (4) that any technological innovation that causes a reduction in personal social capital G will cause a decrease in effort and consequently a reduction of the total benefit of governance (represented by the quantity NBe). This leads directly to the following proposition.

Proposition 3 *A technological innovation that causes a reduction in the extent of personal social networks will cause a decrease in the effort expended on governance as well as the total benefits from governance that accrue to corporations.*

The basic idea is that a technology that reduces personal social capital raises the cost of destroying professional social networks. This causes the agent to scale back the monitoring of CEOs in his social circle, which, in turn, reduces the benefits accruing from corporate governance. We note the evidence (e.g., Nie 2005) that the advent of modern communication tools have decreased the amount of face-to-face communication and have caused personal connections to deteriorate. Our analysis predicts a worsening in the quality of corporate governance in response to this technological innovation.

3 Executive Compensation

3.1 Social Networks and Equilibrium Indirect Compensation

In this section, we explicitly model how social networks may lead to excessive executive compensation, especially in hidden or subtle forms (such as backdated stock options, deferred compensation, and tax reimbursements).[16] We model the benefits to board membership as maintaining social relationships with CEOs. These benefits are increas-

[16]A press release dated July 6, 2006 from Reuters notes that more than 50 companies' option granting practices are being investigated. See also http://online.wsj.com/public/resources/documents/info-optionsscore06-full.html for an updated list of companies currently under examination for options scandals. Other recent articles have focused on how details of compensation packages are hard to decipher. See, for example, "Spotlight on Pay Could Be a Wild Card," by Stephen Labaton, *New York Times*, April 9, 2006, "Congress Seeks to Rein In Special Executive Pensions," by Michael Schroeder, *Wall Street Journal*, January 25, 2006, and "Man of Letters: Bogle Joins Campaign Urging SEC To Act on Executive Pay – And Cites His New Book," by Paul Davies, *Wall Street Journal*, April 15, 2006. An article titled "Is 'Total Pay' that Tough to Grasp?," by Gretchen Morgenson, *New York Times*, July 9, 2006, notes that a recent report on executive compensation by a forum of executives, the Business Roundtable, excluded significant amounts of hard-to-grasp aspects of executive compensation, including dividends, realized gains on stock options, as well as pension benefits, deferred compensation, and money received in severance packages, and that these aspects increased executive compensation well beyond the numbers provided in the report.

ing in the level of hidden compensation the board member chooses to allow. There are, however, costs associated with the board member's hidden compensation; viz., a regulatory authority may levy a fine or penalty on the board member if it discovers the hidden compensation.

More specifically, we consider that a CEO has to be paid at least his reservation wage $\bar{W}$ to remain employed within the firm. The wage is set by the single active board member. Competition in the labor market, when agents operate under complete integrity, causes the wage to be set to $\bar{W}$. However, a CEO can pay himself a variable amount D in the form of hidden compensation.

The board member is aware that hidden compensation is a possibility and controls the level of D he is willing to allow the CEO to pay himself. Ex post, a regulatory authority can investigate and there is a probability q that the hidden compensation will be detected by this entity. If detected, the (possibly reputational) penalty levied on the board member for allowing D to be transferred to the CEO is $0.5VD^2$ (i.e., it is convex in D). This models the notion that penalties for allowing misrepresented compensation are convex rather than linear in order to form a more effective deterrent against such payouts.

The benefit of allowing the transfer D to occur is that the board member retains a social relationship with the CEO. This benefit is linear in D and equals YD. This captures the notion that the higher the D allowed by the board member, the stronger the social ties remain between that member and the CEO. Thus, the board member chooses to allow the level of D that maximizes

$$YD - 0.5qVD^2,$$

which implies that

$$D = \frac{Y}{qV} \tag{5}$$

and leads to the following proposition.

Proposition 4 *The level of hidden executive compensation is increasing in the strength of the social ties between the board member and the CEO, and is decreasing in the probability of the compensation being detected by the regulatory authority as well as the penalty levied on the board member upon such detection.*

The above observation suggests the empirical implication that high levels of (possibly hidden) executive compensation are more likely in firms whose CEOs are prone to having strong social ties with their board members (for example, either they are relatives of the CEO or share commonalities in terms of their educational attainment or religious leanings; viz. McPherson, Smith-Lovin, and Cook, 2001, or Laumann 1973).

3.2 Social Networks Within Boards

Our analysis may also be extended to social connections *amongst* the board members when there are several active board members. For example, consider the case of a single board member, labeled 1, who has social connections with the CEO and thus has a positive Y parameter. Assume that there are no social connections between the CEO and all other board members, so that their Y parameters equal zero. Further assume that there are no social connections between board members and each board member individually acts to minimize the compensation package subject to social networking constraints. Denoting the total number of board members as M, and assuming that a simple majority vote is required for any compensation package to be approved, it can be seen that the wage will be $\bar{W}$ and the level of hidden compensation will be zero so long as $M > 2$.

However, now consider a case where there are social connections between board member 1 and the other $M - 1$ board members (the social connections between the CEO and board members other than 1 remain non-existent). In this case, board member 1 may be able to "persuade" a majority of the other $M - 1$ board members to approve a package that includes hidden compensation. Denote these persuasion costs as θ per unit D (that is, we make the intuitive assumption that the higher the level of hidden compensation, the greater are the persuasion costs). It can then be seen that, so long as $\theta < Y$, the optimal level of hidden compensation becomes

$$D = \frac{Y - \theta}{qV}. \tag{6}$$

As we observed earlier, social connections are more likely between agents who have common attributes along the dimensions of age, religious leanings, or common ethnicities. One can measure some of these criteria objectively, such as whether the ethnicity of the majority of the board members and the CEOs overlap. The more the criteria overlap, the greater the "strength" of the social connection between board members. Making the plausible assumption that persuasion costs are decreasing in the strength of the social network between board members, we have the following proposition.

Proposition 5 *The level of indirect compensation is increasing in the strength of the social connections between board members of a firm.*

Again, the above implication is potentially testable using available data on compensation levels and board member characteristics.

3.3 *Ex ante* Optimality of Social Networks

It is also worth considering the optimal *ex ante* composition of the board of directors in light of the above analysis. It may seem as though *ex ante* optimality would require no social networking between the board and the CEO. This, however, is not necessarily true if the social networking allows the board member to learn about the CEO's ability. To model this, assume that there are two types of potential CEO. These two types, labeled 1 and 2, make respective contributions of Q_1 and Q_2, with $Q_1 > Q_2$, to the present values of cash flows from the firm.

Suppose there are two types of pivotal board members ("pivotal" here is interpreted as the board's sole decision-maker). The first type of pivotal board member is in the social networks of the two CEO types, and thus knows each CEO's true ability. The second type of pivotal board member is only a peripheral part of the CEOs' networks, and is thus equally likely to hire a CEO of type 1 or type 2. Label the analogs of the Y parameters from (5) for the two types of board members as Y_i, $i = 1, 2$, with $Y_1 > Y_2$ (since the first type of board member is more socially connected to the CEOs), and assume that the analogs of q and V are constant across types.

If the board member who is heavily networked with the pool of prospective top management is employed on the board, the net expected benefit to the firm is

$$Q_1 - D_1 = Q_1 - \frac{Y_1}{qV}.$$

But, the net expected benefit for the second type of board member is

$$0.5(Q_1 + Q_2) - D_2 = 0.5(Q_1 + Q_2) - \frac{Y_2}{qV}.$$

This leads to the following proposition.

Proposition 6 *It is ex ante optimal to hire the board member with the weaker social connection to the CEOs if and only if*

$$\frac{Y_1 - Y_2}{qV} > Q_1 - Q_2. \quad (7)$$

The above proposition indicates that if the incremental contribution to firm values by high ability CEOs is sufficiently large, then firm value may be increased by allowing some hidden compensation by employing board members with stronger social ties to the pool of CEOs. An empirical implication of this part of the analysis is that members of boards of firms where CEO ability is crucial (e.g., in complex corporations with multiple divisions) are more likely to have social ties with top management.

4 Information Precision

In this section, we model governance as gathering information about the cash flows generated by the firm and ensuring that it is allocated efficiently to productive activities. We first model how the need to preserve social capital interferes with information collection by the board of directors; we then discuss the equilibrium wherein the information collected by the board of directors interacts with information conveyed by financial market prices. Throughout this section v_X represents the variance of the random variable X. We recognize that our formulation shares some features with other models of information production (e.g., Verrecchia, 1982 or Subrahmanyam and Titman, 2001). Our work is distinguishable, however, in that prior models have not explicitly related information production to social networks.

4.1 Social Capital and Signal Precision

Suppose a firm has assets-in-place that pay off δ, which is a zero-mean, normally distributed random variable, observed with perfect precision by the CEO. A fraction ρ of the amount δ is siphoned away by the CEO as private benefits. The board member's role is (i) to levy a penalty on the CEO that is intended to address the siphoning, and (ii) to adopt an investment policy to allocate resources as efficiently as possible. The board member does not observe δ, but instead observes an imprecise, normally distributed signal correlated with δ.

We assume the exogenous penalty function is a positively-sloped linear function of the conditional signal mean plus a decreasing function of the conditional variance of δ. That is, the less accurate the signal, the lower the penalty. This captures the notion that an inaccurate signal requires a CEO to be penalized less because it increases the chances that the board member is unfairly penalizing the CEO.[17] Note that since the

[17]To understand this function, consider the limiting case where the signal is complete noise. In

expectation of the conditional mean is zero, the *ex ante* expected penalty depends only on the conditional variance.

We also postulate that the greater the expected penalty on the CEO, the more the loss of social capital to the board member penalizing the CEO. In a sense, excessive monitoring alienates the CEO and causes the quality of the social relationship between the board member and the CEO to deteriorate. This implies that if the signal received by the board member is more precise, the CEO is more alienated, because more precise signals imply a lower conditional variance and hence a greater penalty.

The signal received by the board member is denoted $\delta + \epsilon$, where ϵ has a mean of zero and is also normally distributed. The board member also needs to determine how much capital to allocate to a "growth opportunity" which pays off

$$\delta L - 0.5L^2,$$

where L is the amount of capital required to fund the opportunity. Let μ_δ be the mean of δ conditional on the signal received by the board member. To maximize the expected value of this opportunity, we have

$$L = \mu_\delta$$

and the maximized expected value of the growth opportunity, denoted by V^*, is

$$V^* = \frac{\mu_\delta^2}{2}. \tag{8}$$

Ex ante, before the realization of the signal, the expected value of the growth opportunity is simply half the variance of μ_δ (given that μ_δ has an *ex ante* mean of zero). The variance of μ_δ is decreasing in the variance of ϵ and thus increasing in the precision

this case, the penalty should clearly be minimal. If the signal is completely precise, there should be no decrement from the linear part of the penalty function. Our penalty function accords with this intuition and also covers cases of intermediate levels of precision.

of the information signal about δ. This implies that the expected value of the growth opportunity is also increasing in signal precision.

Denote the precision of ϵ as τ_ϵ. We assume that the alienation cost for the board member is increasing in τ_ϵ and can be represented by a function $C(\tau)$, with $C'(\tau) > 0$ and $C''(\tau) > 0$.

The objective is to maximize

$$\frac{\tau v_\delta^2}{\tau v_\delta + 1} - C(\tau),$$

where $C(\tau)$ is the cost of alienating the CEO who belongs to the board member's social circle. We normalize $v_\delta = 1$ and parameterize the cost directly as a function of $T = \tau/(\tau + 1)$, a monotonic transformation of τ; the specific parameterization is the function $F(T)$.[18] In equilibrium,

$$F'(T) = 1.$$

Specifically, suppose the function is $F(T) = 0.5HT^2$. The parameter H represents the extent of the social cost per unit squared precision. We then obtain $T = 1/H$ in equilibrium. Thus, the bigger the social cost, the lower is the precision, and hence the lower is the expected value of the growth opportunity:

Proposition 7 *In equilibrium, the value of the firm is decreasing in the social cost of increasing monitoring by way of gathering more precise information.*

4.2 Implications for CEOs in and out of Board Members' Social Networks

In this section, we consider the implications for social networking issues for CEOs who do and do not belong to board members' social networks. Previous research

[18] Note that T must be between zero and unity. In the scenarios considered in this paper, we assume that the exogenous parameter ranges are such that this is always the case.

has shown that agents tend to choose social networks based on gender (Marsden, 1987), age (Fischer, 1977), religious background (Iannaccone, 1988, Kalmijn, 1998), and education (Wright, 1997). It is reasonable to propose that the parameter H of the previous subsection is lower for CEOs who are not in the board members' social network. This simply implies that the cost from alienating non-network CEOs is lower than that from alienating those who belong to the CEO's network.

Consider an extension of the previous subsection's model to N firms: here the board member belongs to each of the N firms. We therefore attach a subscript i to each variable corresponding to firm i. For analytical convenience, we assume independence of the relevant random variables across firms, and that $v_{\delta_i} = 1$, $v_{\epsilon_i} = v_\epsilon$, and $L_i = L$ $\forall i$. We therefore have that $T_i = 1/H_i$ in equilibrium. Since H_i is smaller for CEOs not in the board members' social network, we have the following proposition.

Proposition 8 *The equilibrium precision and firm values are higher for CEOs who are not in the board members' social network relative to those who are part of the network.*

A straightforward implication of the above proposition is that contentious variables under direct or indirect control of the board of directors, such as executive compensation and perks, would be greater for CEOs who belong to the board of directors' social networks. Given that at least some of the characteristics on which agents tend to select social networks (as described in the preceding paragraph) are measurable, this implication is potentially testable.

4.3 Personal vs. Professional Capital

In this subsection, we show that the minimum needs for personal social capital can have an impact on the equilibrium level of information production. Thus, as in Section 2.3, now assume that the agent has a personal social capital of G, and prior to monitoring, a professional social capital of A. Further, the minimum required social capital is α. We then have that the unconstrained optimum $T^* = 1/H$ is also the equilibrium value of T so long as

$$A + G - F(T^*) > \alpha,$$

which is equivalent to

$$A + G - 0.5H^{-1} > \alpha.$$

If the above inequality is not satisfied, such that

$$2(A + G - \alpha) < H^{-1}, \tag{9}$$

however, then the constrained equilibrium T, denoted T^{**}, will satisfy

$$A + G - 0.5HT^{**2} = \alpha,$$

which yields

$$T^{**} = \sqrt{\frac{2(A + G - \alpha)}{H}}.$$

From (9), we have that

$$T^{**} < T^*.$$

Once again, technologies that reduce personal capital, i.e., reduce G, will reduce the amount of precision in equilibrium.

Proposition 9 *A technological innovation that causes a reduction in the extent of personal social networks will cause a decrease in the precision of information collected by the board in equilibrium. This leads to inferior resource allocation and a reduction in firm values.*

Observe that the cause of the decrease in the information precision in equilibrium is not due to an increase in the board member's tendency to shirk his duties following a technological innovation. Rather, the loss of personal social capital due to the technological innovation increases the cost of alienating agents in the professional network by way of collecting very precise information about the extent of resource-siphoning by CEOs. This reduces the precision of information collected in equilibrium.[19]

4.4 Financial Markets

Suppose that financial markets enable the availability of an alternative signal from the market price. (We endogenize the precision of this signal in the next subsection.) We consider such a scenario in the base model of Subsection 4.1. When an additional signal is available, suppose that it also is normally distributed and that the signal available to the board member is $\delta + \epsilon_1$ and that conveyed by the financial markets is $\delta + \epsilon_2$, where ϵ_i, $i = 1, 2$, are mutually independent and normally distributed random variables with mean zero.

Note that the conditional expected value of δ is

$$E(\delta|\delta + \epsilon_1, \delta + \epsilon_2) = \frac{v_\delta[v_{\epsilon_2}(\delta + \epsilon_1) + v_{\epsilon_1}(\delta + \epsilon_2)]}{v_\delta(v_{\epsilon_1} + v_{\epsilon_2}) + v_{\epsilon_1} v_{\epsilon_2}}.$$

From (8), the unconditional expected value of the growth opportunity is one half the variance of the right-hand side of the above expression. Thus, the expected value of the growth opportunity is

$$V^* = \frac{v_\delta^2[v_{\epsilon_1} + v_{\epsilon_2}]}{2v_\delta(v_{\epsilon_1} + v_{\epsilon_2}) + v_{\epsilon_1} v_{\epsilon_2}}.$$

Let the precision of the BOD's signal and that from the financial markets be τ_1 and τ_2, respectively, and define $\kappa \equiv \tau_1/(\tau_1 + 1)$. Further, suppose that the cost of increasing

[19] If we view the technological innovation as opening up new avenues of communication such as the World Wide Web, then the board member may have more access to information after the innovation. However, direct investigation of the CEO is still likely to be the dominant source of information about the firm, because sources such as the Web will only expose public information, and not complex, difficult-to-detect sources of corporate waste.

precision is $0.25c\kappa^2$ (the 0.25 is simply a scale factor intended to avoid carrying the number in the denominator for the expression for V^* above).

The above implies that the objective is to choose κ in order to maximize $V^* - 0.25c\kappa^2$. As before, we normalize $v_\delta = 1$. Then, the first order condition implies that

$$c\kappa[\kappa\tau_2 - (1+\tau_2)]^2 = 1 \tag{10}$$

in equilibrium. The appendix shows that an increase in τ_2 decreases the optimal κ (provided an equilibrium level of τ_2 exists),which leads to the following proposition.

Proposition 10 *When an alternative signal is available from the financial markets, an increase in its precision implies a decrease in the precision of the information collected by the board of directors.*

Thus, if the financial markets permit a very precise signal, the board is better able to keep its social capital intact because the information collected by the board is less precise.

4.5 Endogenizing the precision of the signal conveyed by financial markets.

Note that in actual financial markets, the variance v_{ϵ_2} is determined endogenously. To endogenize this variance, consider a standard model based on Admati and Pfleiderer (1988) and Kyle (1985) and suppose that there are N informed traders who observe $\delta + \eta_i$, where the η_i's are iid with mean zero and variance v_η. The appendix shows that when all informed agents observe the same signal about δ with perfect precision, the price reveals a signal of the form $\delta + \epsilon_2$, where

$$v_{\epsilon_2} = \frac{Nv_\delta}{(N+1)^2}. \tag{11}$$

In the general case, when informed agents observe noisy signals,

$$v_{\epsilon_2} = \frac{v_\delta + 2v_\eta}{N}. \tag{12}$$

It can be seen from the above expression for v_{ϵ_2} that increasing the precision of private information of informed agents decreases the precision of information collected by the board member by increasing the precision of the signal conveyed by the financial market. The precision of the signal collected by the board member is also decreasing in the number of informed agents.[20] In a sense, then, the financial market signal allows the board member to preserve "social capital" by allowing him to decrease the degree to which the CEO is penalized for expropriation of private benefits from the corporation.

5 Basic Empirical Evidence

Our goal in this section is to provide rudimentary evidence that sheds light on our theoretical model, rather than to perform a full-fledged empirical analysis. We aim to test the basic idea that governance is likely to be worse (and compensation less-controlled) in firms with conditions conducive to networking between CEOs and board members.

We focus on fiscal year 2005, the most recent year for which we could obtain data. Data on the characteristics of board members are obtained from the IRRC database, available from WRDS. This database provides a rich array of characteristics about board members including ethnicity (if reported), gender, and whether the director is also a CEO of a corporation. As a summary measure of corporate governance, we use the governance index obtained from Andrew Metrick's website. The index

[20] This follows because both financial markets and the board collect information about the same fundamental variable δ. If financial markets and board members collect information about different aspects of the firm (e.g., anticipated sales growth versus internal cost management), then the dependence between the precision of the board member's signal and the number of informed agents would be weaker.

is a numerical quantity based on governance provisions in several areas, e.g., director indemnifications from lawsuits stemming from their conduct, anti-greenmail provisions, shareholder voting rights, and whether the board of directors serves on staggered terms. We do not discuss the merits and demerits of the index in our work, but instead, refer the reader to the Gompers, Ishii and Metrick (2003) and view the index as a reasonable representation of the quality of governance within the firm. To the extent that this measure is noisy, we would expect only that the explanatory power of the coefficients in our regressions for governance be lower than if we had a perfect measure. We use index values that were determined in 2006 based on information available in 2005.

Compensation and shareholding data are from the executive compensation (Execucomp) database, also available on WRDS, for 2005. These data are collected from each company's annual proxy, which must be filed 120 days after each company's fiscal year end. We only consider the CEO's compensation (salary plus bonus plus option grants, log-transformed) because, relative to other firm employees, CEOs are the agents most likely to be in contact with board members, and therefore most likely to form networks with them.

We first model the corporate governance index as a function of the following variables. First, we control for size (market capitalization as of the end of the year) since large firms may have better levels of governance simply because institutions may be attracted to such companies for liquidity reasons (specifically, trading large blocks is more convenient for large firms than for small ones). Next, we include several proxies for networking. AGEDIFF represents the absolute value of the difference between the age of the CEO and the average age of the other board members, and EXEC is the number of other board members who also are CEOs. We also include an interactive variable for gender, obtained as follows. We first define a variable that is unity if the CEO is female and zero otherwise. We then interact this variable with the number of board members who also are females (INTGEN). We include a variable, RELATIVE, that captures the number of board members who are immediate relatives of the CEO (as defined by IRRC). Finally, we define a variable corresponding to a match between the ethnicity of the CEO and that of the board of directors. We define this variable as follows. We first create an indicator variable that takes on the value zero if the last names of CEOs indicate a Hispanic or Asian heritage and is equal to unity otherwise. We then divide the total number of board members who declared themselves as Caucasian by the total number of board members, and subtract this proportion from unity to obtain the variable MINORITY. We then interact the indicator variable with MINORITY, and term this variable ETHN. ETHN is intended to capture the degree of a mismatch between the ethnicity of the CEO and that of the board members. It is not perfect because screening African Americans by last (or first) names is not feasible. Nonetheless, so long as there is no systematic bias, since the vast majority of CEOs are Caucasians,[21] ETHN should capture the likelihood that a strong network between the CEO and board members is absent. We recognize that ETHN may tend to be collinear with EXEC, because the vast majority of CEOs tend to be Caucasian. In addition, ETHN and EXEC may also be collinear with AGEDIFF if elderly agents tend to be both Caucasian and CEOs. We thus perform regressions that, in turn, include and exclude ETHN. Summary statistics of the variables we consider are presented in Table 1.

Next, we present the coefficients from the OLS regression of the governance index on the explanatory variables in Table 2.[22] Note that, as per the convention used by Gompers, Ishii and Metrick (2003), large values of the governance index imply *poorer* governance. Size is related to stronger governance, and it can also be seen that higher values of AGEDIFF imply better governance, as indicated by a statistically significant

[21]See Footnote 11.

[22]While we measure board and CEO characteristics in the same year as the one in which the governance index and CEO compensation are determined, lagging the right-hand variables by one year makes no material difference to the results.

coefficient of 0.154. Further, the greater the number of board members who also are CEOs, the worse the implied governance. The variable corresponding to gender, however, does not have a strong influence on governance. Overall, the direction of the coefficients supports our conjectures. The greater the dissimilarity between CEOs and board members along the dimensions of occupation and age, the better the governance.

When added to the regression, the variable ETHN is strongly significant. The negative sign on the variable suggests that a proportionally greater non-Caucasian (or minority) representation on the board implies better governance. This is consistent with the notion that networks are more likely to form between CEOs and predominantly Caucasian boards. Though the variable AGEDIFF becomes insignificant once ETHN is included, neither the signs nor the significance of any of the other variables, including EXEC, are affected.

Next, we present a robustness check using the Poisson regression method. This procedure explicitly accounts for the fact that the governance index is a count variable. Results appear in the two right-most columns of Table 2.[23] In this case, p-values are provided for the coefficients, since significance for Poisson coefficients are based on chi-squared tests. It can be seen that the results generally mimic those from the OLS regressions. Without ETHN, AGEDIFF and EXEC are significant (the former marginally) but, upon the inclusion of ETHN, AGEDIFF maintains its sign but loses its significance. ETHN, however, is strongly significant, and EXEC remains marginally significant with a p-value of 0.053.

We now model total executive compensation as a function of our variables. The results appear in Table 3. It is immediately seen from a statistically significant coefficient of 1.309 that size is positively related to compensation, which is intuitive. In the

[23]The Poisson regression models the logarithm of the governance index, whereas the OLS method uses the untransformed version of the variable. Hence the magnitudes of the coefficients obtained from the two methods are not directly comparable.

absence of ETHN, higher values of EXEC imply higher compensation (the coefficient is 5.548, with a t-statistic of 2.76), and AGEDIFF is negatively related to compensation ($t = -1.99$). EXEC remains significant with the addition of ETHN to this regression, and ETHN is negatively related to compensation. A statistically significant coefficient of -0.614 suggests that non-Caucasian (or minority) representation on the board implies lower compensation. To test if our results are driven by performance-related components of compensation, we include the cumulative return from 2000 to 2004 (based on monthly return data) as well as the return on equity (ROE) in the regression and report the results in the rightmost columns of Table 3.[24] While higher stock market returns do result in higher compensation, the significance of the other variables is largely unaltered.

From the perspective of economic significance, we find that a one standard deviation move in ETHN increases total compensation by about 20%, which amounts to about $1.2 million relative to the cross-sectional mean compensation of approximately $5.84 million. We note that detecting whether social networks are present between top management and board members is an inherently difficult exercise because some of the variables indicating whether networks are likely to form (such as educational attainment, income levels, etc.) are not measurable with the data we currently have. Given this observation, we find our results to be quite encouraging.

6 Conclusion

We consider the impact of social networks on the interplay between corporate boards and firm management and, in turn, on firm values. Social connections have been demonstrated to be more prevalent across agents who share similarities in income, age,

[24] In cumulating the return, we include as many months of data as are available for the relevant company.

and other attributes. Board members often share such attributes with their CEOs. Thus, boards have a disinclination to monitor CEOs because they wish to preserve their social capital, and this phenomenon lowers firm values. We also show that information production may be impeded when board members have strong social ties to CEOs. This argument starts with the postulation that CEOs tend to siphon firm resources to obtain private benefits, and board members only observe an imprecise signal about the extent of siphoning. While collecting precise information improves resource allocation, it also increases the precision with which the draining of firm resources by CEOs can be detected. When information precision is high, it is more likely that the penalty being levied is fair, so the penalty imposed on CEOs for resource siphoning is an increasing function of the signal precision. Since the penalty causes the social relationship between CEOs and board members to deteriorate, the board tends to reduce the precision of information produced in equilibrium.

Furthermore, board members with social connections to top management are more likely to look askance when CEOs move to adopt policies with significant amounts of hidden compensation. It is not always optimal, however, to have board members with little or no social ties to prospective CEOs. If being in a prospective CEO's social network gives board members good information about a prospective CEO's ability, then having board members with strong social ties to the pool of potential top management may be optimal. Thus, when choosing a board member with strong social ties to prospective CEOs, one must trade off the benefits of having high ability CEOs with the costs of reduced monitoring that arise when the board member has strong ties to top management.

Our analysis also indicates a link between the advent of innovations in communication technologies such as the Internet and electronic mail to firm values and the quality of corporate governance. The reasoning is that technologies that reduce face-to-face networking cause agents to seek satisfaction of their social needs at the workplace, increasing the cost of governing those agents who are part of the social network. The rationale is that monitoring of agents in the social network causes a loss in social capital, which acts as a disincentive to monitor agents. Hence, technologies that reduce the extent of in-person communication will lead to poorer corporate governance and lower firm values. The results are consistent with the recent upsurge in the number of episodes that appear to signify inadequate monitoring of corporate disclosures as well as executive compensation.

In our empirical tests, we find that firms that have boards with greater non-Caucasian representation as well as fewer members who also are CEOs tend to be better-governed and have lower levels of executive compensation. This supports the notion that a reduced likelihood of network formation improves corporate governance. Nonetheless, many untested empirical implications remain, such as those related to CEOs' and board members' educational attainment and income – similarities that may promote network formation. These await testing using richer datasets, possibly in international contexts.

Appendix

Proof of Proposition 1: The first-order conditions of the problem are

$$B = Ke_1 + K_I e_2$$

and

$$B = Ke_2 + K_I e_1$$

Solving the above set of equations for e_1 and e_2, we have that

$$e_1 = e_2 = \frac{B}{K + K_I}.$$

Note that the optimum when $K_I = 0$ is simply B/K for $i = 1, 2$. The effort level e_1 when $K > 0$ is less than B/K. The proposition thus follows. □

The Asymmetric Analog of Subsection 2.1: We consider the case where the benefits and costs of exerting effort vary across firms. Specifically, suppose that the CEO of firm i can exert an effort e_i to monitor the CEO of firm j and the monetary benefit to firm j from this monitoring is $B_i e_i$ (this benefit is internalized by the board member). The cost of exerting effort e_i is $K_i e_i^2$. There also is an interactive cost (as in the symmetric model) in the amount $K_A e_i e_j$. Thus, the CEO of firm j maximizes

$$B_i e_i - 0.5 K_i e_i^2 - K_A e_i e_j.$$

In the Nash equilibrium, we then have

$$B_i = K_i e_i + K e_j \tag{13}$$

for $i, j = 1, 2$. Solving this linear system implies that

$$e_1 = \frac{B_1 K_2 - B_2 K}{K_1 K_2 - K_A^2}, \tag{14}$$

and

$$e_2 = \frac{B_2 K_1 - B_1 K}{K_1 K_2 - K_A^2}. \tag{15}$$

As in the main text, within Equations (14) and (15) the second term in the numerator represents the "social cost" of board membership. However, parameter restrictions must be imposed to ensure both that the effort levels remain positive and that the effort level in equilibrium may not be monotonically declining in K_A (the counterpart of K_I in the symmetric model). The intuition is that while increasing K_A tends to decrease e_1, while holding e_2 constant, it also tends to decrease e_2, which, in turn, tends to increase e_1. If these indirect effects of the cost parameter are sufficiently asymmetric, the equilibrium levels of e_1 or e_2 may be increasing in K_A.

To elaborate on this further, note from Equation (2) that the specific condition for e_1 to decrease in K_A is given by

$$B_2(K_A^2 + K_1K_2) > 2B_1K_AK_2.$$

If B_1 is very large relative to B_2, there is considerable asymmetry in the response of e_i to K_A (holding e_j constant). This implies that e_1 may be decreasing in K_A, as already pointed out. For a specific example, consider the parameter values $B_1 = 10$, $B_2 = 5$, $K_1 = K_2 = 1$, and $K_A = 3$. In this case, $e_1 = 0.625$ and $e_2 = 3.125$. Increasing K_A to 4, however, increases e_1 to 0.67 but decreases e_2 to 2.33. When $B_1 = 6$ (i.e., in the case where B_1 is closer to B_2), then, for $K_A = 3$, we have $e_1 = 1.13$ and $e_2 = 1.63$. Consistent with the symmetric model, increasing K_A to 4 in this case reduces e_1 to 0.93 and e_2 to 1.27. □

Proof of Proposition 2: The agent maximizes

$$\frac{N(\beta - LN)^2}{K} + XN,$$

and the first order condition for the above problem is

$$(\beta - 3LN)(\beta - LN) + KX = 0. \tag{16}$$

Provided that $\beta > 3LN_m/2$, the second derivative of the objective function is always negative, ensuring that any optimum to the objective is a maximum. Also, if $\beta^2 >$

$3KX$, then the roots of the quadratic are real. Finally, because the objective function is increasing locally around $N = 0$ and is continuous, the root that places a negative sign in front of the discriminant of the solution to (16) is the unique maximum. This root is given by

$$N = \frac{1}{3L}\left[2\beta - \sqrt{\beta^2 - 3KX}\right],$$

and is increasing (decreasing) in X (L). □

Proof of Proposition 3: The board member will invest effort up to the point where the social capital constraint just binds. The equilibrium allocation of effort will then be given by the solution to the equation

$$0.5NKe^2 = A + G - \alpha.$$

Since $A + G\alpha$, this implies that the effort e per firm is given by

$$e = \left[\frac{2(A + G - \alpha)}{NK}\right]^{0.5}.$$

A reduction in G decreases the effort e in equilibrium. The proposition thus follows. □

Proof of Proposition 4: The board member solves

$$\max_D YD - 0.5qVD^2,$$

which implies that

$$D = \frac{Y}{qV}.$$

The above expression for D is increasing in Y and decreasing in q as well as in V, thus proving the proposition. □

Proof of Proposition 5: The board member solves

$$\max_D (Y - \theta)D - 0.5qVD^2,$$

which implies that

$$D = \frac{Y - \theta}{qV}.$$

The above expression for D is decreasing in θ, but θ is decreasing the strength of the social connection between board members. The proposition thus follows. □

Proof of Proposition 6: The net benefit to the firm from the first type of board member is

$$Q_1 - D_1 = Q_1 - \frac{Y_1}{qV}. \tag{17}$$

The net expected benefit from the second type of board member is

$$0.5(Q_1 + Q_2) - D_2 = 0.5(Q_1 + Q_2) - \frac{Y_2}{qV}. \tag{18}$$

Comparing the right-hand sides of (17) and (18), we obtain (7). □

Proof of Proposition 7: The objective is to maximize

$$T - F(T).$$

The first-order condition for this is that, in equilibrium,

$$F'(T) = 1.$$

For $F(T) = 0.5HT^2$, we have $T = 1/H$. Since the optimal T is decreasing in H (the social cost), the proposition follows. □

Proof of Proposition 8: Recall that $v_{\delta_i} = 1$ and $v_{\epsilon_i} = v_\epsilon \; \forall i$, and further that $L_i = L$ $\forall i$. The agent then maximizes

$$\sum_{i=1}^{N} T_i - F(T_i)$$
$$= T_i - 0.5H_i T_i^2.$$

From this problem, it follows that, in equilibrium, $T_i = 1/H_i$. Since H_i is smaller for CEOs not in the board members' social network, the proposition follows. □

Proof of Proposition 9: The constrained equilibrium T, denoted T^{**}, will satisfy

$$A + G - 0.5HT^{**2} = \alpha,$$

which yields

$$T^{**} = \sqrt{\frac{2(A + G - \alpha)}{H}}.$$

As T^{**} decreases in response to a decrease in G, the proposition follows. □

Proof of Proposition 10: We first argue that there is a unique solution to the optimal κ. Note that the equilibrium κ is determined by the intersection of the functions $1/[c\kappa]$ and $[(\kappa - 1)\tau_2 - 1]^2$. The first function is decreasing in κ whereas the second one is increasing in this variable. This indicates that there is at most one solution to the optimal τ_2.

Next, observe that the second function has its unique zero at $\tau_2^{-1} + 1$. An increase in τ_2 shifts the zero towards the origin and increases the value of the second function everywhere. Thus the second function shifts towards the origin when τ_2 increases. As already noted, the first function does not depend on τ_2. Since the first function is decreasing in κ, the intersection point occurs at a smaller κ as τ_2 increases. Thus the optimal κ is lower when τ_2 is higher. □

Proof of Equations (11) and (12): Suppose informed trader i conjectures that others use strategies of the firm $\bar{\beta}(\delta + \eta_j)$. Let this agent's order be denoted x_i. The trader maximizes

$$E(x_i(\delta - \lambda(x_i + (N-1)\bar{\beta}\delta + \bar{\beta}\sum_{j \neq i} \eta_j + z))|\delta + \eta_i)$$

$$= -\lambda x_i^2 + x_i E(\delta|\delta + \eta_i)[1 - (N-1)\lambda\bar{\beta}]$$

implying that

$$x_i = \frac{\gamma(\delta + \eta_i)(1 - \lambda(N-1)\bar{\beta})}{2\lambda} \qquad (19)$$

where

$$\gamma \equiv \frac{v_\delta}{v_\delta + v_\eta}$$

so that the informed strategy is of the form $\beta(\delta + \epsilon_i)$. In a symmetric Nash equilibrium, $\bar{\beta} = \beta$. From (19) we then have

$$\beta = \frac{k}{\lambda([2 + k(N-1)]}.$$

Now, in equilibrium, from the zero profit condition imposed on market makers, λ is given by the projection of δ on the total order flow, so that

$$\lambda = \frac{\mathrm{cov}(\delta, N\beta\delta + \beta\sum\epsilon_i + z)}{\mathrm{var}(N\beta\delta + \beta\sum\epsilon_i + z)},$$

implying

$$\lambda = \frac{v_\delta}{(N+1)v_\delta + 2v_\epsilon}\sqrt{\frac{N(v_\delta + v_\epsilon)}{v_z}}.$$

When informed agents all observe the same signal about δ with perfect precision, it follows from the above analysis that the variance of ϵ_2, which simply equals λz, is given by $Nv_\delta/(N+1)^2$, where N is the number of informed agents. In the general case, when informed agents observe noisy signals, ϵ_2 equals $\frac{\sum_{i=1}^N \eta_i}{N} + \frac{z}{N\beta}$, and, in equilibrium, it follows that

$$v_{\epsilon_2} = \frac{v_\delta + 2v_\eta}{N},$$

where N is the number of informed agents and v_η is the common error variance. □

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Table 1: Summary Statistics

This table presents summary statistics for the variables we consider. Total compensation (Total Comp) is defined as the sum of salary, bonus and stock option grants, log-transformed for the year 2005. Governance Index is obtained from Andrew Metrick's website for the year 2006. SIZE is the market capitalization as of December, 2005. AGEDIFF is the absolute value of the difference between the age of the CEO and the average age of the other board members. EXEC is the number of other board members who also are CEOs. INTGEN is obtained from interacting a dummy for whether the CEO is a female with the number of female board members. RELATIVE is the number of board members who are immediate relatives of the CEO. ETHN is obtained as follows. We divide the total number of board members who declared themselves as Caucasian by the total number of board members, and subtract this proportion from unity to obtain a variable MINORITY. We then interact a dummy for whether the CEO's last name is non-Asian or non-Hispanic, with MINORITY. The sample size is 1205 firms.

Variable	Mean	Median	Std Dev
Total Comp ($million)	5.837	3.595	7.123
Governance Index	9.344	9.000	2.520
SIZE ($billion)	8.961	2.336	23.955
AGEDIFF	−3.621	−3.462	6.285
EXEC	3.433	3.000	1.649
INTGEN	0.045	0.000	0.364
RELATIVE	0.150	0.000	0.452
ETHN	0.496	0.462	0.307

Table 2: Cross-Sectional Regressions for Corporate Governance

This table presents the results of cross-sectional regressions using the corporate governance index of Gompers, Ishii, and Metrick (2003), obtained from Andrew Metrick's website for the year 2006. SIZE is the market capitalization as of December, 2005. AGEDIFF is the absolute value of the difference between the age of the CEO and the average age of the other board members. EXEC is the number of other board members who also are CEOs. INTGEN is obtained from interacting a dummy for whether the CEO is a female with the number of female board members. RELATIVE is the number of board members who are immediate relatives of the CEO. ETHN is obtained as follows. We divide the total number of board members who declared themselves as Caucasian by the total number of board members, and subtract this proportion from unity to obtain a variable MINORITY. We then interact a dummy for whether the CEO's last name is non-Asian or non-Hispanic, with MINORITY to obtain ETHN. While the coefficient of SIZE is multiplied by 10^{-8}, all other coefficients in the Poisson regressions except ETHN are multiplied by 100. The sample size is 1205 firms.

	OLS regressions				Poisson regressions			
Variable	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	p-value	Coeff.	p-value
SIZE	−0.869	−2.82	−1.234	−4.02	−0.096	0.000	−0.138	0.000
AGEDIFF	−0.024	−2.08	−0.017	−1.50	−0.268	0.074	−0.194	0.199
EXEC	0.156	3.45	0.114	2.54	1.610	0.006	1.144	0.053
INTGEN	−0.321	−1.62	−0.338	−1.74	−3.588	0.193	−3.751	0.172
RELATIVE	−0.170	−1.06	−0.194	−1.23	−1.951	0.355	−2.084	0.322
ETHN	-	-	−1.650	−6.93	-	-	−0.177	0.000

Table 3: Cross-Sectional Regressions for Executive Compensation

This table presents the results of cross-sectional regressions using executive compensation (defined as the sum of salary, bonus and stock option grants, log-transformed) for the year 2005. SIZE is the market capitalization as of December, 2005. AGEDIFF is the absolute value of the difference between the age of the CEO and the average age of the other board members. EXEC is the number of other board members who also are CEOs. INTGEN is obtained from interacting a dummy for whether the CEO is a female with the number of female board members. RELATIVE is the number of board members who are immediate relatives of the CEO. ETHN is obtained as follows. We divide the total number of board members who declared themselves as Caucasian by the total number of board members, and subtract this proportion from unity to obtain a variable MINORITY. We then interact a dummy for whether the CEO's last name is non-Asian or non-Hispanic, with MINORITY. RET is the cumulative monthly return from the years 2000 to 2004. ROE is the return on equity in 2004. While the coefficient for size is multiplied by 10^{-8}, the coefficients for all other variables except ETHN are multiplied by 100.

Variable	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
SIZE	1.309	9.55	1.173	8.55	1.197	8.74
AGEDIFF	−1.026	−1.99	−0.764	−1.50	−0.800	−1.57
EXEC	5.548	2.76	3.968	1.98	4.021	2.01
INTGEN	0.774	0.09	0.142	0.02	0.850	0.10
RELATIVE	−1.358	−0.19	−2.263	−0.32	−2.425	−0.34
ETHN	-	-	−0.614	−5.77	−0.628	−5.90
RET	-	-	-	-	4.042	2.96
ROE	-	-	-	-	2.212	1.13
Adjusted R^2 (%)	8.59		10.99		11.59	