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Social Networks and Corporate Governance

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Abstract

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We link corporate governance and firm values to governing boards' social networks. Agents form social networks with individuals with whom they share commonalities along the dimensions of social status and income, among other attributes. This causes CEOs to often be present in the board members' social networks, which interferes with the quality of governance. Social connections with agents can also allow for better judging of those agents' abilities. Thus, the choice of whether to have board members with social ties to management trades off the benefit of having the members identify high ability CEOs against the cost of inadequate monitoring due to social connections. Technologies which reduce the extent of face-to-face networking (such as the internet and electronic mail) cause agents to seek satisfaction of their social needs at the workplace. This exacerbates the impact of social networks on corporate governance and further lowers firm values. The results are consistent with recent episodes which appear to signify inadequate monitoring of corporate disclosures as well as executive compensation.

1 Introduction

Issues surrounding corporate governance, particularly disclosure policy as well as executive compensation, have taken on increased prominence in recent times. For example, Mishel, Bernstein, and Allegretto (2005) note that CEOs in 2003 were paid 185 times as much as the average worker while the corresponding ratio was only 26 in 1965, and that average CEO compensation soared 342% between 1989 and 2000. Also in the spotlight have been practices like misrepresenting the exercise date on options as well as the backdating of options grants (Lie, 2005). Arrangements consisting of deferred compensation, post-retirement income guarantees, and stock option packages, have also received attention in the popular press.[1]

Of course, a vast body of earlier work studies compensation, particularly since the work of Jensen and Murphy (1990). This work (e.g., Aggarwal and Samwick, 1990, Barro and Barro, 1990, and Kaplan, 1994) generally focuses on cross-sectional variations in pay-for-performance sensitivities. The steep rise in relative levels of compensation over recent decades, together with evidence of fraud in compensation packages, however, warrants a separate investigation. Also in the spotlight has been the apparent delinkage of compensation with financial performance.[2] Spurred by these concerns, the

[1]See http://online.wsj.com/public/resources/documents/info-optionsscore06-full.html for a list of companies currently under examination for options scandals. A recent 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 hidden compensation and that these aspects increased executive compensation well beyond the numbers provided in the report.

[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*

SEC has recently mandated clearer disclosure of executive compensation.[3]

A separate concern has centered around increased episodes of fraudulent disclosures. The Enron crisis, and the WorldCom as well as the Tyco revelations of past years and other indications of misrepresentation by top management have all added to a concern that investors may lose confidence in the financial markets, which may threaten the viability of such avenues as a source of capital. In the case of Enron, revelation of the misrepresentation was accompanied by a loss of market capitalization, and a consequent erasure of about $1 billion in the retirement savings of investors.[4] The misrepresentations have led to jail terms for top executives, and have received considerable attention in the popular press as well as among regulatory authorities. They have served as a major impetus for the Sarbanes-Oxley law aimed at curbing managerial misrepresentation.

The question that arises in the above contexts is that of why the market discipline imposed by public ownership was unable to curb managerial excesses. One noteworthy point is that large segments of the investing population (which determine the equilibrium stock price) scan the public disclosure statements, so it reasonable to suppose that they should have been able discern the extent of corporate fraud from company disclosures. However, as Subrahmanyam (2005) indicates, because of limited under-

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[3]Frieder and Subrahmanyam (2006) 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.

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

standing of financial markets and accounting standards, the investing population may lack the sophistication required to curb managerial excess. But, investors indirectly control governance through the board of directors, and the latter class of agents should have had the sophistication to prevent such events, but were apparently unable to do so.

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 is the observation that the number of board of directors is small,[5] so their human needs may have a substantial impact on the quality of governance. More specifically, we focus on the proclivities of humans towards forming interpersonal relationships and connections, which has been well-established in the literature.[6] We also appeal to the notion 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).[7] 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

[5]The number of board members is not the focus of the paper. However, one could appeal to standard arguments such as prohibitively high coordination costs with large boards to argue why the size of the board must me limited for effective decision-making.

[6]It is worth reiterating 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 based on the notion that social ties would have survival benefits.

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

investigate the CEO too deeply for fear of losing members within their social circle.[8] In equilibrium, while the lack of adequate monitoring of CEOs reduces firm values by allowing managerial excess, it makes CEOs better off by preserving their social circle. We also show that social networks can reduce the precision of information collected and used by boards of directors in determining resource allocation policies.

The question that naturally arises in the context of our argument is that of why boards of directors that do not invest adequate effort cannot be replaced. 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 necessary to punish non-performance. These aspects include voting procedures that do not permit shareholders to allow for votes in against board members in proxy proposals but only a "yes" vote or a withholding of support. The full-fledged proxy fights required for putting up slates of investors' own choices for board members are often prohibitively costly.[9] In a sense, then, our work proposes an externality, wherein the board members' need for social contact is not internalized by corporate governance mechanisms currently in place. We show that this phenomenon reduces firm values by reducing oversight by boards of directors of corporate management.

We also consider whether it is always optimal to have board members with the

[8]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.

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

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 ties to the pool of prospective CEOs may have better information on 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 good social ties to the prospective CEO pool may actually be optimal. The choice of members with strong social affinities towards prospective management thus trades off the benefit from having a high-ability CEO against the cost of inadequate monitoring were a board member with strong ties to management to be appointed.

Our analysis relates to how social networks have been affected by technological innovations such as internet and electronic mail. The starting point of our argument in this regard is to note that there is a view amongst a substantial group of psychologists that use of the internet may actually reduce face-to-face interactions amongst agents and cause their personal social networks to deteriorate; see Nie (2005) for a comprehensive survey of the evidence. Thus, we propose that the advent of technologies that reduce face-to-face interactions cause agents to seek satisfaction of their social needs within the workplace. This causes boards of directors to reduce monitoring of management still further in order to preserve their "social capital."

Other studies have also 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.

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 concludes.

2 The Basic Model

In introducing social networks into models of financial markets, a number of modeling choices are possible. Our initial modeling themes start with the notion that CEOs of firms will, if left unmonitored, consume private benefits that hurt firm values. We further argue that if, say, Agents A and B are within each other's social networks then increased monitoring of Agent B (say, a CEO) by Agent A (say, a member of the firm's board of directors) causes the social relationship between A and B to deteriorate (we say that B gets "alienated" by the monitoring). In turn, this causes Agent A to suffer

[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.

disutility.[11] In equilibrium, this phenomenon 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 where agents require a minimum amount of "social capital" to sustain themselves (see, for example, Jacobs, 1961, Coleman, 1988). This social capital may be satisfied either at the workplace or in agents' private lives. We discuss how the need for a threshold level of social capital can interfere with corporate governance and thereby affect firms' market values.[12] We begin by presenting some simple models of firms which are monitored by agents who are the firms' "board members." In Subsection 2.1, we first present a model of cross-membership wherein one CEO belongs to the board of the other firm, and then in Subsection 2.2 discuss how an agent decides on 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.

2.1 Social Networks and Managerial Monitoring

Consider a very 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

[11]This notion can be justified by the observation (e.g., Putnam, 1995) that social networks need mutual trust to be successful. Monitoring another agent with a view to reducing their private benefits is clearly a violation of this trust, from a purely social standpoint.

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

member, who is the CEO of the other firm.[13] 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 Ke_i^2. There also is an interactive cost which implies that if the CEO of, say, firm 1 exerts too much effort in monitoring firm 2, then the social connection between the two CEOs will deteriorate so that the CEO firm 2 will increase the monitoring of firm 1. This reduces private benefits to the CEO of a firm in the amount $K_I e_i e_j$. For simplicity the benefits and costs are assumed to be symmetric across the two firms; 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.[14] The basic notion is that alienating another CEO board-member

[13]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.

[14]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.

creates the possibility that member will increase his monitoring of one'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. However, both CEOs are in the board member's social circle. The cost represents the costs of "alienating" people within the board members's social circle; in our setting, the cost of alienation are convex in the effort put in to monitoring. However, there also is an interactive term, which implies that the greater the effort put into one firm, the greater is the cost of alienating the other. Thus, losing social capital with one CEO increases the cost of alienating another in the sense that the board member is concerned about alienating one member makes it more important that the other is not alienated in order to have a steady social circle. 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. The cost of expending e_i, as in the previous subsection, is $K_i e_i^2$.

There are no interaction terms, as we choose to model social benefits differently in this subsection. Specifically, we postulate each board member derives a social benefit of X_i from each board to which he belongs. The agent maximizes

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

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

Purely for convenience, we now assume that $B_i = B$, $K_i = K$, 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 assume that $B = \beta - LN$ to account for the notion that distractions from belonging to many firms reduce the governance benefit per firm. 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 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 number of firms, which is denoted as N_m. 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 that 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 is 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 which 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). An agent (who is not a CEO) is on the board of R 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 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

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

subject to the constraint that

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

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

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

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

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

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 reduction in effort and consequently in a reduction in 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 caused a decrease in face-to-face communication and 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).[15] We model the benefits to board membership as maintaining social relationships with CEOs. These benefits are increasing in the level of hidden compensation the board member chooses to allow. The costs arise from the notion that a penalty may be levied on the board member in case the hidden compensation is discovered by a regulatory authority.

More specifically, we consider that a CEO has to paid at least his reservation wage $\bar{W}$ to keep him employed within the firm. The wage is set by the single active

[15]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.

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. 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 VD^2 (i.e., it is convex in the amount 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 remain the social ties between the member and the CEO. All this implies that the board member chooses to allow the level of D which maximizes

$$YD - qVD^2,$$

which implies that

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

This 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 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 relatives of the CEO or share commonalities in terms of their educational attainment, religious leanings, or age; viz. McPherson, Smith-Lovin, and Cook, 2001, or Laumann 1973).

3.2 Social Networks Within Boards

Our analysis may also be extended to the extent of 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, whereas 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 either 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 a simple majority vote is required for any compensation package to be approved, so long as $M > 2$, it can be seen that the wage will be $\bar{W}$ and the level of hidden compensation will be zero.

However, now consider a case where there are social connections between board member 1 and the other $M-1$ board members (though the social connections between the CEO and board members other than 1 continue to equal zero). 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 the mean absolute difference between the ages of board members. The smaller this quantity, the greater is 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 as well as 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 contributions of Q_1 and Q_2 respectively to the present values of cash flows from the firm with $Q_1 > Q_2$.

Suppose there are two types of pivotal board members ("pivotal" here is interpreted as the sole decision-maker on the board). The first type is in the social networks of the two CEO types and thus knows each CEO's true ability. The second type of board member is only a peripheral part of the network, and is thus equally likely to hire a 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 the same for the two 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

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

On the other hand, for the second type of board member, the net expected benefit 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*

$$\frac{Y_1 - Y_2}{qV} > Q_1 - Q_2. \tag{7}$$

The above proposition indicates that if the incremental contribution to firm values by high ability CEOs is sufficiently large, then it may pay to allow for 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 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, and then discuss the equilibrium where 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, Subrahmanyam and Titman, 2001), but other authors 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 a random amount δ, which is a zero-mean, normally distributed variable, and is 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 which 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 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 is the penalty. This captures the notion that an inaccurate signal requires the manager to be penalized less because it increases the chances that the board member is unfairly penalizing the manager.[16] Note that

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

since the 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 greater is loss of social capital of the board member. 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 that

$$L = \mu_\delta$$

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 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. As mentioned earlier, with an increase in τ_ϵ, the cost of alienating the CEO also increases. We assume that the alienation cost for the board member is increasing in τ and can be represented by a function $C(\tau)$, with $C'(\tau) > 0$ and $C''(\tau) > 0$.

Then 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 $F(T)$.[17] We have that 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.

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

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

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 that do and do not belong to board members' social networks. Previous research 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 not in the board members' social network. This implies simply that the cost from alienating non-network CEOs is lower than that from alienating those that belong to network.

Consider an extension of the previous subsection's model to N firms, here the board member belongs to each of the N firms, and attach subscripts $i$to denote the variables corresponding to firm i. For analytical convenience, we assume independence of the relevant random variables across firms, and that $v_{\delta_i} = 1$ and $v_{\epsilon_i} = v_\epsilon$ for all i, and further that $L_i = L$ for all i, we 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 that are* *not in the board members' social network relative to those that 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 that 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 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, so 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 following the 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 on the extent of resources that siphoned by CEOs. This reduces the precision of information collected in equilibrium.

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 are τ_1 and τ_2, respectively and define $\kappa \equiv \tau_1/(\tau_1 + 1)$. Further, suppose that the cost of increasing 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 able to keep its social capital intact to a greater degree because the information collected by the board is of lower precision.

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, each observes $\delta + \eta_i$, where the η_i's are iid and mean zero with variance v_η. The appendix shows that when informed agents all observe the same signal about δ with perfect precision, the price reveals a signal of the form $\delta + \epsilon_2$, where

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

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 will decrease 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.[18] about which the signal is collected is 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 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, and other attributes, and board members often share such attributes with CEOs. Thus, boards have a disinclination to monitor CEOs because they wish to preserve their social capital. This phenomenon lowers firm values. We also show that information

[18]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.

production may be impeded when board members have strong social ties to CEOs. This argument starts by 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 siphoning of firm resources by CEOs can be detected. When information precision is high it is more likely the penalty being levied is fair, so the penalty levied 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 cut back on the precision of information produced in equilibrium.

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 to have board members with little or no social ties to prospective CEOs, however. If board members have good information about prospective CEOs' ability by virtue of being in their social networks, then having board members with strong social ties to the pool of potential top management may be optimal. Thus, the choice of a board member with strong social ties to prospective CEOs trades off the benefit from having high ability CEOs against the costs due to reduced monitoring which arise when the board member has strong ties to top management.

Our analysis indicates a link between the advent of innovations in communication technologies such as electronic mail and the internet 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 the their social needs at the workplace. This increases the cost of governing those agents that 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.

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. $\square$

The Asymmetric Analog of Subsection 2.1: We consider the case where the benefits and costs of exerting effort vary across the firms. Specifically, suppose that 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 $B_i e_i$ (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 $K_A e_i e_j$. This indicates that 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, in this case, two aspects are noteworthy. First, parameter restrictions must be imposed to ensure the effort levels remain positive. Second, the effort level in equilibrium may not monotonically decline 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 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

$$B_2(K_A^2 + K_1 K_2) > 2B_1 K_A K_2.$$

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 $e_2 = 3.125$. However, increasing K_A to 4 increases e_1 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, in this case increasing K_A to 4 reduces e_1 to 0.93 and e_2 to 1.27. $\square$

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). $\square$

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

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

which implies that

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

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

Proof of Proposition 5: The board member solves

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

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 $T = 1/H$. 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 $v_{\epsilon_i} = v_\epsilon$ for all i, and further that $L_i = L$ for all i. The agent then maximizes

$$\sum_{i=1}^{N} T_i - F(T_i)$$

$$= T_i - 0.5H_iT_i^2.$$

From this problem, it follows that $T_i = 1/H_i$ in equilibrium. 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. $\square$

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. $\square$

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

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

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 in equilibrium,

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

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

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