Three Essays on Boards, Blockholders and the Media

by

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Abstract

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Essay 1 examines the impact of an independent blockholder on the board of directors. The problem driving the analysis is a CEO who plans to divert project resources for personal benefit. If successful, he will provide private benefits to insiders who support the diversion. I find that, in the absence of a blockholder, the success of the diversion effort strictly depends on the size of the private benefit to insiders. By contrast, the presence of the blockholder can increase or decrease the willingness of insiders to vote against the CEO, to the point of precluding a rational CEO from even attempting diversion.

Essay 2 investigates the impact of a family blockholder on the board of directors. Theoretically, I find that by controlling the nominating process and rewards to independent insiders, the family can control the vote whether or not they have a voting majority on the board. Empirically, I find qualified support for the theoretical analysis. I find no empirical support for the assertion that family control detracts from firm value.

Essay 3 presents a novel exploration of the theoretical relationships between the media and the corporate board. The analysis in this essay shows how the threat of media exposure can affect the decision-making of a CEO considering diverting project resources for personal consumption, and that of the inside board members who must approve his proposed project implementation. The analysis reveals that the certainty of public exposure will discourage most CEOs from attempting diversion. For the CEO who is unfazed by the threat of public exposure, it is highly probable that he will be abandoned by formerly supportive corporate insiders' even if the private benefits of supporting the 'tainted' CEO are substantial.

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Essay 1

The Effect of an Independent Blockholder on the Board of Directors

Abstract

Recent papers have explored the direct impact of blockholders and boards on the managerial discretion of the CEO. This essay extends that line of research to examine the impact of blockholders on corporate boards. The problem driving the analysis is a CEO who plans to divert project resources for personal benefit. If successful, he will provide private benefits to insiders who support the diversion. Board insiders must decide whether or not to reveal this to outside board members and vote against the CEO's proposed project implementation. I find that, in the absence of a blockholder, the success of the diversion effort strictly depends on the size of the private benefit to insiders. By contrast, the presence of the blockholder can increase or decrease the willingness of insiders to vote against the CEO, to the point of precluding a rational CEO from even attempting diversion.

1.1 Introduction

Few theory papers on corporate governance have explored how the board of directors can enhance or limit managerial discretion of the CEO (Warther, 1998, Adams and Ferreira, 2007, Raheja, 2005). Most have investigated how the CEO's decision making is affected by the presence of a blockholder (Gopalan, 2006, Edmans, 2009). One of these papers, Admati and Pfleiderer (2009a), shows how an independent blockholder, simply acting in his own best interest, can directly affect the ability of the CEO to extract corporate resources for personal benefit.

In this essay, I extend the work of Admati and Pfleiderer by interacting one of their blockholder models with the corporate board model of Raheja (2005). The contribution of the present essay is an analysis of how the presence of the blockholder can directly affect the decision making of the board of directors. I do this in the context of an agency problem - a CEO who proposes a scaled-down implementation of a proposed revenue generating project rather than a full-scale implementation, using the money saved to provide private benefits to himself and to inside board members that support him. These private benefits come at a cost, however. The scaled-down project will produce less revenue than the full-scale implementation. Each insider must decide whether or not to reveal the projected loss under the CEO's proposed implementation to the outside board members. On the one hand, insiders earn a private benefit by remaining silent if the CEO proposes an implementation based on diversion of project resources and it is approved. On the other hand, payoffs to insiders depend on the private benefits from remaining silent *and* the utility of becoming CEO, and it is the outsiders who vote on the CEO's successor.

The analysis produces two key results: (1) When no blockholder is present, whether or not the board approves the CEO's proposed implementation depends on the size of the private benefit to insiders (Corollary 1.1); (2) The presence of the blockholder can aggravate or alleviate the agency problem embodied in the actions of the CEO (Proposition 1.7 and Corollary 1.2).

This essay brings together the board and blockholder strands of the corporate governance literature. In a comprehensive survey of the board literature provided by Adams, Hermalin, and Weisbach (2008), the emphasis is on research done subsequent to the Hermalin and Weisbach (2003) survey. Among the research reviewed by Adams et al. (2008) is the hiring, firing and assessmant of management, how boards are structured, how boards do their work and what motivates directors among other topics. Yet none of the papers cited in the review examine the interaction of the corporate board and blockholders. The strand of the literature that has the most in common with this paper is that reviewed by Adams et al. (2008) under the topic of the board's role in the setting of strategy and in particular, the modeling approach that investigates the choice of strategy as a game of information transmission when the preferences of the CEO and the board concerning projects (strategies) differ. An early study on the topic by Warther (1998), focuses on how the ability of management to select and eject board members affects the board's behavior. The study concentrates on two important dimensions of board behavior - the frequency of open dissent in the boardroom and the board's effectiveness in disciplining management. Specifically, it explores how board compensation, composition, and information about managerial ability are related to board effectiveness and firm profitability. A more recent study by Raheja (2005) models the interaction between insiders and outsiders on a corporate board and addresses the question of the ideal size and composition of the board. The Raheja (2005) model is used extensively in this paper and so will be described in greater detail later on. In an interesting application of the "cheap-talk" model of Crawford and Sobel (1982), Harris and Raviv (2008) present a theory of the size and control of corporate boards of directors. Their study determines when one would expect inside versus outside directors to control the board, when the controlling party will delegate decision-making to the other party, the extent of communication between the parties, and the optimal number of outside directors. Contrary to the extant empirical work in this area, Harris and Raviv show that theoretically, shareholders can sometimes be better off with an insider-controlled board. Adams and Ferreira (2007), in a different application of "cheap-talk", analyze the consequences of the board's dual role as advisor *and* monitor of management. Given this dual role, the CEO faces a trade-off in disclosing information to the board. On the one hand, the more information the CEO reveals, the better advice he receives from the board. On the other hand, the more information he reveals, the more closely the board can monitor him. Since an independent board is supposedly a tougher monitor, the CEO may be reluctant to share information with it. Thus, the authors demonstrate that, contrary to the widespread belief that monitoring management in the interests of shareholders is the primary function of boards, management-friendly boards may in fact be better at protecting shareholders' interests.

None of the aforementioned papers discuss how the board may be impacted by a blockholder. A comprehensive survey of the blockholder literature is provided by Holderness (2003) with particular emphasis on empirical investigations. He notes that in the years following Jensen and Meckling (1976), the agency perspective was almost always applied in the context of diffuse owners and professional managers. However, once it was observed that concentrated stock ownership was more prevalent than at first believed, the academy began to direct greater attention to the impact of large-block shareholders.[1] In a seminal paper on blockholders, Shleifer and Vishny (1986) posit a model in which external blockholders are constantly monitoring management. They focus on the ways in which large shareholders bring about value-increasing changes in corporate policy, often by employing cash tender offers to replace inefficient management. In a related paper Maug (1998) examines the incentives of large shareholders to monitor public corporations. In a theoretical model, he investigates the hypothesis that a liquid stock market reduces large shareholders' incentives to monitor because it allows them to sell their stocks more easily. Notwithstanding that liquid markets do facilitate stock sales, Maug finds a liquid market also makes it less costly to hold larger stakes and easier to purchase additional shares. He concludes that liquid stock markets are beneficial because they make

[1] Many researchers classify a blockholder as any individual or entity owning at least 5% of the firm's shares outstanding. In the U.S. 5% triggers a mandatory SEC filing for all shareholders.

corporate governance more effective. Kahn and Winton (1998) study the relationship between institutional equity ownership and direct firm intervention by the institution in seeking corporate performance improvement. The study reports that institutional equity owners are at an information advantage and can use this position for trading and direct intervention when firm performance deteriorates. Further, they report that intervention increases the value of the institution's existing shareholdings, but intervention only increases the institution's trading profits if it enhances the precision of the institution's information relative to that of uninformed traders. More recently, Admati and Pfleiderer (2009a) examine whether a large shareholder can alleviate the conflict of interest between shareholders and managers through his ability to sell his shares on the basis of private information. They show that the sale of his entire block by a large shareholder often has a disciplinary impact, but that (i) the effectiveness of this mechanism can be quite different depending on whether the agency problem involves a desirable or an undesirable action from shareholders' perspective; (ii) additional private information may increase or decrease the large shareholder's effectiveness; and (iii) in some cases the presence of the large shareholder may exacerbate the agency problem. (One of the information structures introduced in Admati and Pfleiderer (2009a) is a centerpiece of this paper and described more fully in Section 2.) Extending this line of reasoning, Edmans (2009) shows that blockholders can add value even if they cannot intervene in a firm's operations. In the Edmans model, blockholders have strong incentives to monitor the firm's fundamental value, since they can sell their stakes upon the discovery of negative information. By trading on private information (following the "Wall Street Rule"), they cause stock prices to reflect fundamental value rather than current earnings. This in turn encourages managers to invest for long-run growth rather than short-term profits.

As with the board literature, none of the papers cited above explicitly assesses the impact of the blockholders on the corporate board of directors. That is the goal of the research reported here. The essay is organized as follows. Section 1.2 discusses the blockholder model based on Admati and Pfleiderer (2009a), and analyzes CEO diversion with and without a blockholder present. Section 1.3 introduces the board model based on Raheja (2005). The rules governing the behavior of the CEO and the inside and outside board members, as well as the rules governing CEO succession are then discussed. Section 1.4 analyzes board dynamics assuming the absence of a blockholder. Section 1.5 re-analyzes the dynamics in the presence of a blockholder. Section 1.6 analyzes the impact of the blockholder on inside board members. Section 1.7 summarizes the findings and concludes. All proofs are in Appendix A unless otherwise stated.

1.2 The Blockholder Model

The blockholder model is adapted, with slightly different notation, from Model B^a, created and more fully described in Admati and Pfleiderer (2009a).

1.2.1 CEO Diversion With No Blockholder

The model assumes that the world is risk-neutral with no discounting. There are three times $t = 0, 1, 2$ and two periods. At $t = 0$ a firm has access to a project that will produce cash flows of X with probability 1. The CEO - M - is considering diverting a portion of the resources allocated for project implementation for personal consumption. That is, at $t = 0$, M decides whether or not to divert project resources, an action that will reduce the cash flows available for investment and result in lower firm value but produce a stream of private benefits. If M does decide to divert corporate resources for personal consumption, firm value decreases by uX where the measure of loss resulting from the diversion, u, is a random variable, and M receives the private benefit $B > 0$ where $B = \beta X$. I assume that β and X are fixed and common knowledge. At $t = 0$ investors assess that $u \sim F$ with support on (0,1].

M's strategy is described by the random variable a:

$$a \equiv a(u) = \begin{cases} 1 & M \text{ diverts} \\ 0 & \text{Otherwise} \end{cases}$$

At $t = 2$ investors observe the realization of both a and u. The value of the firm at $t = 2$ is then $(1 - au)\,X$.

The firm is owned by many small, atomistic investors and one large blockholder, L, who is unaffiliated with management. L, while monitoring management, observes some private information regarding a in Period 1 and may be in a position to sell shares at $t = 1$ based on this information. L's trading decision will impact stock price and so has the potential to impact M's decision since M's compensation is affected by the market price at $t = 1$.

M's compensation is linear in the realized market price P_k, $k = 1, 2$. Specifically, M's compensation is

$$\alpha P_1 + \omega P_2 \tag{1.1}$$

α and ω are positive coefficients representing the dependence of compensation on short-term and long-term price performance. The impact of L on M comes about through the impact of trading decisions on P_1. I assume P_1 and P_2 are set by risk-neutral, competitive market-makers and so reflect all publicly available information. Thus

$$P_2 = (1 - au)\, X \tag{1.2}$$

If M decides against diversion, then his utility is just his compensation. If he decides to divert, then utility is compensation plus private benefit.

I assume L may be subject to a liquidity shock in Period 1 and that with probability $\theta \in (0,1)$, L will need to sell his entire stake at $t = 1$. While θ is common knowledge, only L knows his true motives for trading. If L does not receive an external shock, then he sells if the expected value of the firm given L's private information is less than X, where the expected value incorporates the information communicated by the sale.

I assume two "tie-breaking" rules: (1) if M is indifferent between diverting and not diverting, he diverts and (2) if L is indifferent between selling and not selling, he sells. These ensure no ambiguity in the actions of M and L.

Given a particular realization of u, M must decide whether or not to divert. In the benchmark case in which L is not present and a is not observed by investors until $t = 2$, M will divert project resources if and only if

$$\beta X + \alpha X + \omega\,(1 - u)\, X \geq \alpha X + \omega X$$

or

$$u \leq \frac{\beta}{\omega} = u_0 \tag{1.3}$$

I assume $\beta X < \omega X$. This assumption rules out extreme cases where the agency problem is so severe that L cannot have an impact, as for example, the trivial case where the CEO first buys the company and then loots it.

1.2.2 CEO Diversion With A Blockholder

Suppose that, during Period 1, L, while monitoring management, discovers privately whether or not M has decided to divert resources for personal consumption, i.e. the realization of a. However, L does not observe the realization of u until $t = 2$. Nevertheless, since diversion reduces the value of the firm, in every equilibrium L sells. Let

$$E_S = E\left[au|S\right], \; S \equiv \text{Sale} \tag{1.4}$$

$$E_{\bar{S}} = E\left[au|\bar{S}\right], \; \bar{S} \equiv \text{No Sale} \tag{1.5}$$

E_S is the expected measure of loss given a sale by L at $t = 1$. $E_{\overline{S}}$ is the expected measure of loss given that L does not sell at $t = 1$. Since L must either sell or not sell, the price of the firm at $t = 1$ can take two possible values. Note that when $\theta > 0$, L might be forced to sell for liquidity reasons. Thus when investors observe a sale, they are uncertain whether L has suffered a liquidity shock or M has diverted corporate resources.

If M decides to divert for a particular u, $P_2 = (1-u)X$. Since L exits with probability 1 when M decides to divert, $P_1 = (1 - E[au|S])X$. Thus M 's expected utility if he decides to divert is

$$\beta X + \alpha(1 - E_S)X + \omega(1-u)X \tag{1.6}$$

If M decides not to divert, $P_2 = X$ and

$$P_1 = \theta(1 - E_S)X + (1-\theta)(1 - E_{\bar{S}})X \tag{1.7}$$

Thus M 's expected utility if he decides not to divert is

$$\alpha\left[\theta(1 - E_S) + (1-\theta)(1 - E_{\bar{S}})\right]X + \omega X \tag{1.8}$$

Comparing (1.6) and (1.8), M will divert project resources in the presence of the blockholder if and only if

$$\beta + \alpha(1 - E_S) + \omega(1-u) \geq \alpha\left[\theta(1 - E_S) + (1-\theta)(1 - E_{\bar{S}})\right] + \omega$$

$$\beta - \omega u \geq \alpha(1-\theta)\left[-(1 - E_S) + (1 - E_{\bar{S}})\right]$$

$$\beta - \alpha(1-\theta)(E_S - E_{\bar{S}}) - \omega u \geq 0 \tag{1.9}$$

Consider the second term in (1.9). Note that the difference between M's Period 1 stock compensation if he decides against diversion versus if he decides to divert is

$$\alpha\left[\theta(1 - E_S) + (1-\theta)(1 - E_{\bar{S}})\right]X - \alpha(1 - E_S)X = \alpha(1-\theta)(E_S - E_{\bar{S}})$$

Thus, this term is a measure of the loss in compensation M suffers by L driving down the stock price.

From (1.9), an equilibrium will be characterized by a cutoff u_M such that M decides to divert if and only if $u \leq u_M$. Given such a strategy and since L sells if M decides to take the action or a liquidity shock occurs,

$$E_S(x) = \frac{P\left(u \leq x\right) E\left[u|u \leq x\right]}{\theta + (1-\theta) P\left(u \leq x\right)} \tag{1.10}$$

and

$$E_{\bar{S}}(x) = 0 \tag{1.11}$$

(See the proofs of Eqs.(1.10) and (1.11) in Appendix C). Since M must be indifferent at the equilibrium cutoff $u = u_M$, u_M must satisfy

$$\beta - \alpha\left(1-\theta\right) E_S\left(u_M\right) - \omega u_M = 0 \tag{1.12}$$

The following lemma states three results that will be needed later.

Lemma 1.1. *1.11.1If u_0, u_M, and $E_S(x)$ are as described in Eqs.(1.3), (1.12) and (1.10) respectively, then*

(a)

$$u_M < u_0 \tag{1.13}$$

(b)

$$E_S(x) < x \tag{1.14}$$

(c)

$$\frac{dE_S(x)}{dx} > 0 \tag{1.15}$$

Lemma 1.1(a) says that the maximum loss the CEO is willing to sustain is less when the blockholder is present than when he is not present. Lemma 1.1(b) says that the expected measure of loss caused by the sale of L's holdings is less than the measure of loss the CEO is willing to sustain. Lemma 1.1(c) says that the expected measure of loss caused by L's sale of his holdings increases as the CEO's maximum acceptable loss increases.

In the next section, I present an overview of the board model I propose to connect with the blockholder model presented above.

1.3 The Board Model

The model of board structure is, with modest behavioral adjustment to accomodate the presence of the blockholder and a slight difference in notation, the model created and described in Raheja (2005).

The firm's management comprises the CEO and several managers to implement the project, and a board of directors to monitor the action of the insiders and to select the CEO's successor. At $t = 0$ the CEO and corporate insiders observe u and based on the CEO's preference, the CEO decides whether or not to divert project resources as described above. At $t = 1$, the inside and outside directors as a board, formally vote on the CEO's proposed implementation and at $t = 2$ cash flows are realized and the board chooses the CEO's successor.

The private benefits from diversion are non-contractible and non-verifiable. They are in addition to compensation from cash flows and are only available to insiders. The market value of the firm reflects only project cash flows. CEO compensation is described by (1.1), which I rewrite here for convenience.

$$\alpha P_1 + \omega P_2$$

1.3.1 The Corporate Board

There are three types of board members - the CEO, firm managers comprising the inside directors, and outside directors. All members are aware that the CEO may divert project resources. All board decisions are based on a simple majority vote.

Consider an extensive form game in which the board decides whether to approve the implementation proposed by the CEO. In the first stage outsiders solicit the proposed project's measure of loss, u, from insiders and each insider decides whether or not to reveal the value of u to them. In the second stage, outsiders decide as a group whether to investigate the CEO's proposed implementation or approve it without investigation.

1.3.1.1 CEO

I assume the CEO suffers no adverse financial consequences if he is caught diverting project resources. This rather unrealistic assumption allows me to avoid having the CEO act strategically and to isolate the impact of the blockholder on the divert or no-divert decision. To provide a narrative, suppose that the CEO is near the end of his tenure and the firm prefers to let the CEO go quietly and avoid the decline in stock price that such news might precipitate.

1.3.1.2 Outsiders

The board must include at least one outside director. Outsiders do not know the measure of loss associated with the CEO's proposed implementation unless they conduct an investigation. All outsiders are identical and their perceived fitness to serve on other boards is based on the performance of the firm on whose board they currently serve. The expected benefit to outsiders of preventing the diversion of corporate resources is measured as

$$E\left[\text{reputation benefit}\right] = \mu\left(1-u\right)X \tag{1.16}$$

where μ is the sensitivity of the outsider's payoff to firm value. The benefit occurs at $t = 2$.

If outsiders vote against the CEO's proposed implementation, they must produce evidence to justify their vote. Outsiders will vote for the CEO's implementation if they investigate and find that the CEO has not diverted project resources or if they choose not to investigate. Investigation is costly, consisting of $\Psi = \psi X$, a cost based purely on project scale plus a coordination and communication cost of $C = cX$ per outsider.

$$\begin{aligned} \text{Investigation Cost} &= \Psi + C\,m = \psi X + cXm \\ &= \left(\psi + c\,m\right)X \end{aligned} \tag{1.17}$$

where m is the number of outsiders on the board.

An investigation will be undertaken if the potential loss, as revealed by at least one insider, is at least as great as the cost of an investigation and enough insiders reveal to form a voting majority. If there is diversion and the outsiders investigate, the diversion will be verified with probability 1.

1.3.1.3 Insiders

There are n identical insiders on the board, excluding the CEO. Each insider has the same ex ante probability of succeeding the CEO. If an insider reveals the measure of loss to the outside directors, he votes against the CEO's proposed project implementation. Remaining silent is equivalent to telling the outside directors that the CEO has implemented the project without diversion. Each insider decides whether to reveal or remain silent.

The incentives of insiders are distorted. Each insider can earn a private benefit $B_n = \beta_n X$ by remaining silent if the CEO proposes an implementation based on diversion of project resources and it is approved. Insiders who choose to reveal forfeit any such private benefit. I assume that

$$n\,B_n < B \Rightarrow n\beta_n < \beta < \omega \tag{1.18}$$

Eq.(1.18) says that the total value of the private benefits the CEO provides to the insiders must be less then the the value of the benefit the CEO receives himself from diversion.

1.3.2 Succession Voting Rules

Outsiders vote for an insider to succeed the current CEO unless otherwise indicated. Insiders do not vote on succession. Based on the voting rules, all outsiders vote for the same insider. If there is only one outsider, then the outsider's vote prevails over the CEO's vote. Let

$\mathcal{R} \equiv$ set of insiders who reveal the value of u, the measure of loss and/or vote with the outsiders

$\overline{\mathcal{R}} \equiv$ set of insiders who remain silent and/or vote with the CEO

The membership of both sets is common knowledge.

In the case where outsiders do not investigate, or investigate and find no evidence of diversion, they vote for the CEO's choice. The CEO will randomly select a successor from $\overline{\mathcal{R}}$, so that each insider who remains silent has a $1/|\overline{\mathcal{R}}|$ chance of being chosen by the CEO. ($|\mathcal{A}| \equiv$cardinality of the set $\mathcal{A}$.)

In the case where outsiders investigate and verify diversion by the CEO, they randomly select a member of $\mathcal{R}$ to receive all of their votes, so that each insider who reveals has a $1/|\mathcal{R}|$ chance of becoming the CEO's successor.

1.4 Analysis of the Board Absent A Blockholder

In order to examine the impact of the blockholder on the board, I begin with an exploration of board dynamics in the benchmark case of no blockholder.

In the board model with no blockholder present, an equilibrium consists of (i) a decision of the CEO to divert project resources, (ii) the decision of insiders to reveal the measure of loss to the board and (iii) the decision of outsiders to investigate the proposed implementation. The CEO maximizes his expected payoff based on the measure of loss. Individual insiders maximize their expected payoffs based on the decision of the CEO, the measure of loss and the expected response of outsiders. Outsiders maximize their expected payoffs based on the decision of insiders.

1.4.1 Outsiders' Decision to Investigate

Once outsiders verify that the proposed implementation is dishonest, they must be able to reject it. Let

$\tau \equiv$ minimum number of insiders who must reveal for outsiders to win a board vote

Since the CEO votes in favor of the proposed implementation, in order to defeat it on a board vote, the number of combined outsiders and insiders who vote against it must be greater than the votes of the CEO and his supporters. That is, the "no" vote must satisfy $\tau + m \geq (1 + n - \tau) + 1 = 2 + n - \tau$ or

$$\tau(n, m) = 1 + \left(\left\lceil \frac{n - m}{2} \right) ^{+} \tag{1.19}$$

(The functions $\lceil$ and $(\cdot)^{+}$ are described in Appendix A.)

Outsiders also take into account the cost of investigation and the expected benefit from rejecting a dishonest implementation of the project.

$$E\left[\text{benefit of investigation}|u\right] = \mu X - \mu (1 - u) X = \mu u X \tag{1.20}$$

Proposition 1.1. *Outside board members investigate the proposed project implementation*

(a) if and only if at least τ insiders reveal the measure of loss u and

(b) if and only if the measure of loss, u, is at least as great as u_m where

$$u_m = \frac{1}{\mu} (\psi + c\, m) \tag{1.21}$$

ψ, c and m are defined in Eq.(1.17) and μ in Eq.(1.16).

If the potential loss is less than $u_m X$, outsiders will not investigate.

An equivalent proposition was proved in Raheja (2005).

1.4.2 Insiders' Incentive to Reveal the Measure of Loss Absent a Blockholder

Payoffs to insiders depend on the private benefits from remaining silent and the utility of becoming CEO[2]. The probability of becoming CEO depends on whether or not an insider reveals and how many other insiders reveal. Let

$W(k, u) \equiv$ the expected utility of an insider from revealing the measure of loss to the outsiders given that k other insiders have also revealed

[2]I ignore insiders' more general labor market considerations, such as mobility.

$S(k,u) \equiv$ the expected utility of an insider from remaining silent given that k other insiders have revealed the measure of loss to the outsiders

$W(k,u)$ consists entirely of the expected utility of being chosen by outsiders to replace the CEO whereas $S(k,u)$ consists of the private benefit from remaining silent plus the expected utility of being chosen by the CEO as his successor. That is,

$$S(k,u) = \hat{S}(k,u) + \beta_n X$$

where

$\hat{S}(k,u) \equiv$ the expected utility of an insider from being chosen by the CEO as his successor

Of course, only by remaining silent can an insider be considered by the CEO as a possible successor. Note that

$$\hat{S}(k,u) = S(k,u)\,|_{\beta_n=0}$$

That is, $\hat{S}(k,u)$ equals $S(k,u)$ evaluated at $\beta_n = 0$.

Let the utility of receiving no promotion be normalized to zero and the utility of becoming CEO be, from (1.1), ωX. If the CEO proposes an honest implementation of the project, there is nothing to reveal, so consider the case where the CEO plans to divert project resources. If the ith insider is the $(k+1)$st insider to reveal, he has a $1/(k+1)$ chance of becoming CEO if outsiders investigate the proposed implementation. He has no chance if outsiders don't investigate. If the ith insider remains silent, even after k other insiders have revealed, he has a $1/(n-k)$ chance of becoming CEO if outsiders don't investigate and no chance if they do.

Recall that in the absence of a blockholder, the CEO will only divert project resources if $u \leq u_0$ where u_0 is defined in (1.3). Let

$P(I\,|k, u \leq u_0) =$ probability that outsiders investigate given that k insiders reveal and the CEO is willing to accept a loss of at most $u_0 X$

If $u_m \geq u_0$, then the probability that outsiders will investigate is zero, so assume $u_m < u_0$. Now outsiders will investigate if $u \geq u_m$ and at least τ outsiders reveal. Thus

$$P(I\,|\,k,\, u \leq u_0) = \chi_{k\geq\tau} P(u \geq u_m|\, k,\, u \leq u_0) = \chi_{k\geq\tau}\left(1 - \frac{F(u_m)}{F(u_0)}\right) \tag{1.22}$$

where

$$\chi_{k\geq\tau}=\begin{cases}1 & k\geq\tau\\ \\ 0 & \text{otherwise}\end{cases} \tag{1.23}$$

(See proof of Eq.(1.22) in Appendix A.) I can use (1.22) to calculate the utilities from revealing and remaining silent, $W(k,u)$ and $S(k,u)$, respectively.

$$\begin{aligned} W(k,u) &= P(I\,|\,k+1,u\leq u_0)\,\frac{1}{k+1}\,\omega X \\ &= \chi_{k+1\geq\tau}P(u\geq u_m\,|\,k,u\leq u_0)\,\frac{1}{k+1}\,\omega X \\ &= \chi_{k+1\geq\tau}\left(1-\frac{F(u_m)}{F(u_0)}\right)\frac{1}{k+1}\,\omega X \end{aligned} \tag{1.24}$$

Similarly,

$$\begin{aligned} S(k,u) &= \left[1-\chi_{k\geq\tau}P(u\geq u_m\,|\,k,u\geq u_0)\right]\left[\frac{1}{n-k}\,\omega(1-u)X+\beta_nX\right] \\ &= \left[1-\chi_{k\geq\tau}\left(1-\frac{F(u_m)}{F(u_0)}\right)\right]\left[\frac{1}{n-k}\,\omega(1-u)+\beta_n\right]X \end{aligned} \tag{1.25}$$

When u is known,

$$u<u_m<u_0\Rightarrow\begin{cases}P(I\,|\,k,\;u\leq u_0)=0\\ \\ W(k,u\,|\,u<u_m)=0\\ \\ S(k,u\,|\,u<u_m)=\left[\frac{\omega(1-u)}{n-k}+\beta_n\right]X\end{cases} \tag{1.26}$$

$$u_m\leq u\leq u_0\Rightarrow\begin{cases}P(I\,|\,k,\;u\leq u_0)=\chi_{k\geq\tau}\\ \\ W(k,u\,|\,u\geq u_m)=\chi_{k+1\geq\tau}\frac{\omega X}{k+1}\\ \\ S(k,u\,|\,u\geq u_m)=\left[1-\chi_{k\geq\tau}\right]\left[\frac{\omega(1-u)}{n-k}+\beta_n\right]X\end{cases} \tag{1.27}$$

Since insiders work together, it is realistic to allow them to communicate to decide whether or not to reveal the measure of loss. In what follows, imagine that an insider's decisionmaking consists of two stages:

1. Announcement - the insider announces an intention to vote yes or no. The ensuing discussion among the insiders may cause the intention to change.

2. Commitment - the insider commits to voting yes or no. Commitment is binding and the insider will not change.

Eqs.(1.24) and (1.25) can be used to prove the following.

Lemma 1.2. *For a board with no blockholder and rules defined as in Section 1.3,*

(a) if at least τ insiders commit to reveal, then an uncommitted insider's best response is to also reveal, i.e.

$$k \geq \tau \Rightarrow W(k, u \mid u \geq u_m) > S(k, u \mid u \geq u_m)$$

(b) If no more than $\tau - 2$ insiders commit to reveal, then an uncommitted insider's best response is to remain silent, i.e.

$$k \leq \tau - 2 \Rightarrow W(k, u \mid u \geq u_m) < S(k, u \mid u \geq u_m)$$

(c) If $k = \tau - 1$ insiders commit to reveal, then

1. *if $W(n-1, u \mid u \geq u_m) > S(0, u \mid u \geq u_m)$, an uncommitted insider's best response is to reveal.*

2. *if $W(n-1, u \mid u \geq u_m) \leq S(0, u \mid u \geq u_m)$, an uncommitted insider's best response is to remain silent.*

But any agreement among insiders must be credible since insiders are free to deviate from the group agreement. The refinement of the Nash Equilibrium concept that allows players to decide individually as well as in credible coalitions, is the Coalition-Proof Nash Equilibrium (CPNE). Credibility requires that no subset of insiders within the group benefits from deviating. In this regard, I prove Proposition 1.2, also proved in Raheja (2005).

Proposition 1.2. (Coalition-Proof Nash Equilibria)

(a) "All insiders reveal" is the only coalition-proof Nash equilibrium if and only if $W(n-1, u \mid u \geq u_m) > S(0, u \mid u \geq u_m)$.

(b) "No insiders reveal" is the only coalition-proof Nash equilibrium if and only if $W(n-1, u \mid u \geq u_m) \leq S(0, u \mid u \geq u_m)$.

(See the proof of Proposition 1.2 in Appendix A.2.)

From (1.27),

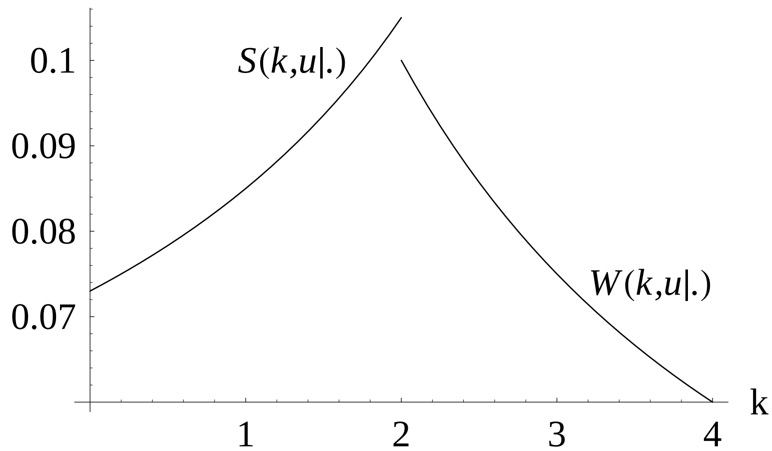

Figure 1.1: $\beta_n = .025 > \frac{\omega u}{n} = .012$

$$\begin{aligned} S(0, u \mid u \geq u_m) &\geq W(n-1, u \mid u \geq u_m) \\ \left[\frac{\omega(1-u)}{n} + \beta_n\right] X &\geq \frac{\omega X}{n} \\ \beta_n &\geq \frac{\omega u}{n} \end{aligned}$$

Thus an easy corollary to Proposition 1.2 is

Corollary 1.1.

(a) "All insiders reveal" is the only coalition-proof Nash equilibrium if and only if $\beta_n < \frac{\omega u}{n}$.

(b) "No insiders reveal" is the only coalition-proof Nash equilibrium if and only if $\beta_n \geq \frac{\omega u}{n}$.

Intuitively, Corollary 1.1 says that the CEO controls the outcome of the vote by how much of the private benefit he is able or willing to share with the insiders. Unless the insiders' private benefit is sufficient to compensate for the expected loss in revenue due to the diversion should an insider succeed the CEO, the insiders will reveal the measure of loss u to the outside board members. Notice that the greater the diversion, u, the greater the compensation required.

Example 1.1. (The functions shown in Fig. 1.1 are drawn as continuous curves for ease of visualization.) For this example $X = 1$, $\omega = .3$, $u = .2$, $n = 5$, and $\tau = 3$ so that

$$S(k, u \mid u \geq u_m) = \frac{.24}{5-k} + \beta_n \quad k = 0, 1, 2$$

$$W(k, u \mid u \geq u_m) = \frac{.3}{k+1} \quad k = 2, 3, 4$$

$\beta_n = .025$ for the plot shown. Since $\beta_n > \frac{\omega u}{n} = .012$, by Corollary 1.1(b), no insiders will reveal. This is confirmed by $.073 = S\left(0, .2 \,|\, .2 \geq u_m\right) > W\left(4, .2 \,|\, .2 \geq u_m\right) = .06$ in accord with Proposition 1.2(b). ■

1.4.3 The Relative Placement of the Insiders' Utility Functions

Observe that in Fig.1, $S\left(\tau - 1, u \,|\, u \geq u_m\right) > W\left(\tau - 1, u \,|\, u \geq u_m\right)$, i.e. the maximum value of S is greater than the maximum value of W. The general condition for this is

$$\left[\frac{\omega\left(1-u\right)}{n-\tau+1} + \beta_n\right] X \quad \geq \quad \frac{\omega X}{\tau}$$

or

$$\beta_n \geq \omega\left[\frac{1}{\tau} - \frac{1-u}{n-\tau+1}\right] \tag{1.28}$$

Note that the minimum value of the right-hand side of (1.28) will occur at the maximum value of τ. From Eq.(1.19), the maximum value of τ occurs at $m = 1$. For n odd,

$$\tau_{max} = \frac{n+1}{2} \Rightarrow n - \tau_{max} + 1 = \frac{n+1}{2}$$

For n odd and $\tau = \tau_{max}$, (1.28) becomes

$$\beta_n \geq \frac{2\omega u}{n+1} \tag{1.29}$$

Notice that $\beta_n \geq \frac{2\omega u}{n+1} \geq \frac{\omega u}{n}$ for $n \geq 1$. Using this relation leads to the following lemma.

Lemma 1.3. *For n odd,*

(a) If $\beta_n \geq \frac{2\omega u}{n+1}$,

1. $S\left(\tau - 1, u \,|\, u \geq u_m\right) \geq W\left(\tau - 1, u \,|\, u \geq u_m\right)$,
2. $S\left(0, u \,|\, u \geq u_m\right) \geq W\left(n - 1, u \,|\, u \geq u_m\right)$ *and*
3. *no insiders reveal.*

(b) If $\frac{\omega u}{n} \leq \beta_n < \frac{2\omega u}{n+1}$,

1. $S\left(\tau - 1, u \,|\, u \geq u_m\right) < W\left(\tau - 1, u \,|\, u \geq u_m\right)$,
2. $S\left(0, u \,|\, u \geq u_m\right) \geq W\left(n - 1, u \,|\, u \geq u_m\right)$ *and*

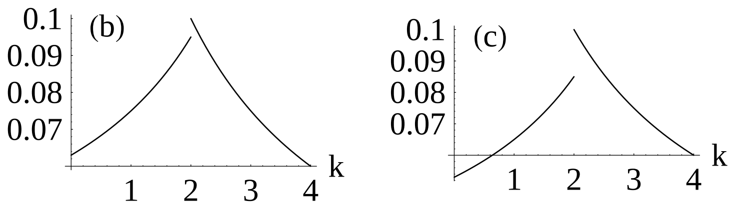

Figure 1.2: Lemma 1.3(b) $\beta_n = .015$ and 1.3(c) $\beta_n = .005$

3. no insiders reveal.

(c) If $\beta_n < \frac{\omega u}{n}$,

1. $S(\tau - 1, u \,|\, u \geq u_m) < W(\tau - 1, u \,|\, u \geq u_m)$,

2. $S(0, u \,|\, u \geq u_m) < W(n - 1, u \,|\, u \geq u_m)$ *and*

3. all insiders reveal.

Example 1.1 (cont'd)**.** $X = 1$, $\omega = .3$, $u = .2$, $n = 5$, and $\tau = 3$. Thus, $\frac{\omega u}{n} = .012$. From Eq.(1.19), $\tau = \tau_{max} = 3$. (1.29) then becomes $\beta_n \geq \frac{2\omega u}{n+1} = .02$. In Fig. 1.1, $\beta_n = .025$ which satisfies $\beta_n \geq \frac{2\omega u}{n+1}$ and $\beta_n \geq \frac{\omega u}{n}$. Consequently, Fig. 1.1 is an illustration of Lemma 1.3(a). In Fig. 1.2(b), $\beta_n = .015$ so that $\frac{\omega u}{n} \leq \beta_n \leq \frac{2\omega u}{n+1}$ which illustrates Lemma 1.3(b). In Fig. 1.2(c), $\beta_n = .005$ and so $\beta_n < \frac{\omega u}{n}$ which lllustrates Lemma 1.3(c). ■

Returning to (1.28), for n even

$$\tau_{max} = \frac{n}{2} + 1 \Rightarrow n - \tau_{max} + 1 = \frac{n}{2}$$

For n even and $\tau = \tau_{max}$, (1.28) becomes

$$\beta_n \geq \frac{2\omega}{n} \left(u - \frac{2}{n+2} \right) \tag{1.30}$$

Using this relation leads to the following lemma for even values of n.

Lemma 1.4. *For n even,*

(a) If $\beta_n \geq \frac{\omega u}{n}$ *and* $\frac{4}{n+2} \leq u \leq \frac{2}{n+2} + \frac{n\beta_n}{2\omega}$,

1. $S(\tau - 1, u \,|\, u \geq u_m) \geq W(\tau - 1, u \,|\, u \geq u_m)$,

2. $S(0, u \,|\, u \geq u_m) \geq W(n - 1, u \,|\, u \geq u_m)$ *and*

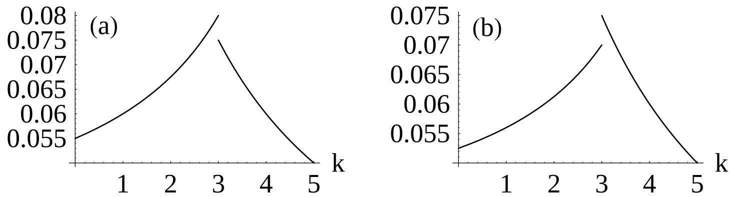

Figure 1.3: Lemma 1.4(a) $\beta_n = .03$, $u = .5$ and 1.4(b) $\beta_n = .035$, $u = .65$

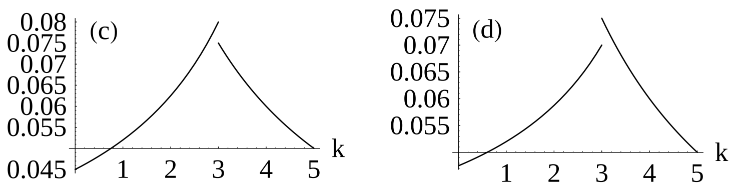

Figure 1.4: Lemma 1.4(c) $\beta_n = .01$, $u = .3$ and 1.4(d) $\beta_n = .025$, $u = .55$

3. *no insiders reveal.*

(b) If $\beta_n \geq \frac{\omega u}{n}$ *and* $u > \frac{2}{n+2} + \frac{n\beta_n}{2\omega}$,

1. $S\left(\tau - 1, u \,|\, u \geq u_m\right) < W\left(\tau - 1, u \,|\, u \geq u_m\right)$,

2. $S\left(0, u \,|\, u \geq u_m\right) \geq W\left(n - 1, u \,|\, u \geq u_m\right)$ *and*

3. *no insiders reveal.*

(c) If $\beta_n < \frac{\omega u}{n}$ *and* $u \leq \frac{2}{n+2} + \frac{n\beta_n}{2\omega}$,

1. $S\left(\tau - 1, u \,|\, u \geq u_m\right) \geq W\left(\tau - 1, u \,|\, u \geq u_m\right)$,

2. $S\left(0, u \,|\, u \geq u_m\right) < W\left(n - 1, u \,|\, u \geq u_m\right)$ *and*

3. *all insiders reveal.*

(d) If $\beta_n < \frac{\omega u}{n}$ *and* $u \geq \frac{4}{n+2}$,

1. $S\left(\tau - 1, u \,|\, u \geq u_m\right) < W\left(\tau - 1, u \,|\, u \geq u_m\right)$,

2. $S\left(0, u \,|\, u \geq u_m\right) < W\left(n - 1, u \,|\, u \geq u_m\right)$ *and*

3. *all insiders reveal.*

Example 1.2. $X = 1$, $\omega = .3$, $n = 6$, and $\tau = 4$ so that

$$S(k, u \,|\, u \geq u_m) = \frac{.3\,(1-u)}{6-k} + \beta_n \quad k = 0, 1, 2, 3$$
$$W(k, u \,|\, u \geq u_m) = \frac{.3}{k+1} \quad k = 3, 4, 5$$

Fig.1.3 illustrates Lemma 1.4(a) and 1.4(b). The conditions are

4(a) $\beta_n \geq \frac{\omega u}{n} = .025$ and $\frac{4}{n+2} \leq u \leq \frac{2}{n+2} + \frac{n\beta_n}{2\omega} \leftrightarrow .5 \leq u \leq .55$

4(b) $\beta_n \geq \frac{\omega u}{n} = .033$ and $u > \frac{2}{n+2} + \frac{n\beta_n}{2\omega} = .6$

Fig. 1.4 illustrates Lemma 1.4(c) and 1.4(d). The conditions are

4(c) $\beta_n < \frac{\omega u}{n} = .015$ and $u \leq \frac{2}{n+2} + \frac{n\beta_n}{2\omega} = .35$

4(d) $\beta_n < \frac{\omega u}{n} = .0275$ and $u \geq \frac{4}{n+2} = .5$ ■

Comparing Lemmas 1.3 and 1.4, it is interesting that for an odd number of insiders (n odd) the relative placement of the expected payoff functions requires a condition on the value of the insiders' private benefit (β_n), but for an even number of insiders (n even), requires a condition on the value of the private benefit *and* a separate condition on the amount the CEO has diverted (u).

1.4.4 Insiders' Willingness to Remain Silent

Up to this point I have described the conditions under which insiders would reveal the CEO's measure of loss, u, or remain silent. This analysis can be used to derive an index of insiders' *willingness* to reveal. Begin by recalling from Lemma 1.3(c)(i) that if $W(\tau-1, u \,|\, u \geq u_m) > S(\tau-1, u \,|\, u \geq u_m)$, insiders will reveal the measure of loss. I want to explore the strategic assessment of insiders and the CEO *before* the measure of loss u is known. Now, by risk-neutrality, insiders are willing to reveal the measure of loss if the expected utility for revealing is greater than the expected utility for remaining silent.

$$W(n-1, u) > S(0, u) = \hat{S}(0, u) + \beta_n X$$

Let

$$b(n, u) = \left(\frac{W(n-1, u) - \hat{S}(0, u)}{X} \right)^+$$

Then, from Eqs.(1.24) and (1.25), and recalling that $\hat{S}(k, u) = S(k, u)\,|_{\beta_n = 0}$,

$$b(n, u) = \frac{\omega}{n} \left(u - \frac{F(u_m)}{F(u_0)} \right)^+ \tag{1.31}$$

The right-hand side of (1.31) is the expected normalized cost of remaining silent, i.e. the difference between the expected utility of the CEO's job if insiders reveal and if they remain silent - $W(n-1,u) - \hat{S}(0,u)$ - normalized by X. Eq.(1.31) says that insiders are prospectively willing to reveal if the expected cost of remaining silent is greater than the expected reward for remaining silent. Thus $b(n,u)$ is the prospective normalized minimum expected payment necessary to induce insiders to remain silent.

What value of u will make a risk-neutral insider prospectively indifferent between revealing and remaining silent? Note that

$$\frac{F(u_m)}{F(u_0)} = P(u \leq u_m | \, u \leq u_0)$$

If τ insiders reveal, as u_m increases, the probability that u is less than or equal to u_m increases and the probability that an investigation takes place decreases, so the more willing insiders should be to remain silent. Similar reasoning shows that as u_0 increases, the willingness to remain silent should decrease. I define the willingness, w, of insiders to remain silent as

$$w(u_m, u_0) = \frac{F(u_m)}{F(u_0)} \tag{1.32}$$

Note that (1.31) says that the prospective normalized minimum expected payment necessary to induce insiders to remain silent is directly proportional to the difference between the proportion of resources diverted and the insider's willingness to remain silent. Proposition 1.3 formalizes this reasoning.

Proposition 1.3. *For a board with no blockholder and rules as defined in Section 3, and willingness to remain silent, w, defined by (1.32),*

(a) as the outsiders' cutoff u_m increases, w increases and

(b) as the CEO's cutoff u_0 increases, w decreases.

Proposition 1.3(a) says that the less willing are outsiders to investigate a proposed project implementation, the more willing are insiders to remain silent. Proposition 1.3(b) says that the more project resources the CEO is willing to divert, the less willing are insiders to remain silent. Proposition 1.4, below, enumerates the properties of $b(n,u)$.

Proposition 1.4. *Assume a board with no blockholder, rules defined as in Section 3, and a prospective normalized minimum expected private benefit required to induce insiders to remain silent - $b(n,u)$ - defined by (1.31). If the prospective measure of loss, u, satisfies $u \leq P(u \leq u_m | \, u \leq u_0)$, the prospective normalized minimum expected private benefit is zero. Otherwise, the prospective normalized minimum expected private benefit* *(a) decreases as the outsiders' cutoff u_m increases,*

(b) increases as the CEO's cutoff u_0 increases,

(c) increases as the CEO's measure of loss u increases,

(d) decreases as the willingness to remain silent, w, increases,

(e) increases with the number of insiders n, and

(f) decreases with the number of insiders τ required to initiate an investigation.

1.5 Analysis of the Board Including a Blockholder

In Section 1.4, I explored the board dynamics in the absence of a blockholder. In this section, I reexamine these dynamics in the presence of a blockholder. In addition to the decisions of the CEO, insiders and outsiders listed in Section 1.4, an equilibrium now includes the decision of the blockholder to sell based on the decision of the CEO.

1.5.1 Outsiders' Decision to Investigate

Recall (Section 1.2.1) that the blockholder L will sell his entire stake if the CEO M decides to divert project resources or if L suffers a liquidity shock. As shown in Section 1.2.2, a sale by L will cause a drop in price at $t = 1$[3]. Recall also that outsiders will investigate if a potential loss, as revealed by at least one insider, is at least $u_m X$. In the case of a blockholder, I make the following additional assumption:

Assumption 1 (Price Trigger)**.** *If the value lost resulting from a sale by L is greater than or equal to $u_m X$, outsiders will investigate whether or not an insider reveals.*

This means an investigation will be triggered if $E_S \geq u_m$ (E_S was defined in Section 1.2.2 as the expected measure of loss given a sale by L at $t = 1$ and an expression for its value given in (1.10)). From Lemma 1.1(b), let

$$E_S\left(u_I\right) = u_m \tag{1.33}$$

so that u_I is the value of u_M that will trigger an investigation (Recall that M decides to divert if and only if $u \leq u_M$). The outsiders' decision to investigate is now described by a modified version of Proposition 1.1.

[3]The effect of a block sale on price is empirically demonstrated by Kraus and Stoll (1972), Hasbrouck (1988, 1991), Holthausen et al. (1987, 1990), Chan and Lakonishok (1993) and Keim and Madhavan (1996) among others.

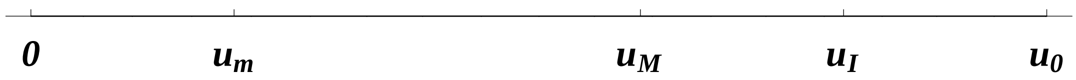

Figure 1.5: $u_I > u_M$

Proposition 1.5. *Outside board members investigate the proposed project implementation if the $t = 1$ price drop caused by the sale of L's holdings satisfies $E_S(u_M) \geq u_m$ with*

$$u_m \leq E\left[u \mid u \leq u_I\right] \tag{1.34}$$

where u_m is given by Eq.(1.21) and u_I is given by Eq.(1.33) or the conditions of Proposition 1.1 hold.

Nevertheless, in order to stop the proposed project implementation, outsiders must be joined in voting against it by enough insiders to form a majority. It is conceivable that, during the course of an investigation triggered by a price drop, outsiders could find evidence of CEO diversion, but not be able to stop the proposed implementation because they are joined by less than τ insiders. The proof of Proposition 1.6 below shows why that will not happen.

1.5.2 Insiders' Incentive to Reveal the Measure of Loss

Section 2.2 shows that with a blockholder present, the CEO will only consider diversion if $u \leq u_M$ and in Lemma 1.1(a) that $u_M < u_0$. From Section 5.1 $E_S(u_I) = u_m$ and by Lemma 1.1(b), $u_m < u_I$. These relations imply that if $u_m > u_M$, outsiders will never investigate, so I assume $u_m \leq u_M$. The next step is then to evaluate the insiders' incentive to reveal under two conditions - $u_I > u_M$ and $u_I \leq u_M$.

1.5.2.1 $u_I > u_M$

A moment's reflection will reveal that this case is very much like that of having no blockholder, which I analyzed in Section 1.4 (See Fig. 1.5). From Lemma 1.1(b) and 1.1(c), $u_I > u_M$ implies that $E_S(u_I) = u_m > E_S(u_M)$, i.e. L's sale of holdings will not enter into the strategic considerations of insiders because the price drop caused by such a sale will never be big enough to trigger an investigation by outsiders. Thus the analysis will be the same as in Section 1.4 with u_M replacing u_0. Nevertheless, the presence of the blockholder will be reflected in the value of the willingness measure w (See Section 1.6).

1.5.2.2 $u_I \leq u_M$

Again, from Lemma 1.1, $u_I \leq u_M$ implies that $E_S(u_I) = u_m \leq E_S(u_M)$. In words, the price drop caused by the sale of the blockholder's stake is greater than that required to trigger an investigation by the outsiders so that an investigation will be initiated. This means that if the CEO diverts project resources, the probability of an investigation is 1.

$$P(I \mid k, u \leq u_M) = 1 \quad \forall k \tag{1.35}$$

The reward for voting with the outsiders, $W(k, u \mid u \leq u_M)$ will be greater than zero if enough insiders vote with the outsiders to stop the proposed project implementation.

$$W(k, u \mid u \leq u_M) = \chi_{k+1 \geq \tau} \frac{\omega X}{k+1} \tag{1.36}$$

The reward for voting with the CEO - $S(k, u \mid u \leq u_M)$ - will be greater than zero if not enough insiders vote with the outsiders. In the latter circumstance, the outsiders would select a CEO from outside the firm to succeed the current CEO and the expected value to insiders of remaining silent would then be only the private benefit. Thus

$$S(k, u \mid u \leq u_M) = (1 - \chi_{k \geq \tau}) \beta_n X \tag{1.37}$$

Proposition 1.6. *If the $t = 1$ price drop caused by the sale of the blockholder L's holdings trigger an investigation by outside board members, all inside board members will vote with the outside board members against the CEO's proposal.*

As in Section 1.4.3, I again use the inequality $W(\tau - 1, u) > S(\tau - 1, u)$ to find a condition that characterizes the insiders' willingness to reveal. From Eqs.(1.36) and (1.37), the prospective normalized minimum expected payment necessary is

$$b(n, u) = \left(\frac{W(n-1, u) - \hat{S}(0, u)}{X} \right)^+ = \frac{\omega}{n} \tag{1.38}$$

since $\hat{S}(0, u) = 0$ in the presence of the blockholder.

The definition of w is modified to

$$w(u_m, u_M) = \begin{cases} \frac{F(u_m)}{F(u_M)} & \hat{S}(0, u) > 0 \\ 0 & \hat{S}(0, u) = 0 \end{cases} \tag{1.39}$$

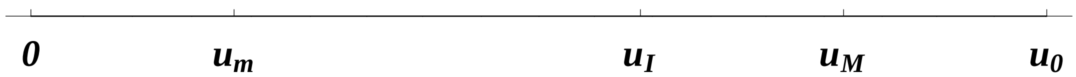

Figure 1.6: $u_I \leq u_M$

Based on Proposition 1.6, I interpret $w(u_m, u_M) = 0$ to mean that insiders are unwilling to remain silent.

1.6 The Impact of the Blockholder on Insiders

In agreement with Admati and Pfleiderer (2009a), the presence of the blockholder disciplines the CEO in the sense that the maximum amount the CEO is willing to divert decreases from u_0 to u_M. The blockholder affects outsiders in that a sale of the blockholder's assets can trigger an outsider investigation, regardless of insiders' revelation decisions. A logical extension would now be to assess how the presence of the blockholder impacts insiders. Specifically, I am keen to establish whether the presence of the blockholder makes insiders more or less willing to reveal the measure of loss u by examining the change in the willingness to remain silent, w. I repeat the results on w for easy reference.

No Blockholder

$$w(u_m, u_0) = \frac{F(u_m)}{F(u_0)} \tag{1.40}$$

Blockholder

$$w(u_m, u_M) = \begin{cases} \frac{F(u_m)}{F(u_M)} & u_I > u_M \\ 0 & u_I \leq u_M \end{cases} \tag{1.41}$$

1.6.1 Impact on Insiders

Proposition 1.7. *(a) If a blockholder is present and $u_I > u_M$, then the willingness w of the insiders on the board to remain silent is greater than it would be were the blockholder not present, i.e.*

$$w(u_m, u_M) > w(u_m, u_0)$$

(b) If a blockholder is present and $u_I \leq u_M$, then $w = 0$ and insiders on the board are unwilling to remain silent and will vote with the outside board members against the CEO's proposal.

In Proposition 1.7(a), since $u_I > u_M$, the sale of the blockholder L's holdings at $t = 1$ will not trigger an investigation. Because $u_M < u_0$ the probability of an investigation if at least τ insiders reveal has decreased. Therefore, insiders are more willing to remain silent. Proposition 1.7(b) restates Proposition 1.6 in terms of w, viz. since $u_I \leq u_M$, the $t = 1$ price drop caused by the sale of the blockholder L's holdings will trigger an investigation by outside board members, and so no insider will remain silent.

1.6.2 Impact on the CEO When $u_I \leq u_M$

Corollary 1.2. *If a blockholder is present and the price trigger u_I is no greater than the CEO's cutoff u_M, then a rational CEO will be deterred from diverting project resources for personal benefit.*

When $u_I \leq u_M$, the presence of the blockholder ends CEO diversion. The insiders are unwilling to remain silent and will vote against the CEO's proposal. The reason is that, if they vote with the CEO they have no chance of succeeding him. To understand the utility implications, recall that insiders would vote with the CEO if

$$S(0,u) \quad \geq \quad W(n-1,u) \Rightarrow \beta_n X \geq \frac{\omega X}{n} \Rightarrow \beta_n \geq \frac{\omega}{n}$$

But the last inequality contradicts (1.18), that $n\beta_n < \omega$. To retain their silence, the CEO would have to compensate insiders for the loss of the chance to succeed him and, as the contradiction shows, this would prove too costly.

1.7 Summary and Conclusion

This essay begins with the diversion of project resources by a duplicitous CEO, resulting in a loss known only to the CEO and the insiders on the corporate board. Using the board model in Raheja (2005) and one of the blockholder information structures in Admati and Pfleiderer (2009a), the essay goes on to explore the impact of a blockholder on the willingness of insiders to reveal to the outside board members the measure of loss associated with the CEO's diversion of project resources. I began by deriving certain board characteristics assuming no blockholder was present. Using the expected utility of becoming CEO by revealing and the expected utility by remaining silent, I defined a measure of insiders' willingness to remain silent.

The analysis is repeated assuming the presence of a blockholder. I added a new behavioral assumption, viz. that a "large" price drop caused by the sale of the blockholder's stake would trigger an investigation by the outside board members. I then conducted the analysis in the cases where the price drop was and was not large enough to trigger an investigation. In the case where the price drop would not trigger an investigation, the analysis was nearly identical to the case of no blockholder. For the case where an investigation would be triggered, I showed that insiders were unwilling to remain silent and that their unwillingness reflected the fact that by voting with the CEO, the probability of succeeding him goes to zero.

Last, I compared the results for the insiders' cutoff with and without a blockholder. When the price trigger is greater than the CEO's cutoff, the presence of the blockholder excerbates the agency problem. The willingness measure is greater with the blockholder, implying that the insiders are less willing to reveal the measure of loss to the outside board members. Intuitively, the maximum loss the CEO is willing to risk decreases in the presence of the blockholder (cf. Lemma 1.1(a)). The less the loss the CEO is willing to sustain, the less he devalues the job of CEO for insiders waiting to succeed him. The less the CEO devalues the job, the less the insiders have to lose by remaining silent.

When the price trigger is less than or equal to the CEO's cutoff, the presence of the blockholder alleviates the agency problem, actually preventing a rational CEO from diverting project resources (cf. Proposition 1.7). This is because the cost to the CEO of compensating the insiders for the loss of the chance to succeed him is simply too great, and so insiders will vote with the outsiders against him, should the CEO attempt to divert project resources.

A model is only a representation of reality. Drawing implications from the model for reality is fraught with drawbacks and caveats. Nevertheless, a feature of the analysis raises questions that might be amenable to empirical verification. In the model, the diversion of project resources for personal benefit by the CEO causes the blockholder to sell his entire stake in the firm. If the drop in stock price caused by the blockholder's sale is not large enough, the CEO's diversion of project resources will go undetected. This raises the question, "Does stock price volatility hide management misfeasance?" In the microstructure literature, informed traders hide their activities in the noise of uninformed trades[4]. Might management similarly use market noise to mask misfeasance?

Finally, the analysis in this essay shows that the presence of a blockholder can ameliorate or exacerbate the agency problem associated with board insiders. To stop there, however, is to miss the forest for the trees. The analysis also shows that whether the effect of the blockholder is to improve or worsen the insider agency problem depends on how closely the board monitors. Within the context of the model, how closely the board monitors depends on the values the firm chooses for its monitoring parameters - the cost of an

[4] See the seminal Kyle (1985) and the many studies of the information content of trades that followed.

investigation and the sensitivity of the outsiders' payoff to firm value. The lesson is that the effect of the blockholder on the firm is principally under the control of the firm itself. By the internal governance choices it makes, a firm, by recognizing the blockholder as part of an extended governance structure, can use the presence of an independent blockholder to enhance its corporate board decision making and enhance the quality of corporate governance. Or not.

Essay 2

Family Blockholders and Control of the Board of Directors

Abstract

It is well-known that among family firms, some families are active in their participation in board management, having a family member serving as either CEO or chairman of the corporate board, or both. In other family firms, members of the family occupy neither of these roles, though maintaining family representation on the corporate board. Among families involved in board management, and particularly so for firms with a founder-CEO, through a combination of family, affiliated and employee directors, the family may control the votes of the board. I derive a theoretical model of family control (a modest extension of Essay 1) and then use the model to empirically assess the impact of active family managment and control of board votes on family firm value. Theoretically, I find that by controlling the nominating process and rewards to independent insiders, the family can control the vote whether or not they have a voting majority on the board. I find qualified empirical support for the theoretical analysis. I find no empirical support for the assertion that family control detracts from firm value.

2.1 Introduction

In their study of mechanisms used to separate cash flow rights from control rights Bebchuk, Kraakman, and triantis (2000) discussed dual-class share structures, stock pyramids and cross-ownership ties. Villalonga and Amit (2009), in their examination of how such separation is achieved in U.S. family firms, added two additional mechanisms - voting agreements and disproportionate board representation. They define disproportionate board representation as "control of the board of directors in excess of voting control." This essay explores the issue of disproportionate board representation theoretically. Using the model of Essay 1 applied to a family blockholder, I show how a founding family can use the board to exert control over firm decisionmaking whether or not the family is the majority shareholder of firm equity. For instance, Anderson and Reeb (2003), in their study of family firms on the S&P 500, note that the Ablon family is viewed as controlling the Ogden Corporation as if they were the majority owners but they hold roughly two percent of the outstanding shares, while at Nordstrom's, the family has retained 24 percent of the shares to maintain control. Anderson and Reeb also find that though on average, families represented on the S&P 500 own less than 18 percent of their firms' outstanding equity, even where the family does not have outright majority ownership, their control of board seats is 2.75 times greater than their equity stake would indicate. Since family ownership is dominant among publicly traded firms across the world (Faccio and Lang, 2002, La Porta, Lopez-de Silanes, and Shleifer, 1999, Claessens, Djankov, Fan, and Lang, 2002), understanding the mechanisms by which families achieve and maintain control of the firm is an important issue for modern corporate governance (Villalonga and Amit, 2009).

The issue of control is examined employing a theoretical framework on family blockholders, corporate boards and CEO resource diversion. An insight that emerges from the analysis is that control has little to do with whether or not the family has a voting majority on the board. The facet of the family's influence that proves critical is control of the nominating process and of rewards to inside directors. I show that, through its control of the rewards to insiders, the family can secure the votes of even nonfamily inside directors.

I then formulate three hypotheses suggested by the theoretical analysis and test them empirically. I find that families not actively involved in firm management are more likely than actively involved families to exercise control of the votes of the board of directors. Further, among such actively involved families, the number of affiliated directors on the nominating committee plays a significant role in the maintenance of control of board votes. Finally, I find no empirical evidence that family control of the votes of the board of directors detracts from family firm value.

The rest of the essay is organized as follows. Section 2.2 offers a model of board and family blockholder dynamics. The data used to investigate the implications of the model are described in Section 2.3. Section 2.4 describes the empirical results and Section 2.5 concludes.

2.2 A Model of Board and Family Blockholder Dynamics

Prior research on family firms has largely focused on: family succession (Almeida and Wolfenzon, 2006;Bhattacharya and Ravikumar, 2001; and Burkart, Panunzi, and Schleifer, 2003); expropriation, diversion and corruption in family firms (Bertrand, Mehta, and Mullainathan, 2002; Bennedsen and Wolfenzon, 2000; and Khanna and Palepu, 2000, among others); and the impact of founders and/or family ownership on corporate performance (Anderson and Reeb, 2003, Anderson, Mansi, and Reeb, 2003 and Villalonga and Amit, 2006). These studies only pay lip service to the dynamics of the corporate board in family firms. A different strand of the research literature on family firms is represented by Bebchuk, Kraakman, and triantis (2000) and Villalonga and Amit (2009). Bebchuk et al. examine an ownership structure in which a shareholder exercises control while retaining only a small fraction of the equity claims on a company's cash flows. In their analysis, the separation of control and cash-flow rights is accomplished through the use of dual-class share structures, stock pyramids, and cross-ownership ties. Villalonga and Amit add two additional mechanisms - voting agreements and disproportionate board representation. They describe disproportionate voting representation as

> "Disproportionate board representation enhances family control by allowing the family to elect a fraction of the board of directors (B) that exceeds not just its share and vote ownership (O and V) but even its voting control (C). Disproportionate board representation is sometimes warranted by shareholder agreements, and sometimes associated with dual-class stock, whereby the class held uniquely by the family grants it superior rights in the election of directors, even when it does not entitle it to superior voting rights. In most cases, however, the election of family members or representatives to the board in excess of the family's voting control takes place de facto rather than contractually."

These authors also point out that only dual-class shares and disproportionate board representation cannot be utilized for reasons other than control enhancement. In a sense, this analysis starts where Villalonga and Amit (2009) leave off, showing how such disproportionate representation can be used to achieve control of the firm's cash flows. It does so using the board model of Raheja (2005) in the context of a CEO considering diverting corporate resources for private benefit as explained in Essay 1.

2.2.1 Family Blockholder and CEO Resource Diversion

Essay 1 presented a model of CEO diversion in the presence of an unaffiliated, large non-family blockholder, which is grounded in Admati and Pfleiderer (2009b). There, the utility of the CEO is merely his compensation if he decides against resource diversion and compensation plus private benefit if he chooses to divert for personal consumption (Jensen and Meckling, 1976, Grossman and Hart, 1988 and Dyck and Zingales, 2002 provide a detailed description on the private benefits of control). The model further assumes that the blockholder privately observes whether or not the CEO has diverted resources. If the blockholder is independent of the CEO then diversion will trigger a sale of the blockholder's ownership in the firm.

Suppose, though, that the blockholder is the firm's founding family and that the bulk of the family's wealth is tied up in the firm.[1] If the CEO is not a family member, it can be safely assumed that, as opposed to the independent blockholder of Essay 1, the family blockholder will never sell its equity stake as result of CEO resource diversion. On the other hand, the CEO may himself be a family member. In that case, the blockholder will not only *not* sell, it will actively collude in the diversion with the CEO. Clearly, the model of Essay 1 is not applicable and a new analysis is called for.

2.2.2 CEO's Diversion Decision

To recap from Section 1.2.1 of Essay 1, the world is assumed risk-neutral with no discounting. There are three times $t = 0, 1, 2$ and two periods. At $t = 0$ a firm has access to a project that will produce cash flows of X with probability 1. The firm is owned by many atomistic investors and one large blockholder, L. The CEO - M - is considering diverting a portion of the resources allocated for project implementation for personal consumption. That is, at $t = 0$, M decides whether or not to divert project resources, an action that will decrease the value of the firm but produce a private benefit. Define X to be firm value if M decides not to divert. If M then does decide to divert, resulting in reduced cash flows available for investment and lower firm value but producing a stream of private benefits, firm value decreases by uX where the measure of loss resulting from the diversion, u, is a random variable, and M receives the private benefit $B > 0$.

2.2.3 Family Blockholder

Assume that the blockholder, now designated L_f, is the firm's controlling family. L_f still privately observes whether or not M has decided to divert project resources. Now however, for reasons explained below, the blockholder also knows u - the measure of loss associated with the diversion. As noted above, for an unaffiliated blockholder, diversion of resources by the CEO will trigger an equity sale. However, in the current setting, the bulk of the family's wealth is tied up in the firm so that L_f will never sell because of CEO misfeasance. Thus, sale of the blockholder's stake will not be an issue here. If the market observes a sale by L_f, the market knows that it is for reasons of liquidity only.

Further, assume that the family controls the nominating committee so that L_f has allies among the board members, both insiders and outsiders. Allies among the outsiders are people who have family affiliations

[1] Anderson and Reeb (2003) note that families that appear in both Forbes' Wealthiest Americans Survey and the S&P 500 have over 69 percent of their wealth invested in their firms.

such as family friends or strong business ties. For simplicity, I assume that allies among the insiders are family members and allies always vote according to the wishes of the family. Let

$$m_f \equiv \text{the number of outside directors affiliated with the family}$$

$$n_f \equiv \text{the number of inside directors who are family members}$$

In the setting where the family acts as a steward of corporate resources, they take a "hands-off" approach. They do not manage the firm, but they closely monitor firm management by having family members work at the firm and sit on the board. These family members are the eyes and ears of the family and will never contend for the position of CEO. Conversely, when the family is expropriative, corporate resources are regarded as existing for the benefit of the family and they will be used on behalf of family interests. In order to ensure the family unfettered access to firm resources, the CEO is always a family member and the family never relinquishes managment of the firm to anyone who is not 'family'.

2.2.4 Family Blockholder and the Corporate Board

Having set-up the family blockholder model, I now juxtapose a slightly modified version of the board structure model fully detailed in Section 1.3 of Essay 1.

The board model comprises two stages. In the first, the board will vote on the CEO's proposed project implementation, and in the second, the cash flows from the project will be realized and the outsiders will select a successor to the incumbent CEO. Outside directors are either independent (i.e., unaffiliated) or family-affiliated and board decisions are taken on majority rule. In this stage of the board model, the outsiders will also solicit information on the possible loss from insiders, and each insider will decide whether or not to reveal this information to the outsiders. In the subsequent stage, the outsiders will either investigate the CEO's proposed project implementation or approve it without further ado. Outsiders will not know the potential loss unless they decide to investigate further. Thus, outsiders will vote for the CEO's project implementation if they choose not to investigate or if they investigate and find no evidence of CEO diversion. An investigation will only occur if the costs of diversion are equal to or greater than the costs of investigation, *and* a sufficient number of insiders reveal information to outsiders to form a voting majority.

Inside directors are also either independent or family-affiliated. Each category of insider has different ex-ante probabilities of succeeding the CEO. By revealing the probable loss to outsiders, an insider by default votes against the CEO's proposed project implementation, and by remaining silent an insider is implicitly signaling that the CEO's project implementation is absent diversion. Consequently, unaffiliated insiders either reveal or remain silent, while each family-affiliated insider acts in accordance with the family's interests. Each unaffiliated insider, knowing that the CEO will divert corporate resources, can earn a private benefit by remaining silent and approving the project. The payoff to insiders is the value of the private benefits and the utility of becoming CEO. The key to this analysis is that for insiders it is all or none with respect to revelation to outsiders, i.e. either everyone reveals or no one reveals (Raheja, 2005 or Corollary 1.1).

2.2.5 Independent CEO

When the CEO is not a family member, resource diversion by the CEO is an assault on the wealth of the family and from the family's point of view, must not be allowed. Obviously, if the family has a majority of votes on the board, then diversion can be prevented. But diversion can be prevented even if the family does not have a voting majority. Assume that whenever the CEO tries to divert project resources, one of the family members on the board reports to the outsiders that the measure of loss associated with the diversion is $\max(u, u_m)$ where u_m (from Essay 1) is the value of u that will trigger an investigation. Up until now, I have implicitly assumed that insiders report truthfully to outsiders. The motivation behind this implicit assumption is the negative reputational consequnces a false report would engender. Notice though, that if $u < u_m$, the report of the family member is not truthful. I justify this behavior by assuming that the family member will always be employed by the family and so will suffer no adverse reputational consequences for a false report on the family's behalf.

I conduct the analysis first assuming that (1) the family has, and then (2) does not have, a voting majority on the board. For that purpose I require the following definitions from Essay 1.

$P(I|k) \equiv$ probability that outsiders investigate given that k independent insiders reveal

$\tau = 1 + \left(\left\lceil \frac{n-m}{2}\right)^{+}\right. \equiv$ minimum number of insiders who must reveal for outsiders to win a board vote

$$\chi_{k\geq\tau} = \begin{cases} 1 & k \geq \tau \\ 0 & \text{Otherwise} \end{cases}$$

2.2.5.1 Independent CEO: Family Has a Voting Majority on the Board

To have a voting majority on the board, n_f, the number of family insiders on the board, must satisfy $n_f \geq \tau$. Thus, for a voting majority,

$$n_f \geq 1 + \left(\left\lceil \frac{n-m}{2}\right)^{+}\right. \tag{2.1}$$

Given (2.1), no rational CEO would attempt to divert project resources.

To illustrate, suppose the board consists of $m = 3$ outsiders and $n = 5$ insiders of which $n_f = 2$ are family members. Even in the worst-case scenario (from the family's viewpoint) the combined vote of the outsiders and the family members ($3 + 2 = 5$) is greater than the votes of the independent insiders and the CEO ($3 + 1 = 4$).

2.2.5.2 Independent CEO: Family Does Not Have a Voting Majority on the Board

A question that naturally arises from the prior analysis is whether outsiders will have the necessary votes to reject a proposed implementation after they have verified it as dishonest. It has been shown that a voting majority on the board will deter CEO diversion. I now show that even if the family does not enjoy a voting majority on the board, diversion of project resources by the CEO can still be deterred. Note that $\tau - n_f$ is the number of nonfamily insiders who must vote with the outsiders and the family in order to defeat the CEO. Since the CEO votes in favor of the proposed implementation, in order to defeat it on a board vote, the number of nonfamily insiders who must vote with the outsiders and the family must satisfy

$$\tau - n_f = 1 + \left(\left\lceil \frac{n-m}{2} \right) ^{+} - n_f \tag{2.2}$$

It will be seen that the number of nonfamily insiders who vote against the CEO's proposed project implementation will always be greater than $\tau - n_f$. In fact, all insiders will vote against it. Note that the report of $\max(u, u_m)$ by a family member on the board means that an investigation *will* occur, i.e.

$$P(I|k) = 1,\ \forall k \tag{2.3}$$

In Essay 1, Sec. 1.4.2, $W(k, u)$ was defined as the utility of (independent) insiders derived from revealing and voting against the CEO. Now $W(k, u) > 0$ if enough independent insiders vote with the outsiders to stop the proposed project implementation.

$$W(k, u) = \chi_{k+1 \geq \tau} P(I|k+1) \frac{1}{k+1} \omega X \tag{2.4}$$

Eq.(2.4) follows from application of the succession voting rule that in the case where outsiders investigate and verify diversion by the CEO, they randomly select an insider who revealed to receive all of their votes (See Essay 1, Sec. 1.3.2.).

Similarly, in Essay 1, Sec. 1.4.2, $S(k, u)$ was defined as the utility of (independent) insiders derived from remaining silent. $S(k, u) > 0$ if insufficient independent insiders reveal and vote with the outsiders. In the latter circumstance, outsiders would not pick an independent insider who voted with the CEO as his successor, so that the expected value to insiders of remaining silent would then be only the private benefit. Thus

$$S(k,u) = [1 - \chi_{k \geq \tau} P(I|k)]\beta_n X = (1 - \chi_{k \geq \tau})\beta_n X \tag{2.5}$$

In essence, the presence of the family ends CEO diversion. To see this, note that the independent insiders are willing to reveal no matter how little the CEO diverts. The reason is that, if they vote with the CEO they have no chance of succeeding him. To retain their silence, the CEO would have to compensate them for this loss and that proves too costly. I demonstrate this by invoking the logic of Corollary 1.1 in Essay 1. I want to show that $W(\tau - 1, u) > S(\tau - 1, u)$. I do this by showing that the reverse inequality leads to a contradiction. Thus, assume $S(\tau - 1, u) \geq W(\tau - 1, u)$ or

$$\beta_n \geq \frac{1}{\tau}\omega \tag{2.6}$$

Ineq. (2.6) says that, β_n, the private benefit provided by the CEO to the independent insiders who remain silent, must be greater than ω/τ. Note that if (2.6) does not hold for τ_{max}, it will not hold for $\tau < \tau_{max}$. Thus, I need only prove $\beta_n \geq \omega/\tau_{max}$ leads to a contradiction.

To illustrate, let n be odd and $m = 1$[2]. In order to buy the insiders' silence, the private benefit paid to them by the CEO must satisfy

$$\beta_n \geq \frac{1}{\tau_{max}}\omega = \frac{1}{\frac{n+1}{2} - n_f}\omega$$

Suppose $n = 5$ and $n_f = 2$. Then $\beta_n \geq \omega$. But this cannot be true since, from Essay 1, I have assumed $\beta_n < \beta < \omega$. In order to compensate the insiders, the CEO would not only have to pay his entire personal benefit from the diversion, but would also have to dip into his own corporate compensation! Thus, diversion would not be worthwhile. More generally, it can be shown that the CEO's insider compensation requirement (2.6), contradicts previous assumptions. I have assumed

$$n\beta_n < \beta < \omega \Rightarrow \beta_n < \frac{\omega}{n}$$

Coupled with the CEO's requirement,

$$\frac{\omega}{\frac{n+1}{2} - n_f} < \frac{\omega}{n} \Rightarrow n + 2n_f < 1$$

a contradiction, since both n and n_f are positive and integral. These ideas form the basis of a proof of the following.

[2] $m = 1$ ensures that $\tau = \tau_{max}$. Cf. Eq.(2.2).

Proposition 2.1. *For a firm with a family blockholder and family representation on the board as insiders, a rational CEO who is not a family member will be deterred from diverting project resources for personal benefit whether or not the family has a voting majority on the board.*

2.2.6 Family-Affiliated CEO

When the CEO is not a family member, all outside directors are united in their opposition to CEO misfeasance. However, when the CEO is a member of the founding family, presumably acting on behalf of the family, this is no longer true. While the independent outside directors are as much opposed to CEO misfeasance as ever, the family-affiliated directors take their orders from the family which, in this case, means supporting CEO diversion of project resources. The first order of business for the family then, is to ensure that the position of CEO stays in the family. This means the family must have an absolute majority of the votes of outside directors. That is, the family must make certain that there are more family-affiliated than independent outside directors. The number, m_f, of family-affiliated outside directors must therefore satisfy

$$m_f > m - m_f \Rightarrow m_f > \frac{m}{2}$$

or

$$m_f \geq \begin{cases} 1 + \frac{m}{2} & m \text{ even} \\ \lceil \frac{m}{2} & m \text{ odd} \end{cases} \tag{2.7}$$

Of course, if the family has a voting majority on the board, diversion of resources by the CEO cannot be stopped. However, in a result that mirrors the previous section, it will be seen that, if (2.7) is satisfied, CEO diversion cannot be stopped even if the family does not enjoy a voting majority.

2.2.6.1 Family-Affiliated CEO: Family Has a Voting Majority on the Board

To have a voting majority, the family must ensure that the combined votes of the family and family-affiliated board members are greater than those of the other members of the board.

$$m_f + n_f \geq m - m_f + n - n_f \Rightarrow m_f + n_f > \frac{m+n}{2}$$

$$m_f + n_f \geq \begin{cases} \frac{m+n}{2} & (m+n) \text{ even} \\ \lceil \frac{m+n}{2} & (m+n) \text{ odd} \end{cases} \tag{2.8}$$

Condition (2.8), when combined with condition (2.7), lead to the following conditions based on the parities of m and n.

$$
\begin{array}{lllll}
(a) & m\,\text{even} & n\,\text{even} & m_f \geq 1+\frac{m}{2} & n_f \geq \frac{n}{2}-1 \\
(b) & m\,\text{odd} & n\,\text{odd} & m_f \geq \lceil \frac{m}{2} \rceil & n_f \geq \lfloor \frac{n}{2} \rfloor \\
(c) & m\,\text{even} & n\,\text{odd} & m_f \geq 1+\frac{m}{2} & n_f \geq \lfloor \frac{n}{2} \rfloor \\
(d) & m\,\text{odd} & n\,\text{even} & m_f \geq \lceil \frac{m}{2} \rceil & n_f \geq \frac{n}{2}
\end{array}
\tag{2.9}
$$

We summarize the results in the following lemma.

Lemma 2.1. *Given a CEO who represents the controlling family and a board composed of m outside directors and n inside directors, if the number, m_f, of family-affiliated outside directors and the number, n_f, of family members serving as inside directors, satisfy either conditions (2.7) and (2.8) or equivalently conditions (2.9), then the family will enjoy a voting majority on the board.*

2.2.6.2 Family-Affiliated CEO: Family Does Not Have a Voting Majority on the Board

If (2.8) is not satisfied, then, even though the family does not control a majority of board votes, independent insiders will still not reveal the measure of loss to independent outsiders. To understand why, recall that only a family member will be allowed to be CEO. This means that there is no reward for voting with the independent outsiders, because it is only the chance to succeed the CEO that gives such a vote value. Hence,

$$W(k,u) = 0 \tag{2.10}$$

Although never allowed to be CEO, by supporting the current CEO, an independent insider will still receive the personal benefit such support brings. In other words,

$$S(k,u) = \beta_n X \tag{2.11}$$

Therefore, all independent insiders will vote with the CEO out of self-interest. The foregoing analysis of the family blockholder leads to the following.

Proposition 2.2. *Given a CEO who is a family member and a board composed of m outside directors and n inside directors, if the number, m_f, of family-affiliated outside directors satisfies condition (2.7), then diversion of project resources for personal benefit by the CEO cannot be deterred by board action whether or not the family has a voting majority on the board.*

Propositions 2.1 and 2.2 are formal statements that by controlling the rewards to independent insiders, the family controls the vote.

Applying the insights of Proposition 2.2 to the real world, one can speculate that independent insiders at such a firm, who have aspirations to be CEO, must either leave the firm or make peace with the fact that those who remain are, in fact, not independent at all but willing participants in a culture of corporate corruption.

2.2.7 Hypotheses

In the theory above, Passive firms are defined by not having a family member as board chairman or CEO. Because family members in Passive firms cannot affect corporate events through managerial action, their only means of influencing corporate outcomes is through control of the votes of the board. This reasoning leads to my first hypothesis.

Hypothesis 1. *Control of the votes of the board of directors is more likely to occur in Passive than in Active family firms.*

Similarly the above theory requires that, whether the CEO is independent or family-affiliated, control of the board requires a certain number of family-affiliated insiders and/or outsiders. The analysis assumes that the required number of family-affiliated board members will be available by positing that the family controls the nominating committee. The assumption is that there is a direct link between the nominating committee and control of the board. I state this as my second hypothesis.

Hypothesis 2. *There is a significant positive correlation between control of the board of directors and the number of affiliated directors on the nominating committee.*

Does family control of the votes of the board of directors add or detract from family firm value? Shleifer and Vishny (1986) modeled a corporation with one large shareholder and an atomistic cloud of small, indistinguishable shareholders. In such a corporation, the classic owner-manager conflict is mitigated because the large shareholder has an incentive to monitor management. However this may give rise to a second type of conflict. The large shareholder may use its controlling position to extract private benefits at the expense of small shareholders. If the large shareholder is an institution, incentives for shortchanging minority shareholders are small, but so are the incentives for monitoring. If the large shareholder is an individual or family, the incentives are greater for both monitoring and abuse. The monitoring of managerial actions can be seen as part of a board's obligation to be vigilant against managerial misfeasance. Without vigilant oversight, large shareholders such as founding families are able to exploit minority shareholders (Adams, Hermalin, and Weisbach, 2008; Faccio, Lang, and Young, 2001). Unsurprisingly, control of the board has been shown to facilitate such large shareholder exploitation more in certain jurisdictions (Dahya, Dimitrov, and McConnell, 2008; Cheung, Rau, and Stouraitis, 2006; Leal and De Oliveira, 2002; Yeh and Woidtke, 2005). Nevertheless, Anderson and Reeb (2004) found a significant valuation premium for family firms that have greater board independence relative to non-family firms or family firms with insider-dominated boards. In addition, they found that firm performance is about 12.8% lower when family control of the board exceeds independent director control (relative to independent directors holding more board seats than family members). This leads me to my final hypothesis.

Hypothesis 3. *Family control of the votes of the board of directors detracts from family firm value.*

2.3 Data Description

I begin with the report Family, Inc. published in Business Week in the November 2003 issue. Using firms on the S&P 500 as of July 2003 as a basis, the report identified 177 firms as family firms.[3] It defined family firms as "any company where founders or descendants continue to hold positions in top management, on the board, or among the company's largest stockholders." Using corporate histories found at the website www.fundinguniverse.com as well as a list of family firm-years for S&P 500 firms between 1992 and 1999 kindly provided by Prof. David Reeb, I gathered data for 1,169 firm-years from which I excluded 42 firm-years for 10 firms which had no family members on the board for those years. The leaner final sample consists of 1,127 firm-years from 150 family firms in the S&P 500 index over the period 1996 through 2003. The maximum length of time series data for firms in the sample is 8 years and the minimum is 2 years.

Information on board members and board structure was hand-collected from corporate proxies obtained mainly from EDGAR filings (but in some cases from Thomson Research) as well as from the IRRC Directors' Database on Wharton Research Data Services (WRDS). Financial data was obtained from the WRDS database - balance sheet and income statement items from Compustat, market value data from CRSP (See Table 3 for the list of variables). Thomson Research was also accessed through WRDS. Family ownership data was hand-collected from corporate proxies. Institutional ownership data was obtained from the 13F Institutional Ownership database on WRDS.

To measure family ownership, I use the fractional equity ownership of the founding family and their representatives. As in Villalonga and Amit (2006), I consider as family representatives "all cotrustees that are beneficial owners by virtue of their association to the family in those trusts. For instance, in the

[3]It should be noted that Ronald C. Anderson of American University and David M. Reeb of Temple University, whose research provided the impetus for the report, were hired as consultants to help compile the list.

Washington Post during 1994, a significant fraction of the shares held by the Graham family were held in trusts in which Katherine Graham, her son, Donald Graham, and director George Gillespie were cotrustees. We consider Gillespie as a family representative and include all shares held in such trusts."[4]

2.3.1 Founders, Families and Family Firms

As in Villalonga and Amit (2006), several clarifications are in order with respect to the precise meaning of "founder." First, the "founder" may have founded either the sample firm or a predecessor firm.[5] Second, when there is more than one founder, I consider "family" as the family of either founder or the combined families of the founders. For instance, the families of Hewlett-Packard cofounders Bill Hewlett and David Packard are both large shareholders and both have a board presence during the sample period. I count both members of both the Hewlett and Packard families in determining how many "family" members are on the board. Third, the person responsible for the firm's early growth and development into the business for which it later became known and generally recognized as the firm's founder need not be the same individual who started and incorporated the company or a predecessor business. For example, though not the founder of Monarch Foods, Robert Walter is generally recognized as the founder of Cardinal Health after he renamed Monarch Foods Cardinal Foods and shifted Cardinal's core business from food wholesaling to health services.[6]

2.3.2 Market Value and Tobin's Q

Tobin's Q is the ratio of the firm's market value to the replacement cost of its assets and is calculated using the approximation given in Chung and Pruitt (1994) as

$$\text{approximate } q = \frac{MVE + PS + DEBT}{TA}$$

where MVE is the product of the firm's share price and the number of shares outstanding, PS is the liquidating value of the firm's outstanding preferred stock, $DEBT$ is the value of the firm's short-term liabilities net of its short-term assets, plus the book value of its long-term debt and TA is the book value of the total assets of the firm. All quantities were calculated as of year end.

[4] Villalonga and Amit (2006).

[5] For example, Bergen Brunswig resulted from the merger, in 1969, of the Brunswig Drug Company (founded in 1885 by Lucien Napoleon Brunswig) and Bergen Drug (founded in 1947 by Emil Martini, who died and was succeeded by his son Emil Jr. in 1956). In 2001, Amerisource acquired Bergen Brunswick and renamed itself Amerisourcebergen.

[6] Walter acquired Cardinal Foods in a leveraged buyout in 1971. Cardinal first moved into pharmaceuticals distribution in 1980 with the acquisition of a drug distributor in Zanesville, OH and went public in 1983 as Cardinal Distribution.

2.4 Empirics

For the empirics, I classify the firms in my sample based on the involvement of the family in firm management. I say the family is actively involved in firm management if a family member is either CEO or Chairman and label such firms as *Active*. I further divide Active family firms into two groups. The first group, which I call *Controlling* consists of family firms where a family member is CEO or chairman and less than half of the directors are independent. The second group, which I call *Non-Controlling*, consists of family firms where 1) a family member is CEO but more than half of board members are independent or 2) a family member is Chairman but the CEO is nonfamily. Apart from Active family firms, I identify a third group of family firms, which I call *Passive.* These are family firms where family members sit on the board but do not occupy the positions of CEO or Chairman. This classification of firms allows me to test the three hypotheses stated at the end of Section 2.2. All tables are in Appendix B.

2.4.1 Variables

Formal definitions of all variables are presented in Table B.3. Firm age is defined from the date the firm was founded. Other than firm age, the remaining 29 variables used in the analysis consists of four types: (1) 10 Financial, (2) 6 Family Management, (3) 4 Governance and (4) 9 Board variables. The Financial variables include debt, dividend, ROA, R&D and fixed assets ratios along with measures of growth, investment, size, business risk and Tobin's Q.

The Family Managment variables are dichotomous including three that indicate if the founder is CEO, board Chairman or just a director (*fndrceo, fndrchmn, fndrdir*) and three indicating if a family member other than the founder occupies these roles (*famceo, famchmn, famdir*).

The Governance variables include the G-Index introduced in Gompers, Ishii, and Metrick (2003), two variables giving the fractional ownership of family and institutions (*famown*, *instown*), and a dichotomous variable indicating the presence of a dual share structure (*dualshrs*).

The Board variables[7] give numbers of directors relating to board and nominating committee participation. Nominating committee variables are included because the theoretical analysis suggested that they might be important. For the board the variables are number of directors (*ndirs*), number of employee family directors (*famempls*), number of non-employee family directors (*famdirs*), number of independent directors (*indpdirs*) and number of affiliated directors (*lnkddirs*) that serve on the board. For the the nominating committee,

[7] Of course the board of directors is itself a governance mechanism. Thus the given partitioning of variables, while perhaps not strictly correct, is most useful for the current purpose.

they are number of directors (*ncdirs*), number of family directors (*ncfam*), number of independent directors (*ncindp*) and number of affiliated directors (*nclnkd*) that serve on the committee.

2.4.2 Family Firm Types

A family or family firm is Active if it is Controlling or Non-Controlling. A family or firm is Controlling if a family member is CEO and less than half of the directors are independent, i.e if $fndrceo = 1$ or $famceo = 1$ and $ndirs > 2 \times indpdirs$.

A family or firm is Non-Controlling if 1) a family member is CEO but at least half of board members are independent or 2) a family member is Chairman but the CEO is nonfamily, i.e. if 1) $fndrceo = 1$ or $famceo = 1$ but $ndirs \leq 2 \times indpdirs$, or 2) $fndrceo = 0$ and $famceo = 0$ but $fndrchmn = 1$ or $famchmn = 1$.

A family or firm is Passive if family members sit on the board but do not occupy the positions of CEO or Chairman, i.e. if $fndrceo = 0$ and $fndrchmn = 0$ and $famceo = 0$ and $famchmn = 0$ but $fndrdir = 1$ or $famdir = 1$.

2.4.3 Univariate Analyses

Table B.1 shows the distribution of firms and firm groups by industrial sector. The All Firms columns report the distribution of all 150 sample firms across industrial sectors. Most of the firms were in the Information Technology sector followed by the Consumer Discretionary sector. The next columns show how family firm types were distributed across industrial sectors. Thus, over the sample period, 61 firms were classified as Controlling, 141 firms as Non-Controlling and 54 as Passive.[8] It is interesting to note that the Consumer Discretionary sector had the most Controlling firms.

One feature of Table B.1 that deserves further explanation is the inclusion of a firm classified as being in the Financials sector. The firm is Loew's Corp. Normally a financial firm would not be included but the breadth of Loews holdings led me to conclude that Loews Corporation was more than a financial firm. Run by brothers Preston Robert (Bob) and Laurence (Larry) Tisch during the sample period, with diversified interests in insurance, tobacco, offshore drilling, hotels, and watches, Loews was a holding company. In the early 21st century, Loews remained in the control of the Tisch family, who held more than 30 percent of the firm's publicly traded stock. Among the company's major holdings was an 86.5 percent stake in the publicly traded CNA Financial Corporation, one of the ten largest insurance companies in the United States.

[8] A firm may be in more than one group over the sample period. For example a firm may start off in 1996 as Controlling with the founder as CEO, but by 2003 have only one or two family members on the board and so be classified as Passive.

CNA contributed about 75 percent of Loews' revenues. Further, an additional 19 percent of firm revenues was derived from the wholly owned Lorillard, Inc., the oldest and fourth largest U.S. cigarette maker and the producer of such brands as Newport, Kent, and True. Another wholly owned subsidiary, Loews Hotels Holding Corporation, operated 14 hotels and resorts in the United States and Canada. Loews also held a 52 percent stake in Diamond Offshore Drilling, Inc., one of the world's leading contract drillers of offshore oil and gas wells; and a 97 percent stake in Bulova Corporation, a major distributor of watches and clocks under the Bulova, Accutron, and Sportstime brands.[9]

Table B.3 defines the variables used in the study and groups them into four categories - Financial, Family Management, Governance and Board. Table B.2 shows how the Financial variables are calculated using CRSP and Compustat data. Table B.4 presents summary statistics for each of the variable groupings. The "w" at the beginning of a variable name indicates that the variable has been winsorized. It is interesting to note that of the 1,127 firm-years of Family Management data for the 150 firms, the founder is CEO 40.3% of the firm-years and Chairman 52.3% of them on average. 96% of the time the founder is both CEO and Chairman. For only 15% of the firm-years is a family member, other than the founder, CEO or Chairman (15.8%).

2.4.4 Univariate Analyses - Differences Between Firm Types

Table B.4 reports variable means and medians by firm group and Table B.5 shows difference-of-means tests (t) and Wilcoxon tests (z) for the mean and median differences in variable values between family firm types. From Table B.5, Active family firms differ significantly (on t and z)[10] in age from Passive family firms, but not significantly ($p > 10\%$) from each other. From Table B.4, Passive firms are almost twice as old as Active firms on average - 71.69 years vs. 37.13 and 36.98 years respectively, with Controlling firms being the youngest. To avoid repetitively adding "on average", I note here that the comparative statements to follow refer to average quantities. Similarly, "not significant" will always mean the associated p-value is greater than 10%.

2.4.4.1 Financial Variables

The Financial variables include debt, dividend payout, ROA, R&D and fixed assets ratios along with measures of growth, investment, size, business risk and Tobin's Q. In the financial economics literature, all of these

[9] http://www.fundinguniverse.com/company-histories/Loews-Corporation-Company-History.html

[10] This notation is meant to communicate that differences are significant according to the t-test (on t), the Wilcoxon ranksum test (on z) or both (on t and z).

variables have been related to firm value. (e.g. Jensen, 1986, Shleifer and Vishny, 1986, McConnell and Servaes, 1990, Jensen, Solberg, and Zorn, 1992, Agrawal and Knoeber, 1996, Himmelberg, Hubbard, and Palia, 1999, Claessens, Djankov, and Lang, 2000, Anderson and Reeb, 2003, Villalonga and Amit, 2006)

Since Active firms have similar management and are in similar stages of their life cycles, one would expect that their financials would be more similar to each other than to Passive firms. Tables 4 and 5 highlight the similarities and differences among family firm types. Apart from the age difference noted above, Active and Passive firms also differ in their financials. However, what these differences connote may not be discernable from the univariate data alone. Consider debt ratios as an example. Active firms have a smaller debt ratio than Passive firms. Although the debt ratio of Controlling firms is smaller than that of Non-Controlling firms, among the three family firm types, only the difference between Controlling and Passive firms is statistically significant (on z). Since the tradeoff theory of capital structure suggests that firms select optimal debt ratios by trading off various tax and incentive benefits of debt financing against financial distress costs, one cannot use the univariate data to reliably draw inferences from the differences in debt ratios among firm types.

Continuing, R&D expenditures have been shown to be an important determinant of market value (cf. Griliches, 1981, Ben-Zion, 1984). In general, higher R&D investment translates into a higher market value. Active firms have a higher R&D ratio than Passive firms. Non-Controlling firms have a significantly higher (on t and z) R&D ratio than either Controlling or Passive firms. The difference between Controlling and Passive firms however, is small and not statistically significant. Perhaps related to the difference in R&D, Active firms have a higher growth rate (measured as the ratio of five-year revenue) than Passive firms. The growth rate of Active firms is significantly higher (on t and z) than that of Passive firms with the growth rate of Controlling firms being significantly greater (on z) than that of Non-Controlling firms. To the extent that R&D expenditures and past growth are indicators of future profitable expansion, it is unsurprising that Active firms have a higher Tobin's Q than Passive firms. Non-Controlling firms have a higher Tobin's Q than Controlling firms but not significantly so. Similarly, Controlling firms have a higher Q than Passive firms but not significantly so. However, the difference in Q between Non-Controlling and Passive firms *is* significant (on t and z).[11]

On other financial measures, for instance size (as measured by log of total assets), the values for Passive firms are larger than those of Active firms. Passive firms are significantly larger (on t and z) in size than

[11] These results for Q have implications for stewardship theory. Using Q as a measure of performance, one would conclude that Non-Controlling firms outperformed Controlling firms which, in turn, outperformed Passive firms. This suggests that even if families do behave as posited by stewardship theory, good intentions may not protect minority shareholders. To see this, use the Q of Non-Controlling firms as the standard and interpret the difference in Q from that standard as a cost. Then the nominal stewards (Passive firms) imposed a higher cost on nonfamily shareholders then did the nominal expropriators (Controlling firms).

Active firms. Recalling that Tobin's Q is a measure of growth opportunities, it is not surprising that Passive firms have a significantly lower value of Tobin's Q than Active firms - significantly lower on t and z than Non-Controlling firms and significantly lower on z than Controlling firms. Among Active firms, Non-Controlling firms are significantly larger (on t and z) than Controlling firms and, as expected, have a larger Tobin's Q but not significantly so.

Turning to the dividend payout ratio, in the idealized world of Modigliani and Miller (1958), firm value is unaffected by dividend policy. In the real world of taxes, asymmetric information and agency costs however, it is widely acknowledged that dividend policy does influence firm value.[12] The likelihood of paying dividends increases with firm size and age[13] so that, being larger and older, it is not surprising that Passive firms have a dividend ratio more than twice as large as that of Active firms. The difference is statistically significant (on t and z) for both Controlling and Non-Controlling firms. Non-Controlling firms have a higher dividend ratio than Controlling firms but the difference is not statistically significant.

Likewise, Passive firms have a significantly higher fixed asset ratio than Active firms. This may help explain the higher debt ratio of Passive firms. Fixed assets can be used as collateral. Thus, firms with a high ratio of fixed assets should have greater borrowing capacity.[14] The difference is statistically significant (on z) for Controlling and also statistically significant (on t and z) for Non-Controlling firms. Non-Controlling firms have a higher ratio than Controlling firms but not significantly so.

Passive firms also have less business risk (measured as the standard deviation of 10-year ROA) than Active firms. Kale, Noe, and Ramìrez (1991) have shown theoretically and empirically that there is a roughly U-shaped relation between business risk and optimal debt level. Thus inferences about the impact on firm value of differences in business risk cannot reliably be drawn based on the univariate data. Notwithstanding, Non-Controlling firms have significantly higher business risk than either Controlling (on z) or Passive (on t and z) firms. Likewise, Controlling firms also have significantly more (on t) business risk than Passive firms.

To sum up the univariate financial evidence, Active firms are younger, smaller, have a lower debt ratio, higher ROA, higher proportionate investment in R&D and higher growth than Passive firms. But Active firms also have lower dividends proportionately, less fixed assets proportionately and higher business risk. Still, on balance, the higher Q of Active firms does weakly support the conclusion that active family managment adds value to family firms.

By contrast, the evidence on the contribution to value of family board control is murky. Between Control-

[12]Just how dividends impact firm value has been a source of much controversy. See Lease et al. (2000) for a comprehensive review of the now-voluminous literature.

[13]See for example Julio and Ikenberry (2004).

[14]See for example Johnson (1997).

ling and Non-Controlling firms, Controlling firms have a lower debt ratio, a similar ROA, less proportionate R&D, higher growth, smaller Q and less business risk. Although the combination of higher growth and smaller Q is suggestive, only the difference in R&D is significant.

As for Passive family firms, the numbers suggest that Passive firms use more debt and pay more dividends than Active firms. One interpretation, in line with agency theory (Jensen, 1986), is that by reducing free cash flow, Passive families are using leverage and dividend policy as a quasi-disciplinary device to limit nonfamily management's ability to divert family wealth.

2.4.4.2 Family Management Variables

The Family Managment variables are dichotomous including three that indicate if the founder is CEO, board Chairman or just a director (*fndrceo, fndrchmn, fndrdir*) and three indicating if a family member other than the founder occupies these roles (*famceo, famchmn, famdir*).

Tables B.4 and B.5 show that the founder is more actively involved in the management of Controlling firms than Non-Controlling firms. (Of course, founder-CEO, founder-chairman, family-CEO and family-chairman variables are not applicable to Passive firms since, by definition, such firms do not have a family member serving as CEO or chairman.) For instance 77% of the time Controlling firms are run by the founder as opposed to only 50% for Non-Controlling firms. The difference is significant (on t and z). Likewise, 80% of the time Controlling Firms have a founder serving as chairman whereas founders are chairmen only 71% of the time for Non-Controlling firms. Again, the difference is significant (on t and z). The founder serves as both CEO and chairman in 75% of Controlling firms but only 45% of Non-Controlling firms.

As for non-founder CEOs, although 24% of the time Controlling firms have a non-founder family member as CEO whereas only 20% of the time Non-Controlling firms do, the difference is not statistically significant. On the other hand, 24% of the time Non-Controlling firms have a non-founder family member serving as chairman compared to only about 19% for Controlling firms and the difference *is* significant (on t).[15].

Regarding non-management board directorships, as might be expected, families in Passive firms are more active. 30% of the time Passive firms have a founder serving as an "ordinary" (i.e neither CEO nor chairman) board member set against 23% for Controlling firms and 17% for Non-Controlling firms. The differences between Active and Passive firms are statistically significant (on t and z) as is the difference between Controlling and Non-Controlling firms. In a similar vein 70% of the time Passive firms have non-

[15]Ignoring Molex, Inc. where, from 1999 to 2003, the founder and a family member were co-CEOs and/or co-chairmen, no Active firm had a founder-CEO and a family-chairman. Among Controlling firms, about 18% had a family-CEO and a family-chairman. Among Non-Controlling firms the figure is only about 16%.

founder family members serving as board members. The corresponding percentage for Controlling and Non-Controlling firms is 41% and 26% respectively. Again as might be expected, the differences between Active and Passive firms are statistically significant (on t and z) as is the difference between Controlling and Non-Controlling firms.

Of the Controlling firms with a founder-CEO, 31% also have non-founder family members on the board. This increases to 74% for non-founder family CEOs. By contrast, though not having the firm or the board managed by the founder, in Passive firms the founder does sit on the board 30% of the time.

In terms of family management, Non-Controlling firms exhibit characteristics of both Controlling and Passive firms. Like Controlling firms, about 70% of the time Non-Controlling firms are run by family - 50% of the time having a founder-CEO and 20% a non-founder family CEO. Like Passive firms, 30% of the time Non-Controlling firms have a nonfamily CEO. Of the Non-Controlling firms with a founder-CEO, 9% also have non-founder family board representation. Like the increase seen for Controlling firms, non-founder family board representation increases to 53% of firms under non-founder family CEOs. Unsurprisingly, it drops to 36% of firms for nonfamily CEOs. Of the Non-Controlling firms with a nonfamily CEO, 22% have a founder-chairman and 8% a non-founder family member as chairman. 29% of those firms with a founder-chairman also have non-founder family board representation. This increases to 58% of firms with a non-founder family member serving as chairman.

Summarizing the data on non-founder family board representation, for Controlling Firms it goes from 31% for a founder-CEO to 74% for a non-founder family CEO. Likewise, for Non-Controlling firms it goes from 29% for a founder-CEO to 58% for a non-founder family CEO. Although not definitive, the evidence strongly suggests that non-founder family management is more likely than founders or nonfamily management to bring other family members onto the board of directors.[16]

2.4.4.3 Governance Variables

The Governance variables include the G-Index introduced in Gompers, Ishii, and Metrick (2003), two variables giving the fractional ownership of family and institutions (*famown*, *instown*), and a dichotomous variable indicating the presence of a dual share structure (*dualshrs*).

In an important and oft-cited paper, Gompers, Ishii, and Metrick (2003) find that, during the 1990s, stock returns of firms with strong shareholder rights outperform, on a risk-adjusted basis, returns of firms with weak shareholder rights by 8.5%/year. The G-Index of Gompers et al., widely cited in the literature

[16] In contrast to agency theory, stewardship theory prescribes a board structure mainly characterized by insiders or affiliated outsiders linked to the organization or to each other by social and family ties. See Sundaramurthy and Lewis (2003).

as a measure of managerial entrenchment (e.g. Bebchuk, Cohen, and Ferrell, 2009, Fahlenbrach, 2009) and of corporate governance quality more generally (e.g. Bhagat and Bolton, 2008, Ferreira and Laux, 2007), is a composite of the twenty-four corporate governance variables representing barriers that a firm can use to insulate its managers from hostile takeovers. The index ranges from zero to twenty-four where a higher score indicates more restrictions on shareholder rights or a greater number of anti-takeover measures. The relevance to the current study is that the G-index score may be an indicator of the impact of family entrenchment on family firm value.

From Table B.4, Passive firms have the highest G-Index and Controlling firms have the lowest G-Index of the three family-firm types. The mean G-Index of Passive firms was 9.625 compared to 9.081 for Non-Controlling and 8.085 for Controlling firms. From Table B.5, the differences between Passive and Active firms is statistically significant (on t and z) as is the difference (on t and z) between Non-Controlling and Controlling firms.

Institutional ownership refers to the ownership stake in a company held by large financial organizations, pension funds or endowments.[17] Woidtke (2002) found that institutional monitoring is associated with valuation effects, but the valuation effects vary according to the objective functions of institutions' administrators. Thus, other shareholders do not necessarily benefit from relationships between institutions and managers, and they could be hurt when the institutional agents watching firm agents, themselves have conflicts of interest with other shareholders. In my sample Active firms have higher institutional ownership than Passive firms. Controlling firms have 11.2% institutional ownership, Non-Controlling firms have 9.0% and Passive firms have 7.4%. The differences between Controlling firms and the others is statistically significant (on t and z) as is the difference (on t) between Non-Controlling and Passive firms.

Regarding family ownership, previous studies have found that it does affect firm value. Anderson and Reeb (2003) and Barontini and Caprio (2006) presented evidence that family ownership increases firm value. Villalonga and Amit (2006), on the other hand, found that family ownership creates value only when the founder serves as CEO of the family firm or as Chairman with a hired CEO. As with institutional ownership, Active firms in my sample have higher family ownership than Passive firms. Controlling firms are 24.2% owned by family, Non-Controlling firms 12.0% and Passive firms 10.5%. The differences between Active and Passive firms is significant (on t and z) as is the difference between Controlling and Non-Controlling firms (on t and z).

Dual-class shares separate voting rights from ownership rights. In the typical dual-class company, there

[17]Researchers have put much effort into measuring the impact of institutional ownership on firm performance. See for example Duggal and Millar (1999) and Wahal (1996) for two different approaches.

is a publicly traded “inferior” class of stock with one vote per share and a non-publicly traded “superior” class of stock with ten votes per share[18]. A number of studies find that firm value is lower when voting rights exceed cash-flow rights. (See for example Claessens et al., 2002, Lins, 2003, Gompers et al., 2010.) From Tables B.4 and B.5, a higher proportion of Active than Passive firms have a dual share structure. Controlling firms have a higher likelihood of a dual share structure than Non-Controlling or Passive firms and significantly so. Dual share structures occurred roughly 28% of the time in Controlling firms and 10% in Non-Controlling firms vs. 7% for Passive firms. The differences between Controlling firms and the others is statistically significant (on t and z) as is the difference (on t) between Non-Controlling and Passive firms. It should also be noted that dual share firms are significantly older than average - 59.6 vs. 37 years, 67.7 vs. 37.1 years and 106 vs. 71.7 years for Controlling, Non-Controlling and Passive firms respectively.

Perhaps surprising, the 28% of Controlling firms that have a dual share structure have a G-Index of 7.0, significantly *lower* than the average 8.085 for Controlling firms. Similarly, the 10% of Non-Controlling firms that have a dual share structure have a G-Index of 8.2, significantly lower than the average 9.081 for Non-Controlling firms. By contrast, the 7% of Passive firms that have a dual share structure have a G-Index of 10.3, *higher* than the average 9.625 for Passive firms (but not significantly so).

Since the common perception is that a dual share structure is associated with poor governance and institutional ownership with good governance, it is perhaps surprising that dual share firms have *higher* institutional ownership than average for all three firm types. The institutional ownership for Controlling, Non-Controlling and Passive firms with dual shares is 12.8%, 10.5% and 11.7% compared to the averages in Table B.4 of 11.2%, 9.0% and 7.4% respectively. However, these differences are not significant.

As might be expected, dual share firms have significantly higher family ownership than average[19]. For Controlling, Non-Controlling and Passive firms with dual shares, family ownership is 51.8%, 31.2% and 55.2% respectively compared to respective averages of 24.2%, 12.0% and 10.5%.

To summarize the variables that proxy for corporate governance, Passive firms have a lower proportion of dual share firms and a lower average family ownership, but also a lower proportion of institutional ownership and a higher average G-Index. On the other hand, Active firms have the highest proportion of institutional ownership and a lower average G-Index score, but also a higher proportion of dual share firms and higher average family ownership.

[18]On average, insiders have approximately 60 percent of the voting rights and 40 percent of the cash-flow rights in dual-class firms. See Gompers et al. (2010).

[19]Nenova (2001)reports that 79% of dual-class firms in her international sample, and 95% of U.S. dual-class firms are family firms. Gompers et al. (2010) find that the single most important determinant of dual-class status is having a person’s name in the firm’s name (e.g. Wrigley, or Ford).

2.4.4.4 Board Variables

The Whole Board

For the whole board the variables are number of directors (*ndirs*), number of employee family directors (*famempls*), number of non-employee family directors (*famdirs*), number of independent directors (*indpdirs*) and number of affiliated directors (*lnkddirs*) that serve on the board.

Jensen (1993) suggests that large boards may be less effective monitors than small boards. Yermack (1996), in a widely cited study, finds an inverse association between board size and firm value. Confirming the Yermack result, Eisenberg et al. document that a similar pattern holds for a sample of small and midsize Finnish firms. Within my sample, Passive firms have significantly larger (on t and z) boards than Active firms.

Anderson and Reeb (2004) find that interests of minority shareholders are best protected when independent directors have greater power relative to family blockholders. Whether or not having more independent directors increases corporate performance however, is probably the most discussed question regarding boards in the literature. After reviewing the methods researchers have used and citing the research that used these methods, Hermalin and Weisbach (2003), in an oft-cited review article, conclude that "... there does not appear to be an empirical relationship between board composition and firm performance." The one notable exception that they cite is Rosenstein and Wyatt (1990) who, on the day of the announcement that outside directors will be added to the board, find a statistically significant 0.2% increase in stock price on average, in response to the announcement. Within my sample, over the sample period, Passive firms had significantly (on t and z) more independent directors than either Controlling or Non-Controlling firms with almost twice as many as Controlling. Between the Active firms Non-Controlling firms had 72% more independent directors than Controlling firms and the difference was significant on t and z.

Regarding family directors, Anderson and Reeb (2004) present evidence that excessive family representation on the board relative to independent directors increases the likelihood of the family expropriating wealth, whereas too little family representation relative to independent directors potentially reduces managerial monitoring and hinders the board's effectiveness. In my sample Passive firms have more than twice as many non-employee, non-founder family directors as Active firms and the differences are again significant on t and z. Controlling firms have significantly (on t and z) more such directors than Non-Controlling firms.

On the other hand, Active firms have more than twice as many (significant on t and z) non-founder family directors who are employed by the firm than Passive firms. Controlling firms have more than Non-Controlling firms and that difference is also statistically significant on t and z. At the same time, Active firms have significantly (on t and z) less independent directors than Passive firms and Controlling firms have significantly (on t and z) less than Non-Controlling firms.

Directors currently employed by or previously retired from the firm, their immediate family members, and individuals with existing or potential business ties to the firm are identified as affiliated directors[20]. Fich (2005) reports that independent boards and companies with high institutional ownership are more likely to appoint outside directors and less likely to appoint affiliated directors, suggesting that such firms favor monitoring by outsiders to reduce potential conflicts of interest. He further finds, in contrast, that ownership by insiders is positively related to the appointment of affiliated directors and inversely related to the likelihood of independent outside appointments, suggesting that insiders may prefer less intense monitoring. Almost as an exclamation point, Helland and Sykuta (2005) find firms that are defendants in securities litigation have higher proportions of insiders and of affiliated directors and have smaller boards than a matched group of firms that are not sued. As pertains to affiliated directors, Controlling firms have more than twice as many (significant on t and z) affiliated directors as either Non-Controlling or Passive firms. Non-Controlling firms also have more than Passive firms but the difference is not statistically significant.

The picture that emerges from inspection of these board variables is that, compared to Active firms, Passive firms have larger boards, more independent directors, more family directors but less family employee directors and fewer affiliated directors. On the other hand, Controlling and Non-Controlling firms have similar board sizes, but compared to Non-Controlling firms, Controlling firms have fewer independent directors and more family directors, more of whom are employed by the firm.

The Nominating Committee

The remaining board variables are numbers of director types associated with the nominating committee. I focus on the nominating commitee because, as suggested by the theoretical model of Section 2.2, control of the nominating committee could be a way to capture and maintain control of a majority of votes on the board. Indeed, as pointed out in Vafeas (1999), in theory, director appointments are made by shareholders. In practice, however, shareholders simply ratify director appointments selected by the board itself. Although I am not aware of other studies relating firm value to the size of the nominating committee, it is interesting that Controlling firms have significantly (on t and z) larger nominating committees than either Non-Controlling or Passive firms. Passive firms though, have significantly (on t and z) larger nominating committees than Non-Controlling firms. In addition, Controlling firms have more than twice as many (on t and z) affiliated (linked) directors as either Non-Controlling or Passive firms and Passive firms have significantly (on t) more

[20] See Anderson and Reeb (2003).

than Non-Controlling firms. Controlling firms also have more than twice as many (significant on t and z) family directors on the nominating committee as either Non-Controlling or Passive firms. The difference in family director committee membership between Non-Controlling and Passive firms is not significant. However Passive firms have more than twice as many non-employee, non-founder family directors than Active firms. The differences are significant (on t and z). As might be expected, Controlling firms have significantly (on t and z) more such family directors than Non-Controlling firms.

The nominating committee evidence seems to shed light on how Controlling firms maintain control. Although the smallest in size of the three firm types, Controlling firms have the largest nominating committees and, relative to the other firm types, these are "packed" with management allies, i.e. more family members, more affiliated directors and fewer independent directors than either of the other two firm types. This is supportive of the hypothesis relating the nominating committee to board control.

Non-Controlling firms, on the other hand, have the smallest nominating committees and seemingly the least objectionable nominating committee membership. Despite having fewer independent directors than Passive firms, Non-Controlling firms have fewer affiliated directors and fewer family directors serving as committee members.

2.4.4.5 Summary

With respect to their Financial, Family Management, Governance and Board variables, the univariate analysis has shown how family firm types - Controlling, Non-Controlling and Passive - differ. Evidence from the Financial variables is unclear on the contribution to value of family board control. On the other hand, evidence from the Board variables relating to the nominating committee seems to give strong support to a connection between committee membership and board control.

2.4.5 Multivariate Analyses - Differences in Performance Between Firm Types

Table B.6

Moving from a univariate to a multivariate framework presents an opportunity to test Hypotheses 1 - 3. Table B.6 presents logit regressions with $bdctrl$ - a variable that equals 1 if $ndirs > 2 * indpdirs$ and 0 otherwise - as the dependent variable. In column (1) both Active and Passive firms are used in the regression. In Columns (2) and (3) only Active and Passive firms respectively are used.

In column (1) d_Pass is a variable that equals 1 if the firm is Passive and 0 otherwise. I use d_Pass to test Hypothesis 1 - that Passive families are more likely than Active families to exercise control of the votes of board of directors. Since the coefficient on *d_Pass* is positive and significant at 1%, the data clearly show that Passive families are significantly more likely than Active families to control board votes.

Moving to Hypothesis 2, recall that it posited a significant positive correlation between control of the board of directors and the number of affiliated directors on the nominating committee. The variable *nclnkd* is the number of affiliated directors on the nominating committee. Examining the coefficients on *nclnkd* in columns (2) and (3) reveals that Hypothesis 2 is supported for Active firms but not for Passive firms. The coefficient for Active firms is positive and significant at .1% whereas that for Passive firms is not significant. Thus, as suggested by Hypothesis 2, the more affiliated directors on the nominating committee of an Active family firm, the more likely the family will control board votes. By contrast, the number of affiliated directors on the nominating committee of a Passive family firm has no effect on the likelihood of the family to exercise control of the board.

Actually, apart from Hypotheses 1 and 2, Table B.6 provides information about variables that significantly differentiate Active and Passive family firms on board control. For example from the coefficient on *wq* ($p = .05$) in column (3), the more valuable a Passive firm is, the less likely is the family to control the votes of the board. Similarly, the higher the debt ratio (*debt*, $p = .001$) a Passive firm has, the less likely is the family to exercise control of board votes. This suggests that in Passive family firms, board control and debt may be substitute mechanisms for constraining the nonfamily CEO. By contrast, from the coefficient on *fndrdir* ($p = .05$), having the founder sit on the board of a Passive firm makes it significantly *more* likely that the family will control board votes. From column (2) though, note that neither firm valuation nor debt nor having a founder as a director has any influence on the likelihood of Active families exercising control of board votes. On the other hand, from the coefficient on *famempls* ($p = .001$) in column (2), the more family employees on the board of an Active family firm, the more likely is the family to control the votes of the board. For Passive family firms, the number of family employees on the board has no effect on the likelihood of the family to control the board.

Active and Passive family firms also have some commonalities with regard to board control. The coefficients on *indpdirs* ($p = .001$) shows that for both family firm types, the family is less and less likely to exercise board control as the number of independent directors increases. The effect is more pronounced in Passive family firms. Again for both firm types, the number of affiliated directors though, has the opposite effect. From the coefficients on *lnkddirs* (Active $p = .001$, Passive $p = .01$), even though the presence of affiliated directors on the nominating committee for Passive firms had no effect on the likelihood of family control of board votes, their general presence on the board *does* increase the likelihood. For both family firm types, the more affiliated directors on the board, the greater the likelihood the family will control board votes. From the coefficients on *famdirs* ($p = .001$), the same is true for nonemployee family directors.

Among Active family firms, it is interesting to see that a non-founder family CEO (*famceo*, $p = .05$) decreases the likelihood of family board control whereas the presence of a non-founder family chairman (*famchmn*, $p = .01$) increases it. Because Active family firm types are defined in terms of board control, I cannot run regressions for Controlling and Non-Controlling firms separately.

Table B.7

Table B.7 presents OLS regressions for each firm type using Tobin's Q as the dependent variable. Column (1) constitutes a test of Hypothesis 3. *d_ Ctrl* equals 1 if a firm is Controlling and 0 otherwise. Recall that of the three family firm types, Non-Controlling firms have the highest average value of Tobin's Q. If the coefficient of *d_ Ctrl* were negative and significant, it would support Hypothesis 3 - that family control of board votes detracts from firm value. The coefficient is negative, but not significant. Therefore, for this data set, as measured by Tobin's Q, control of the votes of the board of directors does not detract from firm value. In a regression not shown here, the same negative result was obtained when ROA was used as the dependent variable.

Columns (2)-(4) provide insight into what determines value for the three family firm types. Clearly, Active firm value is ROA-driven whereas Passive firm value is not. For Controlling family firms the ROA elasticity of Q is approximately .20[21]. For Non-Controlling family firms the elasticity figure is approximately .46[22]. This means that a 1% increase in ROA will increase the Q of Controlling family firms by about .20% vs. that of Non-Controlling firms by about .46%. Apparently Non-Controlling family firms are more effective than Controlling family firms at converting profitability into firm value. It is also interesting that having a non-founder family member as CEO (*famceo*) detracts from Controlling family firm value ($b = -4.8434$, $p = .0144$) but does not significantly affect Non-Controlling family firm value whereas having dual shares (*dualshrs*) detracts from Non-Controlling family firm value ($b = -.8667$, $p = .0223$) but does not significantly affect Controlling family firm value.

For Passive family firms, the most significant contributor to firm value is having family members on the board. The coefficient for a founder on the board (*fndrdir*) is 6.2224 ($p = .0017$) and for a non-founder family member (*famdir*) is 5.9044 ($p = .0059$). The only variable that significantly detracts from Passive family firm value is firm size (*size*, $b = -.9704$, $p = .0356$).

[21] $e = \frac{\Delta q}{\Delta roa} \frac{roa}{q} = 2b_{roa}\overline{roa}\frac{\overline{roa}}{\bar{q}} = 2\,(17.062)\,(.128)\,\frac{.128}{2.753} = .203$

[22] $e = \frac{\overline{roa}}{\bar{q}}\left(b_{roa} + 2b_{roa2}\overline{roa}\right) = \frac{.128}{3.00}\left[3.6 + 2\,(27.979)\,(.128)\right] = .459$

2.5 Conclusion

I began by exploring theoretically the factors that would allow a founding family to control the votes of the board of directors. I analyzed the outcome under two conditions on family management - a family-affiliated and a nonfamily CEO - and two conditions on board control - the family does and does not have a voting majority. The analysis showed that in all cases, by controlling rewards to insiders, the family could control the votes of the board. Further, the analysis suggested that when examining actual data, I should focus on three types of family firms: 1) firms where the family is active in management and has a voting majority (Controlling family firms), 2) firms where the family is active in managment but does not have a voting majority (Non-Controlling family firms) and 3) firms where the the family is not active in management (Passive family firms). For convenience, I group Controlling and Non-Controlling firms together as Active firms.

Using a data set consisting of family firms on the S&P 500 between 1996 and 2003 and partitioned as described earlier, I find control of the votes of the board of directors is more likely to occur in Passive than in Active firms. Further, I find significant support for the importance of the nominating committee in controlling the majority of votes on the board.

Regarding the impact that family control of board votes has on family firm value, there are subtle clues that such control diminishes firm value. For example Non-Controlling family firms have a higher Tobin's Q than Controlling family firms, although the difference is not statistically significant. In addition, the ROA of Controlling and Non-Controlling family firms are nearly the same. Since Q of Non-Controlling firms is higher than that of Controlling firms yet the ROA of Controlling and Non-Controlling firms are virtually identical, the suggestion is that the conversion of profitability to firm value is less efficient for Controlling family firms. Maury (2006), in a paper on family firms in Western Europe, notes that while active family management increases profitability compared to nonfamily firms, "... such increased profitability does not translate into higher valuations when shareholder protection is low." Nevertheless, In agreement with Barontini and Caprio (2006), I find no statistical support for the conclusion that disproportionate board representation of families in family firms detracts from firm value. However, this result does run counter to other research (See for example Claessens et al., 2002, Lins, 2003, Gompers et al., 2010, Villalonga and Amit, 2006, 2009.)

Finally, although not a central topic of research in this paper, these results also have relevance to stewardship theory. As discussed in Anderson and Reeb (2004), stewardship theory has been put forward as an alternative to agency theory to explain the relations between founding families and boards. According to this theory, founding-family members identify closely with the firm, viewing firm health as an extension of their own well-being (Davis, Schoorman, and Donaldson, 1997; Gomez-Mejia, Nunez-Nickel, and Gutierrez, 2001). Acting as stewards, families may place directors on the board to provide industry-specific expertise, to provide objective advice and to act as advocates for corporate health and viability (Adams and Ferreira, 2007). Intuition suggests that one would be more likely to find the "good stewards" of the theory among Passive families. However, the univariate evidence conveys that the presence of family members on the boards of Passive family firms contributes to excessive (relative to Active firms) debt and entrenchment. As repeatedly mentioned, it may be that debt is being used by Passive families as a way to reduce free cash flows that might otherwise be diverted by nonfamily management. It is also worth noting again that Passive family firms have the lowest Q among the three family firm types. Thus, even if families do behave as posited by stewardship theory, there is an endogenous cost imposed on nonfamily shareholders in Passive family firms despite the hypothesized good intentions of the family "stewards".

Essay 3

The Impact of Negative Media on the CEO and Board of Directors

Abstract

A few recent empirical studies examine the effect of the media on a firm's corporate governance and allude to the positive influence of media on firm-level governance. This essay extends that work by presenting a novel exploration of the theoretical relationships between the media and the corporate board. The analysis in this essay shows how the threat of media exposure can affect the decision-making of a CEO considering diverting project resources for personal consumption, and that of the inside board members who must approve his proposed project implementation. To elucidate the consequences to a CEO who is contemplating such resource diversion, prior studies in social network modeling and psychological game theory are applied to derive and apply the cost of a negative media report to both the corporate insiders on the board and the CEO who is the focus of the media attention. The analysis reveals that the certainty of public exposure will discourage most CEOs from attempting diversion. For the CEO who is unfazed by the threat of public exposure, it is highly probable that he will be abandoned by formerly supportive corporate insiders' even if the private benefits of supporting the 'tainted' CEO are substantial.

3.1 Introduction

The scandal that would eventually lay waste to Rupert Murdoch's ambition to dominate U.K. media began, fittingly enough, with a news story. In 2005 *News of the World*, a British Sunday-only tabloid and flagship newspaper of Rupert Murdoch's U.K. media empire, published a story containing confidential information on the knee injury of Prince William, Queen Elizabeth's grandson and second in line to the throne. That lead royal court officials to complain to police about intercepted voicemails. The police opened an investigation. In August of 2006, detectives arrested the *News of the World*'s royal editor Clive Goodman and private investigator Glenn Mulcaire over allegations that they hacked into the mobile phones of members of the royal household. In January of 2007, Goodman and Mulcaire were jailed for four and six months, respectively. After the sentencing, Andrew Coulson, editor of *News of the World* since 2003, resigned claiming "ultimate responsibility" for the hacking, but denying any knowledge of it. In May Coulson became the Conservative Party's director of communications.

In April of 2008, James Murdoch, Rupert Murdoch's son and chief executive of *News Corp.*'s European and Asian operations, agreed to pay more than $1 million to settle another phone hacking claim.

In July 2009, *The Guardian* reported that several *News of the World* journalists had intercepted the voicemails of celebrities and politicians, with the knowledge of senior staff, and that its parent company had paid more than $1.6 million to settle phone-hacking cases that could have unearthed evidence of broader hacking at the paper. Scotland Yard refused to reopen the case.

In May 2010 Conservative Party leader David Cameron was elected Prime Minister and astonishingly, hired Coulson as his media chief. In September, *The New York Times* published a report, based on information from several former *News of the World* reporters and editors, that Coulson knew about and regularly discussed phone-hacking during his tenure. The *Times* article was also critical of Scotland Yard's efforts to investigate the hacking. In January 2011, Coulson resigned as Cameron's communication chief and Scotland Yard opened a new investigation of *News of the World* phone-hacking, citing new evidence.

In early July of 2011 public outrage, which had been building with each new revelation, swelled to a crescendo when it was reported that victims of the phone hacking included Milly Dowler, a murdered teenager and victims of the 2005 London train bombing. That revelation opened the floodgates. *News Corp.* closed the *News of the World*, Britains best-selling Sunday newspaper and dropped its bid for full control of British Sky Broadcasting, a deal that was considered all but done just days prior. Coulson was arrested, and Goodman was arrested again, this time for bribing police officers. David Cameron's judgment became a political issue. High-ranking *News Corp.* executives were forced to resign as was the head of London's Metropolitan Police as well as Scotland Yard's counter-terrorism chief. In the U.S. the FBI opened an inquiry into allegations that *News of the World* tried to intercept the phone records of victims of the Sept. 11, 2001, terrorist attacks on New York city.

As of this writing, Rupert Murdoch and his son James have appeared before a committee of Parliament to answer questions about the scandal, something that would have been unthinkable just a few weeks prior. It is reported that Rupert Murdoch said he was "ashamed" of the phone-hacking scandal, but has no intention of resigning. Nevertheless, some media outlets are reporting rumors that the board of *News Corp.* has selected a non-Murdoch to replace Rupert Murdoch as CEO.

The *News Corp.* scandal illustrates all of the elements that will be discussed in this essay - negative media, a misbehaving CEO, an outraged public and a board being reluctantly forced to act. As the scandal demonstrates, the cost to a corporate executive of a negative media report and its impact on the board of directors can be substantial. Surprisingly, the cost and its consequences have largely escaped theoretical scrutiny. Academic interest in the role of the media was apparently launched by Dyck and Zingales (2002) in a seminal paper entitled "The Corporate Governance Role of the Media" which outlined the channels through which the influence of the media acts on the firm and showed their practical relevance. Thereafter the literature bifurcated into two separate strands. One strand investigated the impact on the market of a firm receiving media attention. Dyck and Zingales (2003) discussed the effect of media coverage on asset prices. Nguyen-Dang and Shatin (2005) investigated how media coverage of CEOs affected the value of their firms. Veldkamp (2006) modeled surges in prices (frenzies) and cross-market price dispersion (herds) that often accompanies abundant media coverage of emerging market firms. Bushee, Core, Guay, and Hamm (2007) examined the impact of the press on firms' information environments during earnings announcements. Kaniel, Starks, and Vasudevan (2007) investigated the role of media coverage in investment decisions of mutual fund investors. Tetlock (2007) measured the interactions between the media and the stock market using daily content from a popular Wall Street Journal column. Finally, Meschke (2011) investigated whether media attention systematically affects stock prices by analyzing price and volume reactions to CEO interviews that were broadcast on CNBC between 1997 and 2006.

The other strand of the literature, of which this essay is a part, examined the impact of the media spotlight on a firm's corporate governance. Hamilton and Zeckhauser (2004) found that CEOs who generate soft news articles in the business and finance press are more likely to be charged later with evading regulations or misusing company resources. Knyazeva (2007) examined the potential role of analysts and media as additional mechanisms that monitor firm management. Louis, Joe, and Robinson (2007) investigated how media exposure of board ineffectiveness affects corporate governance, investor trading behavior, and security prices. Core, Guay, and Larcker (2008) examined the role of the press in monitoring and influencing CEO compensation. Dyck, Volchkova, and Zingales (2008) studied the effect of media coverage on corporate governance by focusing on Russia in the period 1999 to 2002. They found that coverage in the Anglo-American press increased the probability that a corporate governance violation is reversed. Finally, Malmendier and Tate

(2009) in an interesting study of the effects of positive media on CEOs, found that award-winning ("superstar") CEOs subsequently underperform, both relative to their prior performance and relative to a matched sample of non-winning CEOs. At the same time, superstar CEOs extract more compensation following the awards, both in absolute amounts and relative to other top executives in their firms.

Notice that the papers cited as being in the corporate governance strand are all empirical. To the best of my knowledge, the present essay is among the first to initiate a *theoretical* analysis of media's impact on corporate governance. In Essay 1 I studied the problem of a CEO considering diversion of project resources for personal benefit in the presence of an independent blockholder. In Essay 2 I studied the same duplicitous CEO in the presence of a family blockholder. In this essay, the CEO is again considering resource diversion, but this time in the presence of media scrutiny. Using a social network[1] model to calculate the cost of a negative media report, I show how the threat of media exposure can affect the decisionmaking of a CEO considering diversion of project resources for private benefit and that of the inside board members who must approve his dishonest project implementation.

A typology of media would include network television, radio, newspapers, magazines, cable and satellite television, public broadcasting, news agencies, news aggregator websites, news comment websites and blogs among others. For purposes of this analysis the union of these multitudinous sources of information constitute "the media." Similarly, the analysis abstracts from the numerous sources from which the various media outlets get their information. For example in Dyck, Morse, and Zingales (2007), the authors examine which actors "blow the whistle" among other questions related to corporate fraud. They provide a list of whistleblowers which includes non-financial market regulators, auditors, the SEC, analysts, short sellers, strategic players, external equity holders, employees and lawyers in legal proceedings. If information from any of these sources lead to a negative media report about a corporate manager, the analysis ascribes the impact of the negative report to "the media" regardless of the original source.

In the research reported here, the role of the media is to broadcast a negative opinion about management to all members of the managers' individual social networks simultaneously. The analysis then explores how the members of their respective social networks reach a social consensus on the managers who are the subjects of the negative media report, and how a negative consensus affects the decisionmaking of those managers

The essay is organized as follows. In Section 3.2.1 I give examples to justify the use of the model of the adoption of a network good in Sundararajan (2007) to represent the creation of a social consensus. In Subsection 3.2.2 I briefly explain how the results in Sundararajan (2007) (more fully explained in Appendices

[1] A social network is a social structure made up of individuals connected by ties of friendship or common beliefs or financial exchange or some other kind of interdependent relationship. A precise mathematical description will be given in Appendix C.2.

C.2 and C.3) give rise to the cost of negative media used in the subsequent analysis.

The analysis of the impact of negative media is in Section 3.3. Section 3.3.1 presents the CEO's dilemma as a standard problem in finance. In Section 3.3.2, I depart from the standard framework by analyzing the problem as a psychological game (Geanakoplos, Pearce, and Stacchetti, 1989). Using the cost of negative media derived in Appendix C.3 and discussed in Section 3.2.2, I first demonstrate the impact of that cost on a CEO contemplating diversion of project resources. The analysis takes advantage of the fact that the cost fits neatly into the framework of Tadelis (2007), originally developed to analyze the effect of shame on behavior[2]. Using that framework, I show how the threat of public shame potentially divides CEOs into three groups: (1) those who would never divert resources, (2) those who would divert if there were no media exposure and (3) those who would divert even in the face of media exposure.

In Section 3.3.3 I again use the cost and the Raheja (2005) board model (used in the first and second essays) to show how the threat of media exposure and the accompanying public shame affect the willingness of inside board members to support the CEO. I show that a CEO who is not deterred by threat of public shame will no longer be able to count on the support of the inside board members. When insiders in the model take into account the personal cost of media exposure, a vote in support of the CEO that without media exposure would have passed unanimously, is thrown into doubt. This theoretical result is given empirical validity by Louis, Joe, and Robinson (2007). These authors examine the effect of the negative publicity associated with the inclusion of a firm on the Business Week worst-board list. They report that of the 34 worst-board firms that take visible corrective actions, 28 (82%) replace their CEOs, presidents, or board members.

Five appendices are included. Appendix C.1 contains the proofs of results from Section 3.3. Appendix C.2 reviews and adapts the Sundararajan model to the adoption of a negative opinion on a social network. As mentioned, Appendix C.3 uses the analysis from Appendix C.2 to derive the cost of negative media to corporate managers. Because network theory may be unfamiliar, background is provided in Appendices C.4 and C.5. In Appendix C.4 I give background on social networks in general with special emphasis on social networks in economics. In Appendix C.5 I provide background on global games, of which, the model of Sundararajan (2007) is an example.

[2]According to Dyck and Zingales (2002), one of the ways that media helps to enforce corporate law is the threat to publicly shame corporate managers.

3.2 Social Network-Induced Costs

3.2.1 The Social Consequences of Non-Adoption

This study uses the ideas developed to model the adoption of a homogeneous network good by an individual in a social network, first presented in Sundararajan (2007) and outlined in Appendix C.2, to model the creation of a social consensus. Superficially, a new technology spreading through a network of consumers and an opinion spreading through a social network might not appear comparable. A moment's reflection, however, reveals an obvious commonality - in both cases, there is *social* pressure to adopt and failure to adopt has negative *social* consequences.

To see the social consequences of non-adoption in the case of a new technology, consider the early days of cell phones. According to the Statistical Abstract of the United States, in 1990 there were about 5.3 million subscribers. By 1997, that number had risen to about 55.3 million. As more and more people began to own cell phones it became harder and harder *not* to own one. Requests for a cell phone number began to come from all quarters - friends, relatives, colleagues. Any request for personal information (e.g. an employment application) invariably included a home phone and a cell phone number. After 1997, to not own a cell phone was to label oneself either a Luddite or poverty-stricken.

For an example of the social consequences of flouting public opinion, consider Joe Barton of Texas, a Republican and in 2010 the ranking member on the House Energy Committee. On April 20th, 2010 the explosion of BP's *Deepwater Horizon* oil rig in the Gulf of Mexico resulted in the death of 11 men and the largest accidental marine oil spill in the history of the petroleum industry. The spill caused extensive damage to marine and wildlife habitats as well as the Gulf's fishing and tourism industries and has been called the greatest environmental catastrophe in the history of the United States. To make matters worse Tony Hayward, BP's CEO, created a PR disaster by insensitive remarks concerning the effects of the spill on the Gulf. In response to the spill, the Obama administration demanded that BP pay for the cleanup. BP agreed and in addition, set up a $20 billion fund administered by a third party to pay damage claims. As one of many investigations into the disaster, in June of 2010, Congress invited the now-reviled BP CEO Tony Hayward and other leading company executives to testify about the spill before a subcommittee of the House Energy and Commerce Committee. In an extraordinary lack of judgement, in his opening remarks Barton apologized to BP CEO Hayward for the $20B "shakedown" by the Obama White House. An uproar ensued. The Republican leadership moved quickly to distance itself from Barton. Rep. Jeff Miller of Florida, one of Barton's Republican colleagues in the House, called on him to step down as the ranking Republican on the committee. Faced with immediate and near-universal condemnation, Barton apologized for his apology to Hayward later the same day. Although the political damage was apparently contained (it was subsequently announced that he would be allowed to keep his committee status), the *social* damage was already done. Within the ecology community, he was held up as an example of elected representatives selling out the safety of the people for campaign contributions. Newspapers editorialized against him[3] and late-night TV comedians lampooned him.

Given the commonality (at least in kind) of social consequences, it is perhaps not surprising that the mathematics that explains the adoption of a product across a consumer network, also explains the creation of a consensus across a social network.

3.2.2 The Social Cost of Negative Media to Insiders[4]

By "insiders" I mean both the CEO and inside members of the board of directors. Each insider is a member of overlapping network neighborhoods. The complete network consists of the union of members' neighborhoods and is extensive, so that no network member has knowledge of the entire network. However, each member has knowledge about his or her network neighborhood (that could consist of family and friends or business associates, depending on the nature of the network). Based on the negative media report, every member of an insider's network neighborhood forms an opinion, positive or negative, about the insider's honesty.

A member of the network is referred to as an "agent." Suppose that each agent i not an insider forms the same expectation about the behavior of other non-insider agents in their neighborhood, viz. a probability λ that any arbitrary non-insider neighbor will adopt the negative opinion. Based on this expectation λ, the probability that y of their x neighbors will adopt the negative opinion is described by the binomial distribution $b(y|x,\lambda)$where

$$b(y|x,\lambda) \equiv \binom{x}{y} \lambda^y (1-\lambda)^{x-y}$$

and agent i's expected value from adopting the negative opinion is given by $v(x,t,\lambda) - c$ where

$$\begin{aligned} v(x,t,\lambda) &= \sum_{y=1}^{x} u(y,t)\, b(y|x,\lambda) \\ t &\equiv \text{agent type} \\ u(y,t) &\equiv \text{value of } y \text{ neighbor adoptions to an agent of type } t \\ c &\equiv \text{the cost of adopting the negative opinion} \end{aligned}$$

[3]See for example the New York Times, "A Bad Day for BP and Mr. Barton", June 17, 2010

[4]Full explanations and derivations of the expressions in this section are contained in Appendices C.2 and C.3.

Let an insider be labeled κ. The adoption of a negative opinion about κ's honesty by κ's neighbors imposes a *cost* ξ_κ on agent κ. Let the value function for agent κ be linear in the number y of neighbors who adopt the negative opinion, i.e.

$$u(y, \theta_\kappa) = -\xi(\theta_\kappa)\, y$$

Then the expected cost to agent κ arising from his network neighbors' negative opinion of his honesty is

$$v(d_\kappa, \theta_\kappa, \lambda) = -\sum_{y=1}^{d_\kappa} \xi(\theta_\kappa)\, y\, b(y|d_\kappa, \lambda) = -\xi(\theta_\kappa)\, d_\kappa \lambda$$

or

$$v(d_\kappa, \theta_\kappa, \lambda) = -\xi_\kappa d_\kappa \lambda$$

where $\theta_\kappa \equiv$ insider κ's type, $d_\kappa \equiv$ the number of insider κ's neighbors and $\xi_\kappa \equiv \xi(\theta_\kappa)$.

θ_j - agent j's type - is agent j's internal assessment of the likely honesty of agent κ. From Appendix C.2, $\theta_j \in [0,1]$ with higher values representing greater certainty of insider κ's dishonesty. θ_κ, on the other hand, is interpreted as insider κ's estimate of $E[\theta_j]$ for all $j \neq \kappa$ where the expectation is based on κ's subjective probability distribution. That is, θ_κ is insider κ's subjective measure of how other agents view him. Generally, the less others think of us, the worse we feel. To capture this idea, let $\xi : [0,1) \to [0,\infty)$ with $\xi' > 0$, and following Tadelis (2007), interpret ξ as a measure of *shame aversion* where shame is understood as involving the sense that one has done something that makes one "flawed," "no good," "inadequate," or "bad" in the eyes of others. Thus a person with a low shame aversion and a large number of network neighbors can have the same cost as someone with a high shame aversion and a small number of neighbors.[5]

Notice that the cost, $\xi(\theta_\kappa)\, d_\kappa \lambda$, to insider κ depends on κ's belief about the beliefs of other agents in the network. This puts the analysis in the realm of *psychological games* pioneered by Geanakoplos, Pearce, and Stacchetti (1989) and extended by Rabin (1993), Battigalli and Dufwenberg (2005) and Tadelis (2007) among others. A psychological game differs from a traditional game in that utilities are defined on beliefs (about actions and beliefs), as well as on which actions are chosen. I make use of this literature in Section 3.3.

[5]Bernard Madoff, the disgraced portfolio manager sentenced to 150 years in prison in 2009 for swindling investors out of over $60B in a Ponzi scheme, may be the ultimate example of the first category. An unfortunate example of the second is perhaps Mark Madoff, his son, who committed suicide in 2010 on the second anniversary of his father's arrest.

3.3 The Effect of Negative Media on Managerial Decisionmaking

3.3.1 The diversion game

Consider the following abbreviated version of the CEO's decision whether or not to divert project resources, used in the first and second essays. The world is risk-neutral with no discounting. There are three times $t = 0, 1, 2$ and two periods. At $t = 0$ a firm has access to a project that will produce cash flows of X with probability 1. However, the market believes that with probability p the project will produce cash flows of at least X and with probability $1 - p$ cash flows less than X. The CEO - M - is considering diverting a portion of the resources allocated for project implementation for personal consumption. That is, at $t = 0$, M decides whether or not to divert project resources, an action that will reduce the cash flows available for investment and result in lower firm value but produce a stream of private benefits. If M diverts, firm value decreases by uX where the measure of loss resulting from the diversion, u, is a random variable, and M receives the private benefit $B > 0$. I assume no blockholder and the same board model and voting and succession rules as in Essay 1. However, for expositional clarity, I use a simplified CEO decision model.

The timeline is as follows.

$t = 0$ The CEO and corporate insiders observe u and based on the CEO's preference, the CEO decides whether or not to divert project resources.

$t = 1$ The inside and outside directors as a board, formally vote on the CEO's proposed implementation.

$t = 2$ Cash flows are realized, the media reports the financial results and the board chooses the CEO's successor.

3.3.2 The effect on the CEO

According to Dyck and Zingales (2002), the impact of the media comes from its ability to expose the financial misdeeds of management and to thus shame them. This section uses the analysis of the power of shame in Tadelis (2007) to study the impact of shame on a CEO considering an unethical corporate action. Assume that the CEO owns $(100 \times \omega)\%$ of the outstanding shares. Recall that if the project is fully funded, it will produce revenue X with probability 1, but if the CEO diverts project resources for his personal benefit, revenue will fall by uX, while the CEO receives a private benefit, B. Hence, the CEO will only divert project resources if

$$\omega(1-u)X + B > \omega X$$

or

$$B > \omega u X \tag{3.1}$$

I assume the CEO is a member of a social network where each member cares about both wealth and reputation. In this regard, each member is assumed to have a shame aversion function ξ, described in Appendix C.3.3, which measures the member's sensitivity to the opinion of other members. Thus, a CEO with shame parameter ξ and d people in his personal network, who would receive private benefit B from diversion has expected utility

$$U = \omega(1-u)X + B - \xi d\lambda \tag{3.2}$$

where λ is the commonly held probability that any arbitrary neighbor will adopt the negative opinion. (The last term on the right-hand side is derived in Appendix C.3). Although the CEO knows that a fully funded project will produce revenue X with probability 1, the market believes that with probability $1-p$ a fully funded project will produce less than X. The outcome where the project produces revenue X is the "good" outcome (G). Any outcome where the revenue is less than X is the "not good" ($\overline{G}$) outcome. If the market observes G, society infers rightly that the CEO did not divert project resources. If the market observes $\overline{G}$, society does not know whether it is due to the CEO diverting project resources (Δ) or that the CEO did not divert resources ($\bar{\Delta}$), but just experienced bad luck.

The game exhibits *full exposure* ($e = 1$) if the media fully reveals the actions of the CEO. With full exposure, if the CEO chooses diversion and the market observes $\overline{G}$, society will know that it was because the CEO diverted project resources. The game exhibits *no exposure* ($e = 0$) if the media simply reports the financial results without comment so that the members of the network learn nothing from the media about the reason for reduced revenue.

3.3.2.1 Equilibrium analysis

Call ξd the social cost of diversion. Let $s = \xi d$ denote CEO type and let $\delta_s \in [0,1]$ denote the probability that a CEO of type s chooses Δ. Let $E[\delta|h,e]$ be the posterior probability that the members of the network assign to the CEO's dishonesty conditional on the history $h \in \left\{\Delta, \bar{\Delta}, G, \overline{G}\right\}$ and the media exposure $e \in \{0,1\}$. Note that $E[\delta|h,e] = \lambda$. Following the good outcome, the members of the network perfectly infer that the

CEO did not divert, i.e. $E[\delta|\,G,e] = \lambda = 0$. Similarly, $E[\delta|\Delta,1] = \lambda = 1$ and $E\left[\delta|\bar{\Delta},1\right] = \lambda = 0$. However, $E\left[\delta|\overline{G},0\right] = \lambda \in [0,1]$. I state slightly modified versions of the complementary Propositions 1 and 2 in Tadelis (2007) and provide the proofs.

Proposition 3.1. *(Tadelis, 2007)*

If $B > \omega u X$ and $e = 1$ then there exists a unique equilibrium characterized by a cutoff type

$$s_M^1 = B - \omega u X > 0 \tag{3.3}$$

such that all types $s < s_M^1$ choose Δ ($\delta_s = 1$) and all types $s \geq s_M^1$ choose $\overline{\Delta}$ ($\delta_s = 0$).

Proof. First notice that behavior will exhibit monotonicity of types, i.e. if type s chooses not to divert then all types $s' > s$ will also not divert and vice-versa. Second, there cannot be a pooling equilibrium where all types choose $\delta_s = 1$ since that would imply that

$$B > \omega u X + E[\delta|\Delta,1]\, s$$

for all types s. But since $E[\delta|\Delta,1] = 1$, the inequality is violated for all types $s > B - \omega u X$. Similarly, there cannot be a pooling equilibrium where all types choose $\delta_s = 0$ because that would violate the assumption that $B > \omega u X$. This, together with the monotonicity of s implies that there is a cutoff type. The above argument immediately identifies the cutoff type as $s_M^1 = B - \omega u X$. □

Private benefits provide an incentive to divert project resources. However, since behavior is public under full exposure, shame aversion creates a cost of diversion, s. All types $s > B - \omega u X$ have a cost of diversion higher than the payoff advantage of the private benefit.

For the following result, recall from Appendix C.3.2 that because λ represents a fulfilled expectations equilibrium, $\lambda \in \left\{0, \underline{\lambda}, \bar{\lambda}\right\}$.

Proposition 3.2. *(Tadelis, 2007)*

Assume $B > \omega u X$.

(a) If $e = 0$ and $\lambda \in \left\{\underline{\lambda}, \bar{\lambda}\right\}$, then there exists a unique sequential equilibrium characterized by a cutoff type

$$s_M^0(\lambda) = \frac{B - \omega u X}{(1-p)\,\lambda} > s_M^1 \tag{3.4}$$

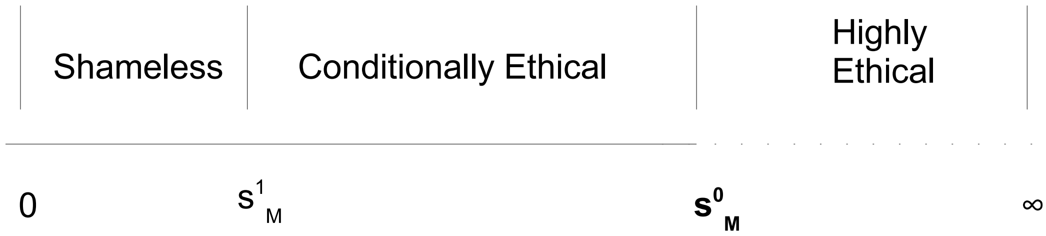

Figure 3.1: Three groups of CEOs

such that all types $s < s_M^0(\lambda)$ *choose* Δ *(*$\delta_s = 1$*) and all types* $s > s_M^0(\lambda)$ *choose* $\bar{\Delta}$ *(*$\delta_s = 0$*).*

(b) If $e = 0$ *and* $\lambda = 0$*, then no cutoff exists.*

Proof. (a) The same logic as in Proposition 1 shows that there cannot be a pooling equilibrium where all types choose either $\delta_s = 0$ or $\delta_s = 1$. Monotonicity of types implies that there can only be one candidate for the cutoff which is labeled s_M^0. Since $e = 0$, the network members only observe outcomes, so there are only two relevant posteriors - $E\left[\delta|\overline{G}, 0\right]$ and $E\left[\delta|\, G, 0\right]$ where $E\left[\delta|\, G, 0\right] = 0 < E\left[\delta|\overline{G}, 0\right] < 1$. For a cutoff to exist, there must be some type s_M^0 such that

$$B = \omega uX + (1-p)\, E\left[\delta|\, \overline{G}, 0\right] s_M^0$$

or

$$s_M^0(\lambda) = \frac{B - \omega uX}{(1-p)\,\lambda} > B - \omega uX = s_M^1$$

Because of monotonicity of types, all types $s < s_M^0$ choose Δ ($\delta_s = 1$) and all types $s \geq s_M^0$ choose $\bar{\Delta}$ ($\delta_s = 0$).

(b) If $\lambda \to 0$, then $s_M^0(\lambda) \to \infty$ and no cutoff exists for $e = 0$. □

Proposition 3.2(a) shows that with no media exposure, if $\lambda \in \left\{\underline{\lambda}, \bar{\lambda}\right\}$ there is a smaller measure of shame-averse types who will be deterred from diversion of project resources and that there is a positive measure of shame-averse types in the interval $\left[s_M^1, s_M^0(\lambda)\right]$ who, although deterred from diversion by full media exposure, will divert project resources if there is no exposure. (I write s_M^0 as a function of λ because I have assumed that $\lambda \in \left\{0, \underline{\lambda}, \bar{\lambda}\right\}$.) Proposition 3.2(b) shows if $\lambda = 0$, then no cutoff exists ($s_M^0(\lambda) = \infty$) for $e = 0$. In that case, the measure of shame-averse types who, although deterred from diversion by full media exposure, will divert project resources if there is no exposure, i.e. lie in the interval $\left[s_M^1, \infty\right)$.

Proposition 3.2(b) presents a rather jaundiced view of human nature. First notice that Propositions 3.1 and 3.2(a) partition CEOs into three groups, as shown in Fig. 3.1. Fig. 3.1 is labeled based on what I think are our intuitive beliefs about human nature. Casual empiricism suggests people's honesty fall into three categories. There are some highly ethical people who would never engage in dishonest behavior under any circumstances. Similarly, there are others who are conditionally ethical - opportunists - who would act dishonestly if, say, they wouldn't get caught. Then there are still others - shameless - for whom dishonesty and deception is a way of life. Proposition 3.2(b) however, says that our intuition is wrong. *All* are either shameless or conditionally ethical. There is no third group. Highly ethical people don't exist. Given the right circumstances, *everybody* will behave dishonestly.

3.3.3 The effect on inside board members

In this subsection, Δ will mean a vote for the CEO's proposal and $\bar{\Delta}$ will mean a vote against the CEO's proposal. n is the number of insiders on the board of directors.

To examine the effect of the threat of media exposure on the inside board members, I use the board model of Raheja (2005), also used in Essays 1 and 2. Recall that the firm has a project that, if correctly implemented, will yield X with probability 1. The CEO proposes a project implementation that will yield only $(1-u)X$ based on diversion of project resources for his private benefit. Each insider must decide whether or not to reveal the projected loss, uX, under the CEO's proposed implementation to the outside board members. If at least τ insiders reveal, the outsiders will investigate and with probability 1 discover the CEO's diversion.[6] Once the outsiders become aware of the diversion, they all vote against the CEO's proposal. If at least τ insiders vote with the outsiders, the proposal will be defeated.

Payoffs to insiders depend on the private benefits from remaining silent and the utility of becoming CEO. The probability of becoming CEO depends on whether or not the insider reveals and how many other insiders reveal. Each insider can earn a private benefit $B_n = \beta_n X$ by remaining silent if the CEO proposes an implementation based on diversion of project resources and it is approved. Insiders who reveal vote with the outside board members against the CEO's proposal. If less than τ insiders reveal, there is no investigation and those who revealed will forfeit the private benefit and not be chosen by the CEO as his successor. On the other hand, if τ or more insiders reveal, the choice of of who succeeds the CEO will be made by the outside board members and no insider who remained silent will be chosen. Every insider who, by dint of his or her vote is in the eliglible pool, has an equal chance to succeed the CEO.

[6] I assume that the amount to be diverted, uX, is large enough to trigger an investigation by outsiders if at least τ insiders reveal.

Let

$W(k,u) \equiv$ the expected utility of an insider from revealing the measure of loss u to the outsiders given that k other insiders have also revealed

$S(k,u) \equiv$ the expected utility of an insider from remaining silent given that k other insiders have revealed the measure of loss u to the outsiders.

$W(k,u)$ consists entirely of the expected utility of being chosen by outsiders to replace the CEO whereas $S(k,u)$ consists of the expected utility of being chosen by the CEO as his successor *plus* the private benefit from remaining silent.

$$W(k,u) = \begin{cases} \frac{\omega X}{k+1} & k \geq \tau - 1 \\ 0 & k < \tau - 1 \end{cases} \tag{3.5}$$

$$S(k,u) = \begin{cases} \left[\frac{\omega(1-u)}{n-k} + \beta_n\right] X & k \leq \tau - 1 \\ 0 & k > \tau - 1 \end{cases} \tag{3.6}$$

$\tau \equiv$ minimum number of insiders who must reveal for the CEO's proposed project implementation to be defeated

In the presence of the media, the payoff to each insider for voting with the CEO becomes individuated. Recall that the cost of negative media exposure to an insider is

$$s_\kappa = \xi_\kappa d_\kappa$$

where $\xi_\kappa = \xi(\theta_\kappa)$ is insider κ's estimated loss per network neighbor and d_κ is the number of people in insider κ's network neighborhood. Insider κ's utility payoff for remaining silent is

$$S_\kappa(k,u) = S(k,u) - s_\kappa E[\delta|h,e] \tag{3.7}$$

and the utility payoff for revealing is

$$W_\kappa(k,u) = W(k,u) - s_\kappa E[\delta|h,e] \tag{3.8}$$

where $E[\delta|h,e]$ is as defined in Section 3.3.2.1. In the case of full exposure ($e = 1$), $E[\delta|\Delta,1] = 1$ and $E\left[\delta|\bar{\Delta},1\right] = 0$. The reason is that society judges that insiders would know whether or not the CEO's

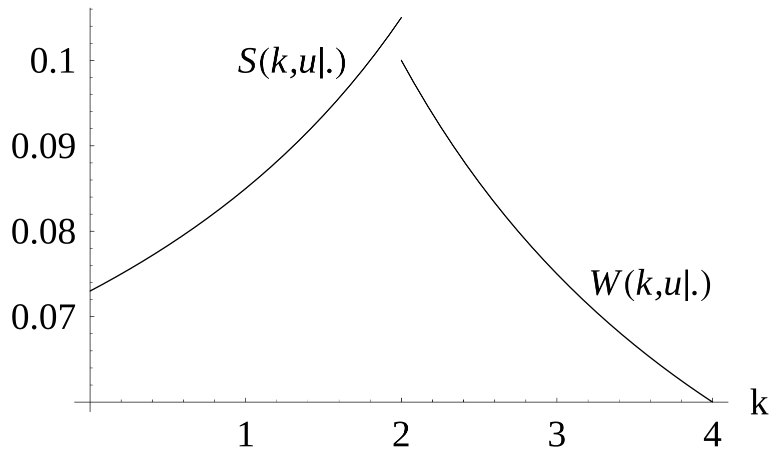

Figure 3.2: Utility functions ($X = 1$, $\omega = .3$, $u = .2$, $\beta_n = .025$, $n = 5$, $\tau = 3$)

proposed implementation was deficient. They therefore conclude that a vote for the CEO's proposal is an indicator of the dishonesty of the inside board member who cast the vote. For $e = 0$ the situation is much murkier. If society is uncertain as to the honesty of the CEO, then a vote for or against the CEO is no longer an indicator of insider honesty. As a consequence, I will assume that in the case of $e = 0$, a member of an insider's social network does not receive enough information from the media for a fair evaluation and so refrains from forming an opinion. I also assume that members feels that other members will reach the same conclusion for the same reason and so adopt the same position. Thus I am assuming that $\lambda = 0$ is the fulfilled expectations equilibrium in an insider's social network for $e = 0$, and so limit the analysis to the case $e = 1$. Thus, if the CEO diverts project resources,

$$S_\kappa (k, u) = S (k, u) - s_\kappa \quad (e = 1) \tag{3.9}$$

and

$$W_\kappa (k, u) = W (k, u) \qquad (e = 1) \tag{3.10}$$

Notice that (3.9) introduces the possibility that $S_\kappa (k, u) < 0$.

3.3.3.1 Full media exposure ($e = 1$)

Fig. 3.2 is a representative plot of the payoff functions facing the inside board members in our analysis. The functions have been drawn as continuous curves for ease of visualization. Proposition 1.2 in Essay 1 showed that, in the absence of the media, either all insiders reveal or none do. Notice that for the displayed functions, $S(0,u) > W(n-1,u)$. From the graph, if no insiders reveal, utility is .073 whereas if all insiders reveal, utility is only .06. In other words, with no media exposure, all insiders will vote for the CEO's proposed project implementation.

In what follows, I will make frequent use of the following:

$$S_\kappa(k,u) < W(n-1,u) \Rightarrow S_\kappa(j,u) < W(n-1,u) \quad \forall j < k$$

This simply says that if the payoff from remaining silent is less than the payoff from revealing given that k other insiders have revealed, then the payoff from remaining silent is also less if fewer than k insiders have revealed.

Lemma 3.1. If $k \geq \tau$ insiders reveal, then all insiders will reveal.

Eqs.(3.6) and (3.9) show that remaining silent would entail a loss.

Lemma 3.2. Assuming full media exposure ($e = 1$),

(a) *if* $S_\kappa(\tau-1,u) < 0$, *then insider* κ *will reveal the loss to the outside board members.*

(b) *if* $0 \leq S_\kappa(\tau-1,u) < W(n-1,u)$,

- *(i)* *if* $k \geq \tau - 1$ *other insiders reveal, then insider* κ *will reveal and receive payoff* $W(n-1,u)$.
- *(ii)* *if* $k < \tau - 1$ *other insiders reveal, then*
  - *(1)* *if* $0 \leq S_\kappa(k,u) < S_\kappa(\tau-1,u)$, *then insider* κ *remains silent and receives payoff* $S_\kappa(k,u) \geq 0$.
  - *(2)* *if* $S_\kappa(k,u) < 0$, *then insider* κ *reveals and receives payoff 0.*

(c) *if* $0 \leq S_\kappa(j,u) < W(n-1,u)$ *and* $S_\kappa(j+1,u) \geq W(n-1,u)$, $j \leq \tau - 2$,

- *(i)* *if* $k \geq \tau$ *other insiders reveal, then insider* κ *will reveal and receive payoff* $W(n-1,u)$.
- *(ii)* *if* $k = j+1, \ldots, \tau - 1$ *other insiders reveal, then insider* κ *will remain silent and receive payoff* $S_\kappa(k,u) \geq S_\kappa(j+1,u)$.
- *(iii)* *if* $k \leq j$ *other insiders reveal, then*
  - *(1)* *if* $0 \leq S_\kappa(k,u) \leq S_\kappa(j,u)$, *then insider* κ *remains silent and receives payoff* $S_\kappa(k,u) \geq 0$.

(2) *if* $S_\kappa(k,u) < 0$*, then insider* κ *reveals and receives payoff 0.*

Referring to Fig. 3.2, imagine that for insider κ the cost of negative media, s_κ, pulls $S(k,u)$ down so far that $S_\kappa(2,u) < 0$ (See Eq.(3.9)). Lemma 3.2(a) says that, under this circumstance insider κ will reveal. The reason is that if he remains silent, he incurs a loss. Suppose now that, although s_κ still pulls $S(k,u)$ down, $0 \le S_\kappa(2,u) < W(4,u)$. Lemma 3.2(b)(i) says that if 2 or more other insiders reveal, insider κ will reveal as well. However if only $k = 1$ or 0 other insiders reveal, then Lemma 3.2(b)(ii) says that insider κ's decision will depend on whether or not $S(k,u)$ is greater than 0. Finally, if s_κ is such that $0 \le S_\kappa(1,u) < W(4,u)$ but $S_\kappa(2,u) \ge W(4,u)$, then by Lemma 3.2(c), insider κ's decision will depend on how many other insiders reveal.

Now consider a situation where $\tau - 1$ insiders have payoffs that satisfy $S_\kappa(\tau-1,u) < 0$. Then by Lemma 3.2(a), all $\tau - 1$ will reveal. If $S_\kappa(\tau-1,u) \ge W(n-1,u)$ for all the other $n-\tau+1$ insiders, then the CEO's proposal will win with $n-\tau+1$ insiders voting for and $\tau-1$ insiders voting against. If, on the other hand, there is one other insider - η - such that $0 < S_\eta(\tau-1,u) < W(n-1,u)$, by Lemma 3.2(b)(i) insider η will reveal and by Lemma 3.1, the CEO's proposal will be unanimously voted down.

Assume now that $\tau - 2$ insiders have payoffs that satisfy $S_\kappa(\tau-1,u) < 0$ and, as per Lemma 3.2(a), all $\tau - 2$ reveal. If the other $n-\tau+2$ insiders have payoffs such that $S_\kappa(\tau-2,u) \ge W(n-1,u)$, no other insider will reveal and the CEO's proposal will win with $n-\tau+2$ insiders voting for and $\tau-2$ insiders voting against. Suppose however, that two other insiders - η_1 and η_2 - have utilities such that $0 < S_\eta(\tau-2,u) < S_\eta(\tau-1) < W(n-1,u)$. Under all circumstances, both are made better off by revealing.

Now suppose that η_1 and η_2 have utilities such that $0 < S_\eta(\tau-2,u) \le W(n-1,u)$ but $S_\eta(\tau-1,u) > W(n-1,u)$. Now the payoff each receives depends on order. If η_1 reveals first and η_2 remains silent, η_1 receives 0 and η_2 receives $S_{\eta_2}(\tau-1,u) > W(n-1,u)$. If η_2 reveals first, the payoffs are reversed. To resolve the uncertainty in payoffs, η_1 and η_2 could try to wait each other out, use a random device such as a coin-flip or agree that the one who remains silent split the proceeds with the one who reveals[7]. I will assume that η_1 and η_2 form a coalition and agree to reveal, and that full media exposure guarantees that the agreement is honored.[8] Again, the CEO's proposal would be unanimously defeated.

Combined with the behavioral assumptions, the above reasoning proves the following result.

[7] Given full media exposure, such a contract would be discovered and publicized and thus void the whole rationale for revelation!

[8] The idea is that η_1 (say) will not cheat because she would not want it known that the CEO's proposal passed because she betrayed the coalition that had agreed to vote against it.

Proposition 3.3. *Assume full media exposure ($e = 1$). Suppose j insiders have payoffs such that $S_\kappa(\tau - 1, u) < 0$. If there exists at least $(\tau - j)^+$*[9] *insiders with payoffs such that $0 < S_\kappa(j, u) < W(n-1, u)$, then the CEO's proposal will be unanimously defeated. Otherwise the proposal will pass with $n - j$ insiders voting for and j insiders voting against.*

Setting j to 0 in Proposition 3 yields a useful corollary.

Corollary 3.1. *The CEO's proposal will pass unanimously if and only if*

(a) there are no insiders with payoffs such that $S_\kappa(\tau - 1, u) < 0$ and

(b) there are fewer than τ insiders with payoffs such that $S_\kappa(0, u) < W(n-1, u)$.

Two points deserve emphasis. First, recall that the utilities depicted in Fig. 3.2 guaranteed that, in the absence of media exposure, the CEO's proposal would pass unanimously. However, in the case of full media exposure, Proposition 3 and Corollary 1 show that, not only is it unlikely that the CEO's proposal will pass unanimously, it is questionable whether it will pass at all!

Second, a major result in Raheja (2005), also proved in the first essay was that "All insiders reveal" and "No insiders reveal" were the only two coalition-proof pure strategy Nash equilibria. Under full media exposure, "All insiders reveal" is still coalition-proof but "No insiders reveal" is not. This is because to remain silent is to incur the cost s_κ. If s_κ makes $S_\kappa(0, u) < 0$, then revealing has higher utility - 0 - than remaining silent. Also, there are now more than two Nash equilibria. If equilibria are labeled by the number of insiders who vote against the CEO's proposal, there are now $n+1$ equilibria. The reason, of course, is that the inside board members can no longer be treated as indistinguishable. Each faces unique risks that individuate him or her from all others. The additional equilibria are the result of insiders voting based on an individual assessment of the unique risk each is facing.

3.3.4 The Effect on Other Blockholders

An interesting side issue that can be addressed is the impact of negative media on the blockholders of Essays 1 and 2. Consider the actions of the independent blockholder of Essay 1 given that the media reports that the CEO is diverting resources for personal consumption. From the discussion in Section 1.2.2, since such diversion reduces the value of the firm, the blockholder will sell. Under the "Price Trigger" assumption in Section 1.5.1, if the value lost resulting from a sale by the blockholder is at least as large as the investigation

[9] $(x)^+ \equiv \max[0, x]$ *and is read as "the positive part of x.*

cutoff[10], the outside members of the board will investigate. From Section 1.3.1.2, the outsiders will uncover the diversion and by Proposition 1.6, all inside board members will vote with the outsiders against the CEO's proposal. If, on the other hand, the value lost by the blockholder's sale is not big enough to trigger an investigation, the analysis of Section 1.5 applies as described in Essay 1.

The impact of a negative media report about a nonfamily CEO on the family blockholder in Essay 2 is even easier to state. There is none. The reason is that by Section 2.2.3, the family controls the nominating committee and so has allies among board members, both insiders and outsiders. Thus the family knows the CEO is planning to divert resources for personal consumption long before a report of such diversion appears in the media. In fact, the expectation is that mention of CEO diversion will appear in a media report explaining why the CEO is being forced to step down.

In the case of a family CEO, the situation is different. From Section 2.2.6, the family has an absolute majority of the votes of outside directors. That is, the family has made certain that there are more family-affiliated than independent outside directors. By Proposition 2.2, absent the media spotlight, CEO diversion cannot be prevented. However once the planned diversion is exposed by the media, the analysis of Section 3.3.3.1 obtains. If, as described in Lemma 3.2 of that section, the socially induced cost makes the utility of voting against the CEO's proposal less than the utility of supporting him for enough of the outside directors, they will abandon him. If not, the family will ride out the media storm and business will go on as usual.

3.4 Summary and Conclusions

Since the appearance of the seminal paper, "The Corporate Governance Role of the Media" by Dyck and Zingales in 2002, I know of no paper that models the corporate governance role of the media and/or explains the anecdotal observations in Dyck and Zingales (2002) or the more rigorous empirical results in Louis et al. (2007). This essay seeks to fill that gap.

A novel feature of the analysis in this essay is the use of social network theory. This is based on the simple observation that human behavior is motivated by both economic and social considerations. Neoclassical financial economics research focuses on the former and ignores the latter. Yet economic transactions have always been shaped by the social context in which they occur. In a much-quoted line, Adam Smith complained that "people of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices."

[10] Recall that the diversion has to have substantive value to trigger an investigation. For example, no one would investigate if it were revealed that the CEO was taking project stationery supplies for personal use.

A second novel feature is the use of psychological game theory. Like social network theory, the use of psychological game theory is also based on a simple observation - people value the good opinion of other people. The utility of the theory is that it allows one to model belief-dependent emotions such as anger and surprise that are problematic for conventional game theory (Geanakoplos et al., 1989). Using a psychological game theory framework, I am able to model an essential feature of economic transactions embedded in social networks, namely that the payoff to a transacting agent will depend not only on what he does, but also on what he thinks other players believe about him.

To the point, I use results from social network theory (Sundararajan, 2007) to calculate the cost of negative media, and results from psychological game theory (Tadelis, 2007) to express the cost in terms of a shame aversion parameter. Through this device I am able to demonstrate that a CEO considering the diversion of project resources for private benefit must also consider the loss of social capital and subsequent loss of wealth to which his contemplated dishonesty might lead. Using the board model in Raheja (2005), I also show the impact of the cost to inside board members who, if they support the CEO will share in the private benefits, but who will also share in the public shame that media exposure of the CEO's actions will bring. The analysis reveals that the certainty of public exposure will discourage most CEOs from attempting the diversion. For those CEOs who are undaunted, the analysis demonstrates that the threat of public shame to the inside board members may make them abandon the CEO even if the private benefits of voting with the CEO are substantial.

Finally, the corporate finance literature, in discussing governance, distinguishes between internal governance mechanisms - institutional ownership, blockholders and the board of directors - and an external governance mechanism - takeover market monitoring. Given the anecdotal evidence in Dyck and Zingales (2002), the empirical observations in Louis et al. (2007) and the theoretical results in this essay, the strong suggestion is that the media should also be considered an external mechanism of corporate governance. Demonstrating that empirically is the subject of future research.

Appendix A

Appendix for Essay 1

A.1 Definitions and Proofs

A.1.1 The functions "floor", "ceiling" and "positive part"

$\lceil$ is "ceiling" and it has a companion function, $\lfloor$, "floor." Let x be real, and non-integer. Then $\lceil x = 1 + \lfloor x$ where

$\lceil x \equiv$ the largest integer greater than or equal to x

$\lfloor x \equiv$ the smallest integer less than or equal to x

If x is an integer, than $\lceil x = \lfloor x = x$.

$(x)^+ \equiv \max(x, 0)$ where $(x)^+$ is read "the positive part of x."

A.1.2 Proofs

Proof of Lemma 1.

(a) Follows from Eqs.(1.3) and (1.12)

$$\begin{aligned}
\beta - \omega_1 (1-\theta) E_S(u_M) - \omega_2 u_M &= 0 \\
(\omega_2 u_0) - \omega_1 (1-\theta) E_S(u_M) - \omega_2 u_M &= 0 \\
\omega_2 (u_0 - u_M) - \omega_1 (1-\theta) E_S(u_M) &= 0 \Rightarrow u_0 > u_M
\end{aligned}$$

(b) From Eq.(1.10),

$$\begin{aligned} E_S(x) &= \frac{P(u \le x)\, E[u \,|\, u \le x]}{\theta + (1-\theta)\, P(u \le x)} \\ &= E[u|u \le x] \frac{F(x)}{\theta + (1-\theta)\, F(x)} \end{aligned}$$

Note that, since $\theta > 0$,

$$\theta + (1-\theta)\, F(x) > F(x) \Rightarrow \frac{F(x)}{\theta + (1-\theta)\, F(x)} < 1$$

Thus

$$E_S(x) < E[u \,|\, u \le x] \le x$$

(c) From Eq.(1.10),

$$\begin{aligned} \frac{\mathrm{d}E_S(x)}{\mathrm{d}x} &= \frac{\mathrm{d}}{\mathrm{d}x} \left(\frac{\int_0^x u\, f(u)\, \mathrm{d}u}{\theta + (1-\theta)\, F(x)} \right) \\ &= \frac{\theta\, x\, f(x) + (1-\theta)\, f(x) \left(x\, F(x) - \int_0^x u\, f(u)\, \mathrm{d}u \right)}{[\theta + (1-\theta)\, F(x)]^2} > 0 \end{aligned}$$

□

Proof of Proposition 1.

(a) Follows from the definition of τ.

(b) Equate Eqs.(1.20) and (1.17) and solve for u. □

Proof of Eq.(1.22).

$$\begin{aligned} P(I \,|\, k, u \le u_0) &= P(I \,|\, k, u \le u_0, u < u_m)\, P(u < u_m \,|\, k, u \le u_0) \\ &+ P(I \,|\, k, u \le u_0, u \ge u_m)\, P(u \ge u_m \,|\, k, u \le u_0) \end{aligned} \tag{A.1}$$

From Prop. 1 and the CDF of u,

$$\begin{aligned} P(I \,|\, k, u \le u_0, u < u_m) &= 0 \\ P(I \,|\, k, u \le u_0, u \ge u_m) &= \chi_{k \ge \tau} \\ P(u \ge u_m \,|\, k, u \le u_0) &= 1 - \frac{F(u_m)}{F(u_0)} \end{aligned}$$

Substituting into (A.1) gives Eq.(1.22). □

Proof of Lemma 2.

(a) From (1.27), $k \geq \tau \Rightarrow W(k, u \,|\, u \geq u_m) = \frac{\omega X}{k+1}$ and $S(k, u \,|\, u \geq u_m) = 0$

(b) From (1.27), $k \leq \tau - 2 \Rightarrow W(k, u \,|\, u \geq u_m) = 0$ and $S(k, u \,|\, u \geq u_m) = \left[\frac{\omega(1-u)}{n-k} + \beta_n\right] X$

(c) If $k = \tau - 1$ insiders announce their intention to reveal, then if an uncommitted insider joins them, and the expanded group commits, from Lemma 2(a), all insiders will reveal and receive the payoff $W(n-1, u \,|\, u \geq u_m)$. On the other hand, if no other insider joins them, by Lemma 2(b), they will not reveal and all insiders will receive the payoff $S(0, u \,|\, u \geq u_m) < W(n-1, u \,|\, u \geq u_m)$. Hence the best response for an uncommitted insider is to reveal. The same argument shows that if the inequality is reversed, the best response for an uncommited insider is to remain silent. □

Proof of Lemma 3.

(a) $\beta_n \geq \frac{2\omega u}{n+1} \Rightarrow \beta_n \geq \frac{\omega u}{n}$. ((1.29)) implies (i) and Corollary 3.1(b) implies (ii) and (iii).

(b) For $\frac{\omega u}{n} \leq \beta_n \leq \frac{2\omega u}{n+1}$, ((1.29)) implies (i) and Corollary 3.1(b) implies (ii) and (iii).

(c) $\beta_n < \frac{\omega u}{n} \Rightarrow \beta_n < \frac{2\omega}{n+1}$. ((1.29)) implies (i) and Corollary 3.1(a) implies (ii) and (iii). □

Proof of Lemma 4.

Note that for each letter the assumption on β_n proves (ii) and (iii) by Corollary 3.1. I simply need to prove that the assumptions are consistent. (i) will be implied by (1.30).

(a) $u \leq \frac{2}{n+2} + \frac{n\beta_n}{2\omega} \Rightarrow \beta_n \geq \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right)$ and $u \geq \frac{4}{n+2} \Rightarrow 2\left(u - \frac{2}{n+2}\right) \geq u \Rightarrow \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right) \geq \frac{\omega u}{n}$. Combined, $\beta_n \geq \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right) \geq \frac{\omega u}{n}$.

(b) $u > \frac{2}{n+2} + \frac{n\beta_n}{2\omega} \Rightarrow \beta_n < \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right)$ and $\left(u > \frac{2}{n+2} + \frac{n\beta_n}{2\omega}\right) \wedge \left(\beta_n \geq \frac{\omega u}{n}\right) \Rightarrow u > \frac{2}{n+2} + \frac{u}{2} \Rightarrow u > \frac{4}{n+2} \Rightarrow \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right) > \frac{\omega u}{n}$. Combined, $\frac{2\omega}{n}\left(u - \frac{2}{n+2}\right) > \beta_n \geq \frac{\omega u}{n}$

(c) $u \leq \frac{2}{n+2} + \frac{n\beta_n}{2\omega} \Rightarrow \beta_n \geq \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right)$. $\left(u \leq \frac{2}{n+2} + \frac{n\beta_n}{2\omega}\right) \wedge \left(\beta_n < \frac{\omega u}{n}\right) \Rightarrow u < \frac{2}{n+2} + \frac{u}{2} \Rightarrow u < \frac{4}{n+2} \Rightarrow \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right) < \frac{\omega u}{n}$. Combined, $\frac{\omega u}{n} > \beta_n \geq \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right)$

(d) $u \geq \frac{4}{n+2} \Rightarrow 2\left(u - \frac{2}{n+2}\right) \geq u \Rightarrow \frac{2\omega}{n}\left(u - \frac{2}{n+2}\right) \geq \frac{\omega u}{n}$. Combined with $\beta_n < \frac{\omega u}{n}$ gives $\frac{2\omega}{n}\left(u - \frac{2}{n+2}\right) \geq \frac{\omega u}{n} > \beta_n$. □

Proof of Proposition 3.

(a) $\frac{\partial w}{\partial u_m} = \frac{f(u_m)}{F(u_0)} > 0$

(b) $\frac{\partial w}{\partial u_0} = -\frac{F(u_m) f(u_0)}{[F(u_0)]^2} < 0$ □

Proof of Proposition 4.

(a-b) From (1.31), $b(n, u) = \frac{1}{n}\left[u - w(u_m, u_0)\right]^+$. Prop. 4(a) and 4(b) follow from Prop. 3(a) and 3(b).

(c) From (1.31), $\frac{\partial b}{\partial u} = \frac{1}{n} > 0$.

(d) From (a-b), $\frac{\partial b}{\partial w} = \frac{1}{n}$

(e) $b(n+1,u) - b(n,u) = -\frac{u+w}{n(n+1)}$

(f) $\tau = 1 + \left(\lceil \frac{n-m}{2} \right)^{+}$ □

1. n, m even or n, m odd. I prove (f) for n, m odd.

a) $n = 2k+1,\ m = 2j+1,\ k > j \Rightarrow \tau = 1+k-j \Rightarrow \tau+j-1 = k \Rightarrow \tau+j-1 = \frac{n-1}{2} \Rightarrow n = 2(\tau+j)-1$

i. $b(\tau+1,u) - b(\tau,u) = (u+w)\left(\frac{1}{2(\tau+j)+1} - \frac{1}{2(\tau+j)-1}\right) = -\frac{2(u+w)}{4(\tau+j)^2-1} < 0$

b) n even, m odd or n odd, m even. I prove (f) for n odd, m even.

i. $n = 2k+1,\ m = 2j,\ k \geq j \Rightarrow \tau = 2+k-j \Rightarrow \tau+j-2 = k \Rightarrow \tau+j-2 = \frac{n-1}{2} \Rightarrow n = 2(\tau+j)-3$

ii. $b(\tau+1,u) - b(\tau,u) = (u+w)\left(\frac{1}{2(\tau+j)-1} - \frac{1}{2(\tau+j)-3}\right) = -\frac{2(u+w)}{4(\tau+j)^2-8(\tau-j)+3} < 0$

Proof of Proposition 5.

From Eqs.(1.10) and (1.33),

$$\begin{aligned} E_S(u_I) &= \frac{E[u \mid u \leq u_I]\,F(u_I)}{\theta + (1-\theta)F(u_I)} = u_m \\ F(u_I) &= \frac{\theta u_m}{E[u \mid u \leq u_I] - (1-\theta)u_m} \\ F(u_I) &\leq 1 \Rightarrow u_m \leq E[u \mid u \leq u_I] \end{aligned}$$

□

Proof of Proposition 6.

If all insiders vote with the CEO, their payoff will be $S(0,u) = \beta_n X$. If all insiders vote with the outsiders their payoff will be $W(n-1,u) = \frac{\omega X}{n}$. I have assumed that $n\beta_n < \beta < \omega$ which implies that $S(0,u) < W(n-1,u)$ and by Proposition 3, all insiders will vote with the outsiders. □

Proof of Proposition 7.

(a) $u_M < u_0 \Rightarrow w(u_m, u_M) = \frac{F(u_m)}{F(u_M)} > \frac{F(u_m)}{F(u_0)} = w(u_m, u_0)$

(b) See (1.39) and Prop. 6. □

A.2 Proof of Proposition 1.2

Only pure strategy Nash equilibria can be candidates for a CPNE.

Lemma A.1. *There are exactly two pure strategy Nash equilibria: (i) all insiders reveal and (ii) no insiders reveal.*

Proof. From Lemma 1.2, for every value of k, either all insiders reveal or no insiders reveal. □

Proof of Proposition 1.2.

(a) First I show if $W(n-1,u) > S(0,u)$, no insiders revealing is not a CPNE (I ignore the condition $u \geq u_m$ for notational convenience). Let $I \equiv$the set of insiders and suppose $I = I_R \cup I_S$ where $I_R \equiv$insiders who plan to reveal and $I_S \equiv$insiders who plan to remain silent. Suppose $I_S = I$ have announced their intention to remain silent and receive the payoff $S(0,u)$. Consider a coalition $A \subset I$ with $|A| = \tau$, that announce its intention to reveal. If it commits, by Lemma 2(a), $I \backslash A$ will join it in revealing and all insiders will receive the payoff $W(n-1,u) > S(0,u)$ and thus be made better off. To see that A is credible, suppose a second coalition $H \subset A$ with $|H| \geq 2$ deviates from A and announces its intention to again remain silent. If it commits, by Lemma 2(b), $A \backslash H$ will join it in remaining silent and all insiders will receive the payoff $S(0,u) < W(n-1,u)$. Thus the members of H are worse off, which shows that A is credible. Since deviating makes the members of A better off and A is credible, no insiders revealing cannot be a CPNE.

Next I show that all insiders revealing is a CPNE. Suppose $I_R = I$ and a coalition $A \subset I$ announce their intention to remain silent. Consider two cases. □

1. If $|A| < n - \tau + 1$, then $k \geq \tau$ and by Lemma 1.2(a), no other insiders will join the coalition and its members will return to I_R.

2. If $|A| \geq n - \tau + 1$ then $k < \tau$, so that A can prevent an investigation by outsiders, but doing so will make the members of A worse off, so A is not credible.

Proof. Since there is no credible coalition that is made better off by deviating from I_R, $I_R = I$ is a CPNE if $W(n-1,u) > S(0,u)$.

Having proved sufficiency, I must prove necessity. Consider again case 2 above. If $W(n-1,u) \leq S(0,u)$, the members of A would not be made worse off and might be made better off by deviating. Hence they would be credible and I_R could not be a CPNE. This shows that I_R is a CPNE only if $W(n-1,u) > S(0,u)$.

(b) First I show that all insiders revealing is not a CPNE if $W(n-1,u) \leq S(0,u)$. Suppose $I_R = I$ have announced their intention to reveal and receive the payoff $W(n-1,u)$. Consider a coalition $A \subset I$ with $|A| \geq n-\tau+1$ that announces its intention to remain silent. Since $k \leq \tau - 1$, A can block an investigation by outsiders. If the members of A commit to remain silent, by Lemma 2(b) and 2(c).2, $I \backslash A$ will join them and all insiders will receive the payoff $S(0,u) > W(n-1,u)$ and thus be made better off. To see that A is credible, suppose a second coalition $H \subset A$ with $|H| \geq \tau - n + |A|$ deviates from A and announces its intention to again reveal. Since $k = |H| + n - |A| \geq \tau$, if it commits, by Lemma 2(a), $A \backslash H$ will join it in revealing and all insiders will receive the payoff $S(0,u) < W(n-1,u)$. Thus the members of H are worse off, which shows that A is credible. Since deviating makes the members of A better off and A is credible, all insiders revealing cannot be a CPNE.

Next I show that no insiders revealing is a CPNE. Suppose $I_S = I$ and a coalition $A \subset I$ announce its intention to reveal. □

1. If $|A| \leq \tau - 1$, by Lemma 2(b) and 2(c).2, no other insiders will join and its members will return to I_S.
2. If $|A| \geq \tau$, A will enable an investigation by outsiders and by Lemma 2(a), $I \backslash A$ will join it in revealing and all insiders will receive the payoff $W(n-1,u) \leq S(0,u)$ and thus not be made better off and perhaps be made worse off. Consequently, A is not credible.

Proof. Since for no value of $|A|$is there a credible coalition that is made better off by deviating from $I_S = I$, if $W(n-1,u) \leq S(0,u)$ then $I_S = I$ is a CPNE.

To prove necessity, notice that in case (b).2 above, if $W(n-1,u) > S(0,u)$, the members of A would be made better off by deviating from I_S, and hence, A would be credible. Therefore $I_S = I$ is a CPNE only if $W(n-1,u) \leq S(0,u)$. □

A.3 Proof of Eqs.(1.10) and (1.11)

Eqs.(1.10) and (1.11), though taken from Admati and Pfleiderer (2009a), are not proved there.

Proof of Eq.(1.10).

From (1.9), an equilibrium will be characterized by a cutoff x such that M diverts if $u \leq x$ and L sells if M diverts. Let $H \equiv$ shock and $\overline{H} \equiv$ no shock and recall from (1.4) that $S \equiv$ sale and $E_S = E[a\,u \,|\, S]$.

$$E[a\,u \,|\, S] = E[a\,u \,|\, S, H]\, P(H \,|\, S) + E\left[a\,u \,|\, S, \overline{H}\right] P\left(\overline{H} \,|\, S\right) \tag{A.2}$$

Eq.(A.2) must be calculated term by term. I begin by calculating the conditional probabilities.

$$\begin{aligned} P(S) &= P(S \mid H)\,P(H) + P\left(S \mid \overline{H}\right) P\left(\overline{H}\right) \\ &= \theta + F(x)(1-\theta) \end{aligned}$$

so that

$$P(H \mid S) = \frac{P(S \mid H)\,P(H)}{P(S)} = \frac{\theta}{\theta + F(x)(1-\theta)}$$

$$P\left(\overline{H} \mid S\right) = \frac{P\left(S \mid \overline{H}\right) P\left(\overline{H}\right)}{P(S)} = \frac{F(x)(1-\theta)}{\theta + F(x)(1-\theta)}$$

For $E\left[a\,u \mid S, \overline{H}\right]$, note that $S \wedge \overline{H} \Rightarrow a = 1$. Thus

$$E\left[a\,u \mid S, \overline{H}\right] = E\left[u \mid S, \overline{H}\right] = \int_0^x \frac{u}{F(u)} \mathrm{d}F(u) = E\left[u \mid u \leq x\right]$$

For $E[a\,u \mid S, H]$, it's possible that L could sell for liquidity reasons *and* M could divert. Since investors can't tell,

$$\begin{aligned} E[a\,u \mid S, H] &= E\left[E[a\,u \mid S, H, a]\right] \\ &= E[u \mid S, H, 1]\,F(x) + E[0 \mid S, H, 0]\,(1 - F(x)) \\ &= E[u \mid u \leq x] \end{aligned}$$

Substituting back into (A.2),

$$\begin{aligned} E[a\,u \mid S] &= E[u \mid u \leq x]\,\frac{\theta}{\theta + F(x)(1-\theta)} + E[u \mid u \leq x]\,\frac{F(x)(1-\theta)}{\theta + F(x)(1-\theta)} \\ &= \frac{E[u \mid u \leq x]\,F(x)}{\theta + F(x)(1-\theta)} \end{aligned}$$

□

Proof of Eq.(1.11).

$$\overline{S} \Rightarrow a = 0 \Rightarrow E\left[a\,u \mid \overline{S}\right] = 0$$

□

Appendix B

Appendix for Essay 2

B.1 Tables

Table B.1: Distribution of Firms by Industrial Classification

The study sample of 150 unique family firms appearing on the S&P 500® Index as of July 2003 are classified by industrial sector using the Global Industrial Classification Standard. The firms provide 1128 firm-year observations.

	All Firms	
GICS Sectors	**Firms**	**Percent**
Energy	5	3.3%
Materials	9	6.0%
Industrials	17	11.3%
Consumer Discretionary	37	24.7%
Consumer Staples	12	8.0%
Healthcare	20	13.3%
Financials	1	0.7%
Information Technology	43	28.7%
Telecommunication Services	2	1.3%
Utilities	4	2.7%
Total	150	100.0%

Table B.2: Financial Variables

This table lists the 10 financial variables used in the study along with their descriptions. "w" preceding a financial variable indicates winsorization, which amounts differ across winsorized variables.

Variable	Variable Label	Variable Description
debt	Debt	Ratio of long term debt to the book value of total assets. Source: Compustat
wdivd	Dividend	Ratio of total dividends to operating income. Source: Compustat
wroa	Return on Assets	Ratio of operating income to total assets. Source: Compustat
wrd	Research and Development	Research and development expense scaled by total assets. Source: Compustat
fixd	Fixed Assets	Property, plant and equipment scaled by total assets. Source: Compustat
wgrowth	Growth	Five-year growth rate in sales. Source: Compustat
invest	Investment	Expenditure for property, plant, and equipment and research and development as a percentage of total assets. Source: Compustat
size	Size	Natural log of total assets. Source: Compustat
wbrisk	Business Risk	Standard deviation of the first difference in operating income divided by total asset. Source: Compustat
wq	Tobin's Q	Sum of the market value of equity, the book value of preferred stock, long term debt and the difference between current liabilities and current assets, all scaled by total assets. Source: CRSP and Compustat

Table B.3: Non-Financial Variables

Firm age is defined from the date the firm was founded. The remaining 19 variables consists of three types: (1) 6 Family Management, (2) 4 Governance and (3) 9 Board variables. The Family Managment variables are dichotomous including three that indicate if the founder is CEO, board Chairman or just a director (*fndrceo*, *fndrchmn*, *fndrdir*) and three indicating if a family member other than the founder occupies these roles (*famceo*, *famchmn*, *famdir*). The Governance variables include the G-Index of Gompers, Ishii and Metrick (2003), two variables giving the fractional ownership of family and institutions (*famown*, *instown*), and a dichotomous variable indicating the presence of a dual share structure (*dualshrs*). The Board variables give numbers of directors relating to board and nominating committee participation.

	Family Management Variables
fndrdir	Founder Director - founder not Chairman or CEO (0 or 1)
fndrceo	Founder CEO (0 or 1)
fndrchmn	Founder Chairman (0 or 1)
famdir	Family Director - family not Founder, Chairman or CEO (0 or 1)
famceo	Family CEO - family not Founder (0 or 1)
famchmn	Family Chairman - family not Founder (0 or 1)

	Governance Variables
dualshrs	Dual Shares (0 or 1)
g_index	G-Index value (Gompers, Ishii and Metrick, 2003)
instown	Institutional Ownership fraction
famown	Family Ownership fraction

	Board Variables
ndirs	Number of Directors
famempls	Number of Employee Family Directors
indpdirs	Number of Independent Directors
lnkddirs	Number of Affiliated Directors
famdirs	Number of Non-Employee Family Directors
ncdirs	Number of Directors on the Nominating Committee
ncindp	Number of Independent Directors on the Nominating Committee
nclnkd	Number of Affiliated Directors on the Nominating Committee
ncfam	Number of Family Directors on the Nominating Committee
firmage	Age of the Firm

Table B.4: Variable Means and Medians by Firm Type

The table gives the number of firm-year observations and the mean and median of those observations for each variable by family firm type - Controlling, Non-Controlling and Passive. The sample consists of 1128 firm-year observations representing 150 family firms appearing on the S&P 500® Index between 1996 and 2003 and still on the S&P 500® Index as of July 2003. A family is Controlling if it is Active in board management and controls the votes of the board of directors. A family is Non-Controlling if it is Active in board management but does not control board votes. A family is Passive if it is not Active in board management. Firm age is defined from the date the firm was founded. The remaining 29 variables consists of four types: (1) 10 Financial, (2) 6 Family Management, (3) 4 Governance and (4) 9 Board variables. The Financial Variables are defined in Table B.2. "w" preceding a financial variable indicates winsorization, which amounts differ across winsorized variables. Non-Financial variables are defined in Table B.3

Panel A: Financial Variables

	Controlling			**Non-Controlling**			**Passive**		
	Firm-Yrs	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**
debt	208	0.162	0.116	642	0.170	0.145	293	0.173	0.158
wdivd	207	0.073	0.007	635	0.082	0.018	287	0.173	0.150
wroa	209	0.128	0.127	644	0.128	0.119	293	0.110	0.113
wrd	102	0.050	0.022	412	0.068	0.049	220	0.047	0.038
fixd	208	0.298	0.234	642	0.286	0.207	293	0.306	0.282
wgrowth	192	4.788	2.125	611	3.944	1.932	289	2.515	1.384
invest	102	0.318	0.282	412	0.321	0.275	220	0.350	0.332
size	209	7.787	7.699	643	8.094	8.079	293	8.475	8.374
wbrisk	135	0.038	0.026	471	0.041	0.033	265	0.031	0.025
wq	196	2.753	2.016	597	3.000	1.836	276	2.539	1.659

Panel B: Family Management Variables

	Controlling			**Non-Controlling**			**Passive**		
	Firm-Yrs	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**
fndrdir	211	23.2%	0	623	17.0%	0	293	30.0%	0

continued...

Table B.4: (continued)

	Controlling			Non-Controlling			Passive		
	Firm-Yrs	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**
fndrceo	211	77.3%	1	623	49.8%	0	293	0	0
fndrchmn	211	80.1%	1	623	71.4%	1	293	0	0
famdir	211	40.8%	0	623	26.2%	0	293	70.3%	1
famceo	211	23.7%	0	623	20.2%	0	293	0	0
famchmn	211	18.5%	0	623	23.6%	0	293	0	0

Panel C: Governance Variables

	Controlling			Non-Controlling			Passive		
	Firm-Yrs	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**
dualshrs	211	28.4%	0	623	9.8%	0	293	7.2%	0
g_index	164	8.085	8	541	9.081	9	261	9.625	10
instown	185	11.2%	7.4%	569	9.0%	5.7%	270	7.4%	5.4%
famown	206	24.2%	12.5%	612	12.0%	5.6%	293	10.5%	2.3%

Panel D: Board Variables

	Controlling			Non-Controlling			Passive		
	Firm-Yrs	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**
ndirs	211	9.825	9	623	9.730	10	293	11.218	11
famempls	211	1.621	1	623	1.234	1	293	0.249	0
indpdirs	211	3.403	3	623	5.851	5	293	6.683	7
lnkddirs	211	2.564	2	623	1.220	1	293	1.242	1
famdirs	211	0.578	0	623	0.433	0	293	1.348	1

continued. . .

Table B.4: (continued)

	Controlling			Non-Controlling			Passive		
	Firm-Yrs	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**	**Firm-Yrs**	**Mean**	**Median**
ncdirs	211	7.166	7	623	4.963	4	293	5.468	5
ncindp	211	2.412	2	623	3.196	3	293	3.614	4
nclnkd	211	2.934	3	623	0.880	1	293	1.024	0
ncfam	211	1.820	2	623	0.888	1	293	0.829	1
firmage	211	36.98	28	648	37.13	25	293	71.69	77

Table B.5: Wilcoxon Ranksum (z) and Difference of Means (t) Tests

The table reports the results of difference-in-means (t) and difference-in-medians (z) tests between family firm types for all variables. The sample consists of 1128 firm-year observations representing 150 family firms appearing on the S&P 500® Index between 1996 and 2003 and still on the S&P 500® Index as of July 2003. Definitions of Financial Variables are given in Table B.2. "w" preceding a financial variable indicates winsorization, which amounts differ across winsorized variables. Non-Financial variables are defined in Table B.3. A family is Controlling (C) if it is Active in board management and controls the votes of the board of directors. A family is Non-Controlling (NC) if it is Active in board management but does not control board votes. A family is Passive (P) if it is not Active in board management. The order of subtraction of means is given in each column header, e.g. C-P. If a score is statistically significant, the level of significance is indicated by the number of asterisks. * means $p < .05$. ** means $p < .01$. *** means $p < .001$.

	Panel A			**Panel B**		
	Financial			**Financial**		
	t-score (C-P)	**t-score (NC-C)**	**t-score (NC-P)**	**z-score (C-P)**	**z-score (NC-C)**	**z-score (NC-P)**
debt	-.813	.638	-.291	-1.651	.397	-1.373
wdivd	-8.19***	.968	-8.358***	-8.05***	.264	-10.327***
wroa	2.491**	-.115	2.942**	2.738**	-.985	1.903
wrd	.404	2.487**	4.135***	-1.042	2.281*	2.224*
fixd	-.441	-.713	-1.582	-1.911	-.795	-3.46***
wgrowth	2.524**	-.948	2.523**	7.268***	-2.269*	7.217***
invest	-1.749*	.21	-2.092*	-1.845	-.446	-2.874**
size	-5.832***	2.834**	-4.13***	-5.952***	3.443***	-4.059***
wbrisk	2.348**	.996	5.296***	1.07	2.003*	4.843***
wq	.714	1.098	1.687*	2.406*	-.592	1.996*
	Family Management			**Family Management**		
	t-score (C-P)	**t-score (NC-C)**	**t-score (NC-P)**	**z-score (C-P)**	**z-score (NC-C)**	**z-score (NC-P)**
fndrdir	-1.72*	-1.893*	-4.232***	-1.694	-2.003*	-4.496***
fndrceo	26.704***	-7.811***	24.82***	18.272***	-6.962***	14.837***

continued...

Table B.5: (continued)

	Panel A			Panel B		
fndrchmn	29.069***	-2.628**	39.433***	18.771***	-2.467*	20.164***
famdir	-6.843***	-3.819***	-13.785***	-6.623***	-4.001***	-12.698***
famceo	8.076***	-1.037	12.557***	8.771***	-1.068	8.285***
famchmn	6.9***	1.611	13.86***	7.654***	1.541	9.07***

	Governance			Governance		
	t-score (C-P)	**t-score (NC-C)**	**t-score (NC-P)**	**z-score (C-P)**	**z-score (NC-C)**	**z-score (NC-P)**
dualshrs	6.148***	-5.594***	1.364	6.408***	-6.642***	1.297
g_index	-6.309***	4.622***	-2.799**	-5.906***	4.338***	-2.942**
instown	3.829***	-2.022*	1.746*	3.761***	-3.376***	1.066
famown	6.828***	-6.553***	1.38	8.52***	-5.624***	6.025***

	Board			Board		
	t-score (C-P)	**t-score (NC-C)**	**t-score (NC-P)**	**z-score (C-P)**	**z-score (NC-C)**	**z-score (NC-P)**
ndirs	-5.345***	-.4	-7.778***	-5.804***	-.101	-7.566***
famempls	17.619***	-5.048***	23.643***	17.35***	-5.534***	20.154***
indpdirs	-17.546***	17.941***	-4.681***	-13.341***	14.327***	-5.846***
lnkddirs	9.245***	-10.994***	-.226	9.837***	-11.328***	-1.295
famdirs	-9.983***	-2.444**	-14.673***	-10.234***	-2.704**	-15.487***
ncdirs	6.07***	-8.503***	-2.787**	5.641***	-8.46***	-4.175***
ncindp	-8.442***	6.558***	-3.502***	-8.112***	6.33***	-3.837***
nclnkd	12.622***	-15.38***	-1.506	12.153***	-15.142***	-.144
ncfam	9.728***	-9.627***	.968	9.489***	-10.237***	.636

continued...

Table B.5: (continued)

	Panel A			Panel B		
firmage	-10.288***	.06	-11.858***	-8.747***	-1.392	-11.425***

Table B.6: Logit Regressions for Active and Passive Board Control

This table gives coefficient estimates and p-values for logit regressions with *bdctrl* as the dependent variable for 1029 firm-year observations collected on a sample of 150 family firms appearing on the S&P 500® Index between 1996 and 2003 and still on the S&P 500® Index as of July 2003. *bdctrl* is a binary variable that codes for board control, equaling 1 if independent directors ($indpdirs$) are outnumbered by affiliated, family and employee directors ($ndirs > 2 * indpdirs$) and 0 otherwise. A family is Active in board management if a family member is CEO or chairman of the board. A family is Passive if it is not Active in board management but has at least one family member on the board. d_Pass is a binary variable that equals 1 for Passive family firms and 0 otherwise. The definition of the six financial variables (wq - $size$) is explained in Table B.2. "w" preceding a financial variable indicates winsorization, which amounts differ across winsorized variables. All Non-Financial Variables are defined in Table B.3. The associated p-value is given in parentheses below each coefficient estimate. If an estimate is statistically significant, the level of significance is indicated by the number of asterisks. * means $p < .05$. ** means $p < .01$. *** means $p < .001$.

Dependent Var	**(1)**	**(2)**	**(3)**
bdctrl	**All**	**Active**	**Passive**
d_Pass	**2.8408****		
	(0.0055)		
wq	**-0.1544***	-0.1481	**-0.2090***
	(0.0176)	(0.0681)	**(0.0302)**
wroa	3.1762	3.9018	2.5216
	(0.1893)	(0.1605)	(0.8131)
debt	-0.8477	0.0433	**-13.9492*****
	(0.5061)	(0.9762)	**(0.0009)**
wdivd	-1.0306	-2.4916	7.8005

continued...

Table B.6: (continued)

Dependent Var	**(1)**	**(2)**	**(3)**
bdctrl	**All**	**Active**	**Passive**
	(0.4870)	(0.2092)	(0.0713)
fixd	1.8203	1.4448	8.7891
	(0.1013)	(0.1934)	(0.1511)
size	0.1344	0.1845	0.2463
	(0.4653)	(0.4093)	(0.7362)
dualshrs	0.7547	0.4328	2.1474
	(0.2181)	(0.4717)	(0.0940)
indpdirs	**-1.8476*** **	**-1.7911*** **	**-3.6345*** **
	(0.0000)	**(0.0000)**	**(0.0005)**
lnkddirs	**1.4392*** **	**1.4114*** **	**3.2685** **
	(0.0000)	**(0.0000)**	**(0.0012)**
famdirs	**1.9648*** **	**2.6700*** **	**3.3802*** **
	(0.0000)	**(0.0000)**	**(0.0010)**
famempls	**1.8699*** **	**2.4759*** **	2.5318+
	(0.0000)	**(0.0000)**	(0.0585)
fndrdir	-0.4016	-0.9116	**8.3517* **
	(0.3804)	(0.1494)	**(0.0271)**

continued...

Table B.6: (continued)

Dependent Var	**(1)**	**(2)**	**(3)**
bdctrl	**All**	**Active**	**Passive**
fndrceo	-0.6394	-0.6806	.
	(0.2237)	(0.2180)	.
fndrchmn	0.6279	0.5603	.
	(0.4417)	(0.4963)	.
famdir	-0.6371	-1.3033	6.7293
	(0.3789)	(0.0510)	(0.1609)
famceo	-2.0637	**-2.3048***	.
	(0.0544)	**(0.0414)**	.
famchmn	**3.4248****	**3.3502****	.
	(0.0019)	**(0.0068)**	.
famown	1.7740	2.6896	-3.7467
	(0.1859)	(0.0701)	(0.4282)
ncindp	**-0.4862****	**-0.7545*****	0.6481
	(0.0027)	**(0.0000)**	(0.0973)
nclnkd	**1.0151*****	**1.2885*****	0.1889
	(0.0000)	**(0.0000)**	(0.4937)
ncfam	-0.0186	-0.1103	-0.6551
	(0.9486)	(0.7540)	(0.3758)

continued...

Table B.6: (continued)

Dependent Var	**(1)**	**(2)**	**(3)**
bdctrl	**All**	**Active**	**Passive**
Intercept	-0.4962	-1.5256	-5.1715
	(0.7670)	(0.4293)	(0.4043)
N	1029	759	270
pseudo R-sq	0.757	0.764	0.838

Table B.7: Tobin's Q Regressions for Firm Types

This table gives coefficient estimates and p-values for OLS regressions of Tobin' Q (wq) for all family firm types (column (1)) - Controlling, Non-Controlling and Passive - as well as for each firm type individually (columns (2)-(4)). 1029 firm-year observations were collected on a sample of 150 family firms appearing on the S&P 500® Index between 1996 and 2003 and still on the S&P 500® Index as of July 2003. A family is Controlling if it is Active in board management and controls the votes of the board of directors. A family is Non-Controlling if it is Active in board management but does not control board votes. A family is Passive if it is not Active in board management. *d_Ctrl* is a dummy variable that equals 1 for Controlling firms and 0 otherwise. The definition of the six financial variables (wq - $size$) is explained in Table B.2. $wroa2$ is $wroa^2$. "w" preceding a financial variable indicates winsorization, which amounts differ across winsorized variables. All Non-Financial Variables are defined in Table B.3. The associated p-value is given in parentheses below each coefficient estimate. If an estimate is statistically significant, the level of significance is indicated by the number of asterisks. * means $p < .05$. ** means $p < .01$. *** means $p < .001$. Coefficients for year and industry dummies are not shown.

Dependent Var	**(1)**	**(2)**	**(3)**	**(4)**
wq	**All**	**Controlling**	**Non-Controlling**	**Passive**
d_Ctrl	-0.3180			
	(0.4886)			
wroa	3.7268	5.9458	**3.6003***	13.7072
	(0.0635)	(0.1101)	**(0.0238)**	(0.1548)
wroa2	**23.9747****	**17.0620***	**27.9791*****	-20.7879
	(0.0012)	**(0.0494)**	**(0.0001)**	(0.6926)
debt	-1.6434	2.0411	-1.4524	-2.1733
	(0.0690)	(0.1185)	(0.1473)	(0.1333)
wdivd	-0.4890	2.0674	-1.0721	0.1444
	(0.4929)	(0.3703)	(0.3345)	(0.9036)
fixd	-0.6496	1.4255	-1.3646	-0.7329

continued...

Table B.7: (continued)

Dependent Var	**(1)**	**(2)**	**(3)**	**(4)**
wq	**All**	**Non-Controlling**	**Controlling**	**Passive**
	(0.3721)	(0.2647)	(0.1096)	(0.5824)
size	**-0.3484***	-0.3371	-0.3369	**-0.9704***
	(0.0484)	(0.1781)	(0.2060)	**(0.0356)**
fndrdir	0.6656	-0.2985	0.2152	**6.2224****
	(0.1320)	(0.5365)	(0.5780)	**(0.0017)**
fndrceo	-0.4839	-2.7592	-0.3678	
	(0.2634)	(0.0881)	(0.4115)	
fndrchmn	-0.0844	-0.1652	0.5158	
	(0.9096)	(0.8560)	(0.2923)	
famdir	-0.2671	-1.4687	-0.5556	**5.9044****
	(0.3958)	(0.0833)	(0.3924)	**(0.0059)**
famceo	-0.4801	**-4.8434***	-0.1281	
	(0.2646)	**(0.0144)**	(0.7631)	
famchmn	-0.1801	2.0006	-0.2791	
	(0.6313)	(0.1089)	(0.5681)	
dualshrs	-0.6176	-0.6459	**-0.8667***	0.0135
	(0.0990)	(0.3038)	**(0.0223)**	(0.9910)

continued...

Table B.7: (continued)

Dependent Var	**(1)**	**(2)**	**(3)**	**(4)**
wq	**All**	**Non-Controlling**	**Controlling**	**Passive**
famown	0.6715	1.0989	1.5750	0.1376
	(0.4343)	(0.4481)	(0.3996)	(0.9608)
ndirs	-0.0852	-0.0951	-0.0909	-0.3023
	(0.4603)	(0.4718)	(0.6217)	(0.3379)
famempls	-0.0275	0.7273	-0.2526	0.2097
	(0.9224)	(0.1215)	(0.5221)	(0.7355)
indpdirs	-0.0039	-0.0542	0.1109	0.2496
	(0.9754)	(0.8097)	(0.5769)	(0.3612)
lnkddirs	-0.0643	0.1343	-0.1700	0.0434
	(0.6492)	(0.4511)	(0.4808)	(0.9238)
famdirs	-0.0068	0.4725	0.4522	0.0178
	(0.9774)	(0.3412)	(0.3380)	(0.9694)
ncdirs	-0.0904	-0.1281	-0.0554	0.0314
	(0.5435)	(0.6125)	(0.7999)	(0.9230)
ncindp	0.0706	0.1242	0.1952	-0.3273
	(0.6953)	(0.6939)	(0.4608)	(0.4746)
nclnkd	0.2601	0.1138	0.2930	0.4814
	(0.3325)	(0.7325)	(0.3036)	(0.4330)

continued...

Table B.7: (continued)

Dependent Var	**(1)**	**(2)**	**(3)**	**(4)**
wq	**All**	**Non-Controlling**	**Controlling**	**Passive**
N	1029	191	568	270
R-sq	0.257	0.366	0.338	0.271
adj. R-sq	0.228	0.214	0.291	0.166

Appendix C

Appendix for Essay 3

C.1 Proofs

Proof. **(Lemma 1)**

Because $S_\kappa(k,u) = -s_\kappa$ for $k \geq \tau$, and $W(n-1,u) > 0$, if at least τ insiders reveal, any other insider κ must also reveal or suffer a loss. □

Proof. **(Lemma 2)**

(a) Since $\tau - 1 = \text{argmax}_k S_\kappa(k,u)$, $S_\kappa(\tau-1,u) < 0$ would mean that there is no value of k such that insider κ would not suffer a loss if he remained silent. On the other hand, if he reveals, either $k \geq \tau - 1$ other insiders reveal and his payoff is $W(n-1,u) > 0$ or $k < \tau - 1$ others reveal and his payoff is $0 > S_\kappa(k,u)$ $\forall k$.[1] In either case, he receives a bigger payoff by revealing then by remaining silent.

(b,i) If $k \geq \tau$ other insiders reveal, then by Lemma 1, insider κ will reveal. If $k = \tau - 1$ others reveal, then if insider κ remains silent, he receives payoff $S_\kappa(\tau-1,u)$. If he reveals, then by Lemma 1 all insiders reveal and he receives payoff $W(n-1,u) > S_\kappa(\tau-1,u)$. Hence, he reveals.

(b,ii) If $k < \tau - 1$ other insiders reveal, then

(1) if $0 \leq S_\kappa(k,u) \leq S_\kappa(\tau-1,u)$, then if insider κ reveals, he receives payoff 0. If he remains silent, he receives payoff $S_\kappa(k,u) \geq 0$. Hence insider κ remains silent.

(2) if $S_\kappa(k,u) < 0$, then insider κ reveals and receives payoff $0 > S_\kappa(k,u)$

(c,i) If $k \geq \tau$ other insiders reveal, then by Lemma 1, insider κ will reveal.

(c,ii) If $k = j+1, \ldots, \tau-1$ other insiders reveal, then if insider κ reveals, he receives payoff 0. If he remains silent, he receives payoff $S_\kappa(k,u) \geq S_\kappa(j+1,u) > 0$. Hence insider κ remains silent.

[1] Recall that if less than $\tau - 1$ insiders reveal, an insider who reveals forfeits both the private benefit and the chance to succeed the CEO, yielding a payoff of 0.

(c,iii) If $k \leq j$ other insiders reveal, then

(1) if $0 \leq S_\kappa(k,u) \leq S_\kappa(j,u)$, then if insider κ reveals, he receives payoff 0. If he remains silent, he receives payoff $S_\kappa(k,u) \geq 0$. Hence insider κ remains silent.

(2) if $S_\kappa(k,u) < 0$, then insider κ reveals and receives payoff $0 > S_\kappa(k,u)$. □

C.2 Local Network Effects

C.2.1 The model of Sundararajan (2007)

The following description of his model is taken directly from Sundararajan (2007).

Sundararajan (2007) studies network effects that are "local" in the following sense. A typical user of communication software like AOL's Instant Messenger (IM) is generally interested in communicating with a very small fraction of the potential set of users of the product (friends and family, colleagues, or more generally, members of an immediate 'social network'). This user benefits when more members of their immediate social network adopt IM; they get no direct benefits from the adoption of IM by other users who they have no desire to communicate with (this observation is true of most person-to-person communication technologies). Similarly, firms often benefit when their business partners (suppliers, customers) adopt compatible information technologies; this set of partners (the business network local to the firm) is a small subset of the total set of potential corporate adopters of these technologies. Buyers benefit when more sellers join a common electronic market (and vice versa), though each buyer benefits directly only when those sellers whose products they want to buy join their market. This is typically a small fraction of the potential set of sellers.

Although local to individual users, these networks (social, business, trading) are not isolated from each other. Each individual agent (user, business, trader) values adoption by a distinct subset of other agents, and is therefore connected to a different "local network". However, each member of this local network is in turn connected to their own local network of other agents, and so forth. The interconnection of these local networks implies that even if agent A is not directly connected to agent B (and does not benefit directly from agent B's adoption of a network good), the choices of agents A and B may affect each other in equilibrium. Additionally, different agents have information about the structure of a different portion of the entire network; each agent knows the structure of their own local network, but is likely to know less about the structure of their neighbors' local networks, and probably almost nothing about the exact structure of the rest of the network.

In the model, potential adoption complementarities[2] between agents are specified by a graph representing an underlying 'social network'. Each agent is a vertex in this graph, connected to a typically small subset of the other vertices (their neighbors), the subset of other agents whose adoption the agent values. The size of this subset (the

[2]Adoptions are said to be *strategically complementary* if adoption by one's neighbor increases the value of adoption to oneself.

number of neighbors, or degree of the agent) varies across agents. Each agent knows the local structure of the graph in their neighborhood (that is, they know who their neighbors are), but does not know the structure of the rest of the social network. This lack of exact information about the entire graph is modeled by treating it as an instance of a random graph drawn from a known distribution of graphs. Each agent who adopts the network good values the good more if more of their neighbors adopt the good. Additionally, agents are indexed by a heterogeneous valuation type parameter, and higher valuation type agents value adoption by a fixed number of their neighbors more than lower valuation type agents.

The adoption of the network good is modeled as a simultaneous-move game of incomplete information. This game is shown to have greatest and least Bayes-Nash equilibria that are in monotone pure strategies. Under some assumptions about the independence and symmetry of the posteriors implied by the distribution over graphs, every symmetric Bayes-Nash equilibria of this game is shown to involve all agents playing a threshold strategy, which is defined by a vector of thresholds on valuation type, each component of which is associated with a different degree. When there are multiple equilibria, these threshold vectors can be strictly ordered, and the ordering is based on a common equilibrium probability of adoption by each neighbor of any agent. This ordering also determines a ranking of equilibria: outcomes under a higher-ranked equilibrium strictly Pareto dominate those under a lower-ranked equilibrium. The greatest equilibrium is shown to be the unique symmetric equilibrium that satisfies a refinement of being coalition-proof with respect to self-enforcing deviations in pure strategies.

Outcomes under each symmetric Bayes-Nash equilibrium are shown to be identical to those under a corresponding "fulfilled expectations" equilibrium (and vice versa), under which agents form expectations locally about the probability that each of their neighbors will adopt, and make unilateral adoption choices based on this expectation, which is then fulfilled. The greatest Bayes-Nash equilibrium corresponds to the fulfilled expectations equilibrium that maximizes expected adoption.

C.2.2 The creation of social consensus: Sundararajan's model re-interpreted

Let G be a social network. The network is extensive, so that no network member has knowledge of the entire network. However, each member has knowledge about his or her “local” network (that could consist of family and friends or business associates, depending on the nature of the network). The set of nodes of G is $N \equiv \{1, 2, \ldots, n\}$. Each node, i, represents an *agent*, i.e. a member of the network. $g_{ij} \in \{0, 1\}$ indicates the existence of a link between agents i and j, i.e. whether or not agents i and j are connected. $g_{ii} = 0$ by convention. G is a member of the set

$$\Gamma = \{G : (g_{ij} = g_{ji}) \wedge (g_{ij} \in \{0, 1\}), \quad i, j \in N\} \tag{C.1}$$

Using the *adjacency matrix* representation of G, Γ contains all possible $n \times n$ symmetric, binary matrices of which there are $2^{\frac{n(n-1)}{2}}$, one of which is G. The set of agents directly linked to agent i is called the *neighborhood* of i and is denoted by G_i. G_i corresponds to the local network of family and friends referred to above. $G_i \in \Gamma_i$ where

$$\Gamma_i = \{j : g_{ij} = 1, \quad j \in N\} \tag{C.2}$$

Γ_i is the set of all possible neighborhoods of i. In an adjacency matrix representation of G, the neighborhood of i is the ith column of G and Γ_i is a set of 2^{n-1} binary column vectors. The neighborhoods of all agents $j \neq i$ is denoted by $G_{-i} \in \Gamma_{-i}$ where Γ_{-i} is the set of sets of neighborhoods G_j for $j \neq i$. (Think of Γ_{-i} as Γ where each matrix G is missing the ith row and column.) Formally,

$$\Gamma_{-i} = \{G_j : \quad j \in N \setminus \{i\}\} \tag{C.3}$$

The number of neighbors agent i has is referred to as agent i's *degree* $d_i = |G_i|$.

Upon exposure to the media report, each agent's internal response to the report is indexed by a valuation type $\theta \in \Theta \equiv [0,1]$. θ may be thought of as the agent's internal assessment of the likely honesty of the subject(s) of the report. After observing θ_i, each agent i declares an opinion $h_i \in H = \{0,1\}$ where 0 and 1 indicate honesty and dishonesty respectively. Call $h_i = 1$ the *negative* opinion. Let

$$\begin{aligned} h &= (h_1, h_2, \ldots, h_{i-1}, h_i, h_{i+1}, \ldots, h_n) \\ h_{-i} &= (h_1, h_2, \ldots, h_{i-1}, h_{i+1}, \ldots, h_n) \end{aligned}$$

Then the payoff to agent i from opinion vector h is

$$\pi_i(h_i, h_{-i}, G_i, \theta_i) = h_i \left[u\left(\sum_{j \in G_i} h_j, \theta_i \right) - c \right] \tag{C.4}$$

where u is a value function, and c is the cost to agent i of adopting the negative opinion. u has the property of *increasing differences*. That is, if $x' > x$ and $t' > t$, then $u(x', t') - u(x, t') > u(x', t) - u(x, t)$. This means that the more strongly agent i feels about the dishonesty of the subject of the media report, the higher the reward for adopting the negative opinion.

One implication of (C.4) is that the payoff to agent i is only influenced by the opinions of i's neighbors and is not influenced by the internal state θ_j of any other agent $j \neq i$. For simplicity, I assume that the cost c, and value function u, come along with membership in the network and are thus held in common by all agents. An example of c might be the cost to an agent of reassessing the relationship with the subject(s) of the media report, e.g. avoiding social contact.

An agent's *uncertainty* about the exact structure of the social network is modeled by drawing G from a known distribution ρ over Γ and each θ_i independently from a common distribution F over Θ. Agent i observes G_i and θ_i, but does not know G_j or θ_j for $j \neq i$. Thus, each agent only has knowledge about their own neighborhood. ρ is assumed to be *symmetric* with respect to agents, i.e. it does not change with permutation of agents' labels (identities). Each agent's posterior beliefs about (G_{-i}, θ_{-i}) are therefore identically distributed. The distribution

ρ satisfies the condition of *increasing posteriors* if the posterior distribution it implies is increasing (in the sense of first-order stochastic dominance) with respect to the partial order on Γ_i. That is, if j is a neighbor of agent i,

$$G_i' \subseteq G_i \Rightarrow P\left[G \subseteq G_j | G_i, \theta_i\right] \geq P\left[G \subseteq G_j | G_i', \theta_i\right] \qquad G \in \Gamma_j$$

This means that agents with larger neighborhoods are more likely to have neighbors with larger neighborhoods.

The timeline of events is as follows:

1. Nature draws $G \in \Gamma$ according to ρ.
2. A negative report appears in the media and is observed by every agent in G.
3. Nature draws $\theta_i \in \Theta$ independently for each agent i according to F.
4. Each agent i observes θ_i and G_i.
5. Agents simultaneously express their opinions $h_i \in H$.
6. Each agent realizes their payoff $\pi_i\left(h_i, h_{-i}, G_i, \theta_i\right)$.

Let $D \subseteq \{0, 1, 2, \ldots, n-1\}$ be the set of possible values that d_i can take. The symmetry of ρ implies a common prior on the degree - the *prior degree distribution* - with density (mass) function $p\left(x\right)$. For each $x \in D$, denote by $\Gamma_j\left(x\right)$ the subset of Γ_j such that for each $X \in \Gamma_j\left(x\right)$, $|X| = x$. The set of permissible distributions ρ over Γ is restricted by assuming that ρ generates posteriors that have marginal distributions with the following properties:

$$\text{for } j \in G_i,\ P\left[G_j \in \Gamma_j\left(x\right) | G_i, \theta_i\right] = q\left(x\right) \quad \forall i \tag{C.5}$$

$$\text{for } j \notin \left(G_i \cup \{i\}\right),\ P\left[G_j \in \Gamma_j\left(x\right) | G_i, \theta_i\right] = \hat{q}\left(x\right) \quad \forall i \tag{C.6}$$

$q\left(x\right) \equiv$ density (mass) function of the *posterior neighbor degree distribution*

$\hat{q}\left(x\right) \equiv$ density (mass) function of the *posterior non-neighbor degree distribution*

A distribution that satisfies (C.5) and (C.6) is said to satisfy the *symmetric independent posteriors* condition. Qualitatively, this condition implies that if the presence of agent j in the neighborhood of agent i changes i's priors, the change is symmetric for each neighbor $j \in G_i$ and is independent of agent i's degree[3]. If the posterior neighbor degree distribution first-order stochastically dominates the posterior non-neighbor degree distribution, i.e. if for each $x \in D$,

$$\sum_{j=0}^{x} q\left(j\right) \leq \sum_{j=0}^{x} \hat{q}\left(j\right) \tag{C.7}$$

then symmetric independent posteriors imply increasing posteriors.

[3] This is not an innocuous condition. It precludes networks that display a kind of clustering exhibited by most real-world social networks and modeled using the Markov random graph model of Frank and Strauss (1986).

Given a fixed set of actions by each agent $j \in G_i$, the actions of agents $j \notin G_i$ do not affect agent i's payoffs. Symmetric independent posteriors imply that the marginal distributions of x (degree) and t (type) are independent. Symmetric independent posteriors also imply that (C.4) can be rewritten as $h_i \left[\Pi\left(d_i, \theta_i\right) - c\right]$. Assuming that indifferent agents adopt the negative opinion, a symmetric strategy s is therefore a Bayes-Nash equilibrium if it satisfies the following conditions for each i:

$$\Pi\left(d_i, \theta_i\right) \geq c \Rightarrow h_i = s\left(d_i, \theta_i\right) = 1 \tag{C.8}$$

$$\Pi\left(d_i, \theta_i\right) < c \Rightarrow h_i = s\left(d_i, \theta_i\right) = 0 \tag{C.9}$$

Proposition 1 defines the strategy for adoption implied by conditions (C.8) and (C.9).

Proposition 1 *(Sundararajan, 2007)*

(a) In each symmetric Bayes-Nash equilibrium, the equilibrium strategy $s : D \times \Theta \rightarrow H$ is non-decreasing in both degree and valuation type. Therefore, in every symmetric Bayes-Nash equilibrium, the equilibrium strategy takes the form

$$s\left(d_i, \theta_i\right) = \begin{cases} 0 & \theta_i < \theta^*(d_i) \\ 1 & \theta_i \geq \theta^*(d_i) \end{cases} \tag{C.10}$$

where $\theta^* : D \rightarrow H$ is non-decreasing.

(b) If $u\left(0, \theta\right) = 0$ for each $\theta \in \Theta$, then $s\left(x, t\right) = 0$ for each $x \in D$, $t \in \Theta$ is a symmetric Bayes-Nash equilibrium for any adoption costs $c > 0$.

A strategy of the form (C.10) is called a *threshold strategy* with threshold vector $\theta^* = \left(\theta^*\left(1\right), \theta^*\left(2\right), \ldots, \theta^*\left(n\right)\right)$ where

$$\theta^*\left(x\right) = max\left\{t : s\left(x, t\right) = 0\right\} \tag{C.11}$$

An implication of Proposition 1 is there are likely to be multiple symmetric Bayes-Nash equilibria.

Consider any threshold strategy of the form in Proposition 1. When s is played by all agents, for any agent i with $h_i = 1$, the realized payoff under s is

$$u\left(\sum_{j \in G_i} s\left(d_j, \theta_j\right), \theta_i\right) - c \tag{C.12}$$

Now for each $j \in G_i$, from (C.10),

$$s\left(d_j, \theta_j\right) = 1 \Rightarrow \theta_j \geq \theta^*\left(d_j\right) \tag{C.13}$$

Thus, conditional on d_i, ex-ante (after observing degree and type, but before choosing),

$$P\left[s\left(d_j,\theta_j\right)=1|d_i\right]=1-F\left(\theta^*\left(d_i\right)\right) \tag{C.14}$$

Since the posterior probability that an arbitrary neighbor of i has degree x is $q\left(x\right)$,

$$P\left[s\left(d_j,\theta_j\right)=1\right]=\sum_{x=1}^{m}q\left(x\right)\left[1-F\left(\theta^*\left(x\right)\right)\right] \tag{C.15}$$

where $m=max\left\{x:x\in D\right\}$. Note that this probability does not depend on j and given agent i's information, is the *same* ex-ante for each neighbor $j\in G_i$. Denote this common probability - the *neighbor adoption probability* - as $\lambda\left(\theta^*\right)$. That is,

$$\lambda\left(\theta^*\right)=\sum_{x=1}^{m}q\left(x\right)\left[1-F\left(\theta^*\left(x\right)\right)\right] \tag{C.16}$$

Moreover, the payoff to agent i only depends on the *number* of neighbors who adopt the negative opinion. Let $Y\sim\text{Binom}\left(x,\lambda\left(\theta^*\right)\right)$ with probability mass function

$$B\left(y|x,\theta^*\right)\equiv P\left[Y=y\right]=\begin{pmatrix}x\\y\end{pmatrix}\left[\lambda\left(\theta^*\right)\right]^y\left[1-\lambda\left(\theta^*\right)\right]^{x-y} \tag{C.17}$$

If all agents $j\neq i$ play the symmetric strategy (C.10), the expected payoff to agent i where $h_i=1$ is

$$\sum_{y=1}^{d_i}u\left(y,\theta_i\right)B\left(y|d_i,\theta^*\right)-c \tag{C.18}$$

This establishes that under a threshold strategy with threshold vector θ^*,

$$\Pi\left(d_i,\theta_i\right)=\sum_{y=1}^{d_i}u\left(y,\theta_i\right)B\left(y|d_i,\theta^*\right) \tag{C.19}$$

where Π replaces u in (C.4).

Suppose that each agent i forms the same expectation about the behavior of other agents in their neighborhood, viz. a probability λ that any arbitrary neighbor will adopt the negative opinion. Based on this expectation λ, the probability that y of their d_i neighbors will adopt the negative opinion is described by the binomial distribution $b\left(y|x,\lambda\right)$where

$$b\left(y|x,\lambda\right)\equiv\begin{pmatrix}x\\y\end{pmatrix}\lambda^y\left(1-\lambda\right)^{x-y} \tag{C.20}$$

and agent i's expected value from adopting the opinion is $v\left(d_i,\theta_i,\lambda\right)-c$ where

$$v\left(x,t,\lambda\right)\equiv\sum_{y=1}^{x}u\left(y,t\right)b\left(y|x,\lambda\right) \tag{C.21}$$

Therefore agent i adopts the negative opinion if $v(d_i, \theta_i, \lambda) - c \geq 0$. For a fixed λ, define the adoption threshold $\underline{\theta}(x, \lambda)$ as

$$\underline{\theta}(x, \lambda) = \begin{cases} 1 & v(x, 1, \lambda) < c \\ t : v(x, t, \lambda) = c & \text{Otherwise} \end{cases} \tag{C.22}$$

Since $\frac{\partial u}{\partial t} > 0 \Rightarrow \frac{\partial v}{\partial t} > 0$, $\underline{\theta}$ is well-defined.

Additionally, an agent of valuation type θ_i and degree d_i adopts the negative opinion if and only if $\theta_i \geq \underline{\theta}(d_i, \lambda)$. Therefore, ex-ante, the probability that a neighbor of agent i who has degree x will adopt the negative opinion is $1 - F(\underline{\theta}(x, \lambda))$. Since all agents share a common expectation λ, the *actual* probability $\Lambda(\lambda)$ that an arbitrary neighbor of any agent adopts the negative opinion, given the posterior degree distribution $q(x)$ is

$$\Lambda(\lambda) = \sum_{x=1}^{m} q(x) \left[1 - F(\underline{\theta}(x, \lambda))\right] \tag{C.23}$$

Therefore λ is fulfilled as an expectation of the neighbor adoption probability only if it is a fixed point of $\Lambda(\lambda)$. Notice that

$$\lambda = 0 \Rightarrow b(y|x, \lambda) = 0 \Rightarrow v(x, t, \lambda) = 0 \Rightarrow \underline{\theta}(x, \lambda) = 1 \Rightarrow \Lambda(\lambda) = 0$$

Thus the expectation $\lambda = 0$ is fulfilled. Each outcome associated with a fulfilled expectation λ is a *fulfilled expectations equilibrium.*

Proposition 4 *(Sundararajan, 2007)*

(a) For each Bayes-Nash equilibrium of the adoption game with threshold θ^*, the expectation $\lambda(\theta^*)$ defines a fulfilled expectations equilibrium.

(b) For each fulfilled expectation λ, the threshold strategy with threshold vector defined by $\theta^*(x) = \underline{\theta}(x, \lambda)$ is a Bayes-Nash equilibrium of the adoption game.

C.3 The Cost of Negative Media

C.3.1 The Poisson Random Graph

A negative media report about the honesty of the CEO may also, in the eyes of the public, raise questions about the honesty of the members of the board of directors. Recall that the CEO and the board members are each members of separate but overlapping social networks. The results of Appendix C.2.2 provide a model for the effect on the other agents (in the respective social networks of those affected by the report) having no private knowledge of the facts reported in the media. I want to first examine the impact of the report on the agents not affected by the report and then on those who are. Following Sundararajan (2007), I do this in the context of a special network structure - the classic Poisson random graph (Solomonoff and Rapaport (1951), Erdos and Renyi (1959), among many others).

Real-world social networks exhibit clustering - a friend of a friend is more likely to be my friend than a person chosen at random from the population. The generalized random network models in the literature currently fail to capture this common phenomenom (called *homophily* in the sociology literature. See McPherson et al. (2001)). For general networks, the techniques currently used to derive solutions depend crucially on the *independence* of neighbors of a vertex. The main hope for progress in understanding the effects of clustering seems to lie in formulating a completely different model. One candidate is the *exponential graph*[4] model (also called, in a slightly generalized form, the $p*$ model) of Frank and Strauss (1986). The model was later introduced into the social network literature by Wasserman and Pattison (1996) and further generalized and extended Pattison and Wasserman (1999), Robins et al. (1999, 2001a,b).

Let $\{\epsilon_i\}$ be a set of measurable properties of a single graph, such as the number of edges, the number of vertices of given degree, or the number of triangles of edges in the graph. Let $\{\beta_i\}$ be a set of parameters, whose values are freely chosen by the analyst. The exponential random graph model is then defined to be the set of all possible graphs (undirected in the simplest case) of n vertices in which each graph G appears with probability

$$P\left(G\right) = \frac{1}{Z} \exp\left(-\sum_i \beta_i \epsilon_i\right) \tag{C.24}$$

where Z is a constant that makes $0 \leq P\left(G\right) \leq 1$. The Poisson random graph is the simplest model in the class of exponential random graph models and is derived from (C.24) by retaining only the first term in the sum on the right-hand side. The Poisson random graph reproduces well one of the principal features of real-world networks, namely the small-world effect Watts (1999). However in almost all other respects, the properties of the Poisson random graph do not match those of networks in the real world. In particular, it differs from real networks in two crucial ways: it lacks network clustering, and it has an unrealistic degree distribution. The degree distribution is Poisson, quite unlike the degree distributions observed in real social networks. (See for example Newman et al. (2001) who provide degree distributions on some real-life social networks.)

Yet, in some sense, the use of the Poisson random graph is forced because a model that retained more terms in the sum of Eq.(C.24) would violate the condition of symmetric independent posteriors which plays a crucial role in the derivation of Sundararajan's model as explained in Appendix C.2. This is an example of what was referred to above, viz. the techniques currently used to derive solutions depending crucially on the independence of neighbors of a vertex.

[4]In the mathematics literature, networks are called graphs.

C.3.2 Non-members of management

Poisson random graphs are constructed as follows: take n vertices and connect each pair with probability r. It is well known that the prior degree distribution has the probability mass function

$$p(x) = \binom{n-1}{x} r^x (1-r)^{n-1-x} \tag{C.25}$$

Excluding agent i, the distribution of the number of neighbors that an arbitrary agent has (the *excess degree* of agent j) is simply

$$p_{ex}(x) = \binom{n-2}{x} r^x (1-r)^{n-2-x} \tag{C.26}$$

Therefore the posterior *neighbor* degree distribution is

$$q(x) = \begin{cases} 0 & x = 0 \\ p_{ex}(x-1) & 1 \leq x \leq n-1 \end{cases} \tag{C.27}$$

since for any agent j a neighbor of i, agent i knows that $i \in G_j$, but knows nothing else about j's neighbors. Similarly, the posterior *non-neighbor* degree distribution is

$$\hat{q}(x) = \begin{cases} p_{ex}(x) & 0 \leq x \leq n-2 \\ 0 & x = n-1 \end{cases} \tag{C.28}$$

since agent i knows only that for each non-neighbor j, $i \notin G_j$. The Poisson random graph therefore satisfies the symmetric independent posteriors condition (Eqs.(C.5) and (C.6)).

Let the value of adoption of the negative opinion be linear in both valuation type (t) and the number of neighbor adoptions (y). That is, $u(y,t) = y\,t$. Further, let

$\lambda \equiv$ probability, commonly held by network members, that any arbitrary neighbor will adopt the negative opinion

$\Lambda(\lambda) \equiv$the *actual* probability that any arbitrary neighbor will adopt the negative opinion (See Eq.(C.23))

λ is a fixed point of $\Lambda(\lambda)$ and is thus the probability in a fulfilled expectation equilibrium. Based on Proposition 4 in Appendix C.2, the set of Bayes-Nash equilibria can be determined by constructing the set of neighbor adoption probabilities that define a fulfilled expectations equilibrium. For any candidate neighbor adoption probability λ, from Eq.(C.21), the *expected* value of adoption is

$$v(x,t,\lambda) \equiv \sum_{y=1}^{x} y\,t\,b(y|x,\lambda) = t\,x\,\lambda \tag{C.29}$$

where x is the number of neighbors and $b(y|x,\lambda)$ is the probability that y of the x neighbors will adopt the negative opinion (See Eq.(C.20)).

Based on (C.22) and (C.29) in Appendix C.2, for any cost $c > 0$, the adoption thresholds are

$$\underline{\theta}(x,\lambda) = \begin{cases} 1 & x < \frac{c}{\lambda} \\ \\ \frac{c}{x\lambda} & x \geq \frac{c}{\lambda} \end{cases} \tag{C.30}$$

Consequently, from (C.23) and (C.30),

$$\Lambda(\lambda) = \sum_{x=\lceil \frac{c}{\lambda}}^{n-1} \left[\binom{n-2}{x-1} r^{x-1} (1-r)^{n-1-x} \right] \left[1 - F\left(\frac{c}{x\lambda}\right) \right] \tag{C.31}$$

where $\lceil u \equiv$ the smallest integer less than or equal to u. Note that $\Lambda(\lambda)$ is continuous in λ, though there are discontinuous changes in its slope at each λ for which c/λ is integral (See Fig. 1). For λ a fixed point of $\Lambda(\lambda)$, there is a Bayes-Nash equilibrium with threshold

$$\theta^*(x) = \begin{cases} 1 & x < \frac{c}{\lambda} \\ \\ \frac{c}{x\lambda} & x \geq \frac{c}{\lambda} \end{cases} \tag{C.32}$$

Example: $\theta \sim$ Beta (5,2)

Let let $r = .1$ and $c = 1$. Fig.1 shows a plot of the Beta (5,2) probability density function and plots of $\Lambda(\lambda)$ for $n = 24, 33$ and 50. For these choices $\Lambda(\lambda)$ will have, in addition to $\lambda = 0$, an additional either one or two fixed points depending on whether or not the line $y = \lambda$ actually intersects $\Lambda(\lambda)$ at the lower end or passes through a discontinuity as $\lceil c/\lambda$ changes integral values. For example, for $n = 24$, there is only one other fixed point at $\lambda = .9$. Notice in Fig. 1 that for $n = 24$ and $\lambda < .2$, $y = \lambda$ lies above $\Lambda(\lambda)$ whereas for $y \geq .2$ it lies below $\Lambda(\lambda)$ until they intersect at $\lambda = .9$. At $n = 33$, there are two other fixed points - $\lambda = .189$ and $\lambda = .961$. For $n = 50$ there is again only one other fixed point at $\lambda = .993$. Label the fixed points in order as 0, $\underline{\lambda}$ and $\bar{\lambda}$ respectively. In general, in addition to 0, there are either one or two more fixed points with $\underline{\lambda} \to 0$ (when it exists) and $\bar{\lambda} \to 1$ as $n \to \infty$. It turns out that very similar results are obtained for any values of α and β such that Beta (α,β) is a unimodal distribution and so this will be assumed going forward.

$\lambda \in \{0, \underline{\lambda}, \overline{\lambda}\}$ is actually a very interesting result. It means, for example, that based on the negative media report, the probability assigned by an arbitrary member of the CEO's social network to the CEO's dishonesty will be very high or very low. Speaking loosely, whether convinced of guilt or innocence, the majority will hold that opinion with a high degree of certainty.

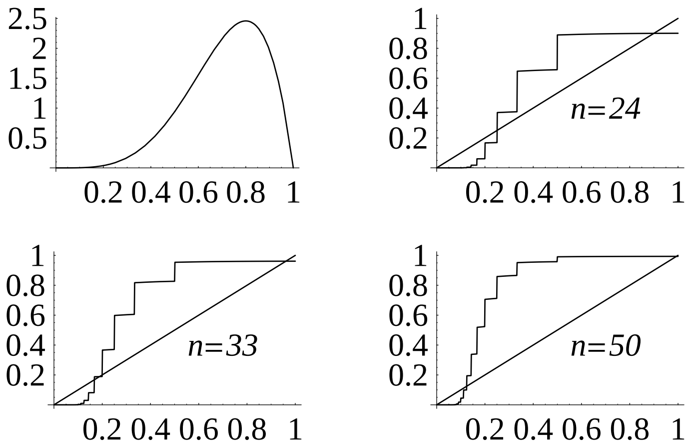

Figure C.1: Beta (5,2) pdf and $\Lambda(\lambda)$ for $n = 24, 33$, and 50

C.3.3 Members of management

By "members of management" I have in mind the CEO and members of the board of directors, particularly insiders. Let a member of management be labeled $\kappa \in K$ where

$$K = \{\kappa : \kappa \in N \text{ and } \kappa \text{ is affected by the negative media report}\}$$

The adoption of the negative opinion by agent κ's neighbors represents a *cost* ξ_κ to agent κ. Let the value function for agent κ be linear in the number of complementary adoptions, i.e.

$$u(y, \theta_\kappa) = -\xi(\theta_\kappa)\, y \tag{C.33}$$

Then

$$v(d_\kappa, \theta_\kappa, \lambda) = -\sum_{y=1}^{d_\kappa} \xi(\theta_\kappa)\, y\, b(y|d_\kappa, \lambda) = -\xi(\theta_\kappa)\, d_\kappa \lambda \tag{C.34}$$

or

$$v(d_\kappa, \theta_\kappa, \lambda) = -\xi_\kappa d_\kappa \lambda \tag{C.35}$$

where $\xi_\kappa \equiv \xi(\theta_\kappa)$ and $d_\kappa \equiv$the number of insider κ's neighbors.

Recall that θ_j is interpreted as agent j's internal assessment of the likely honesty of the subject(s) of the media report. θ_κ is interpreted as agent κ's estimate of $E[\theta_j]$ for all $j \neq \kappa$ where the expectation is based on κ's subjective probability distribution. That is, θ_κ is agent κ's subjective measure of how other agents view him. Generally, the less others think of us, the worse we feel. To capture this idea, let $\xi : [0, 1) \to [0, \infty)$ with $\xi' > 0$, and following Tadelis (2007), interpret ξ as a measure of a management member's *shame aversion* where shame is understood as involving the sense that one has done something that makes one "flawed," "no good," "inadequate," or "bad" in the

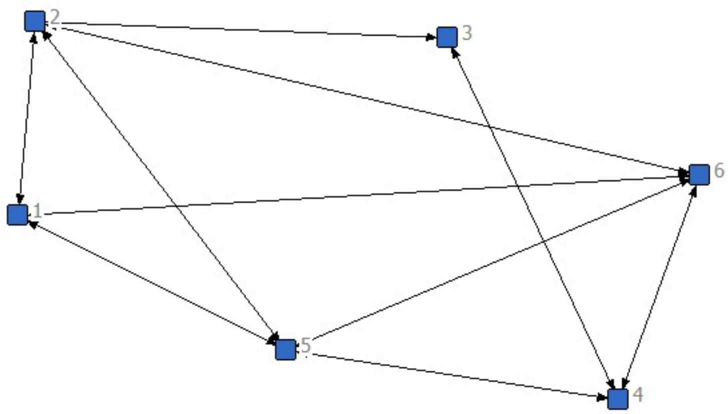

Figure C.2: An example network.

eyes of others. The form of (C.35) - the number of κ's neighbors times ξ_κ - suggests that a monetary interpretation for ξ would not be inappropriate. That is, ξ can be interpreted as a function that translates the loss of perceived social capital due to the negative opinion of others into a monetary value - loss per neighbor. Thus a person with a low shame aversion and a large number of network neighbors can have the same cost as someone with a high shame aversion and a small number of neighbors.[5]

Notice that the cost to agent κ depends on agent κ's belief about the beliefs of other agents in the network. This puts the analysis in the realm of *psychological games* pioneered by Geanakoplos et al. (1989) and extended by Rabin (1993), Battigalli and Dufwenberg (2005) and Tadelis (2007) among others. A psychological game differs from a traditional game in that utilities are defined on beliefs (about actions and beliefs), as well as on which actions are chosen. I make use of this literature in Section 3.3.

C.4 Social Networks

This material is drawn from the excellent surveys by Newman (2003), Jackson (2005), Jackson (2006), and Ioannides (2006).

C.4.1 Background

Fig. C.1 is an example of a network consisting of 6 nodes and 10 edges. The nodes might be people or perhaps companies. The edges might be friendships or shared directors. Or something else. Systems taking the form of

[5]Bernard Madoff, the disgraced portfolio manager sentenced to 150 years in prison in 2009 for swindling investors out of over $60B in a Ponzi scheme, may be the ultimate example of the first category. An unfortunate example of the second is perhaps Mark Madoff, his son, who committed suicide in 2010 on the second anniversary of his father's arrest.

networks (also called "graphs" in much of the mathematical literature) abound in the world. Examples include the Internet, the World Wide Web, social networks of acquaintance or other connections between individuals, organizational networks and networks of business relations between companies, neural networks, metabolic networks, food webs, distribution networks such as blood vessels or postal delivery routes, networks of citations between papers, and many others. The study of networks, in the form of mathematical graph theory, is one of the fundamental pillars of discrete mathematics. Euler's celebrated 1735 solution of the Königsberg bridge problem is often cited as the first true proof in the theory of networks, and during the twentieth century graph theory has developed into a substantial body of knowledge. Networks have also been studied extensively in the social sciences. Typical network studies in sociology involve the circulation of questionnaires, asking respondents to detail their interactions with others. One can then use the responses to reconstruct a network in which vertices represent individuals and edges the interactions between them. Typical social network studies address issues of centrality (which individuals are best connected to others or have most influence) and connectivity (whether and how individuals are connected to one another through the network). Recent years however have witnessed a substantial new movement in network research, with the focus shifting away from the analysis of single small graphs and the properties of individual vertices or edges within such graphs to consideration of large-scale statistical properties of graphs. This new approach has been driven largely by the availability of computers and communication networks that allow us to gather and analyze data on a scale far larger than previously possible. Where studies used to look at networks of maybe tens or in extreme cases hundreds of vertices, it is not uncommon now to see networks with millions or even billions of vertices. This change of scale has forced a corresponding change in analytic approach. Many of the questions that might previously have been asked in studies of small networks are simply not useful in much larger networks. A social network analyst might have asked, "Which vertex in this network would prove most crucial to the network's connectivity if it were removed?" But such a question has little meaning in most networks of a million vertices—no single vertex in such a network will have much effect at all when removed. On the other hand, one could reasonably ask a question like, "What percentage of vertices need to be removed to substantially affect network connectivity in some given way?" and this type of statistical question has real meaning even in a very large network.

C.4.2 General social networks

A social network is a set of people or groups of people with some pattern of contacts or interactions between them. The patterns of friendships between individuals Horvath and Rapoport (1961), business relationships between companies Mariolis (1975), and intermarriages between families Padgett and Ansell (1993) are all examples of social networks that have been studied in the past. Of the academic disciplines the social sciences have the longest history of the substantial quantitative study of real-world networks Freeman (1996). Of particular note among the early works on the subject are: Jacob Moreno's work in the 1920s and 30s on friendship patterns within small groups Moreno (1934); the so-called "southern women study" of Davis et al. Davis et al. (1941), which focused on the social circles of women in an unnamed city in the American south in 1936; the study by Elton Mayo and colleagues of social networks of factory workers in the late 1930s in Chicago Roethlisberger and Dickson (1939); the mathematical models of Anatol Rapoport Rapoport (1957), who was one of the first theorists, perhaps *the* first, to stress the importance of the degree distribution in networks of all kinds, not just social networks; and the studies of friendship networks of school children by Rapoport and others (Horvath and Rapoport (1961), Foster et al. (1963)). In more recent years, studies of business communities (Mariolis (1975), Davis et al. (1997)) and of patterns of sexual contacts Klovdahl (1985) have attracted particular attention.

An important set of experiments are the famous "small-world" experiments of Milgram Milgram (1967), Travers and Milgram (1969). No actual networks were reconstructed in these experiments, but nonetheless they tell us about network structure. The experiments probed the distribution of path lengths in an acquaintance network by asking participants to pass a letter to one of their first-name acquaintances in an attempt to get it to an assigned target individual. Most of the letters in the experiment were lost, but about a quarter reached the target and passed on average through the hands of only about six people in doing so. This experiment was the origin of the concept of the "six degrees of separation" popularized by a play of the same name Guare (1990), although that phrase did not appear in Milgram's writing.

Traditional social network studies often suffer from problems of inaccuracy, subjectivity, and small sample size. With the exception of a few ingenious indirect studies such as Milgram's, data collection is usually carried out by querying participants directly using questionnaires or interviews. Such methods are labor-intensive and therefore limit the size of the network that can be observed. Survey data are, moreover, influenced by subjective biases on the part of respondents; how one respondent defines a friend for example could be quite different from how another does. Although much effort is put into eliminating possible sources of inconsistency, it is generally accepted that there are large and essentially uncontrolled errors in most of these studies.

Because of these problems many researchers have turned to other methods for probing social networks. One source of copious and relatively reliable data is collaboration networks. These are typically affiliation networks in which participants collaborate in groups of one kind or another, and links between pairs of individuals are established by common group membership. A classic, though rather frivolous, example of such a network is the collaboration network of film actors, which is thoroughly documented in the online Internet Movie Database.3 In this network actors collaborate in films and two actors are considered connected if they have appeared in a film together. Statistical properties of this network have been analyzed by a number of authors (eg. Newman et al. (2001)). Other examples of networks of this type are networks of company directors, in which two directors are linked if they belong to the same board of directors (eg. Davis et al. (2003)) and networks of coauthorship among academics, in which individuals are linked if they have coauthored one or more papers (Goyal et al. (2006) in economics; Grossman and Ion (1995) in mathematics; Newman (2004) in biology and physics).

C.5 Behavior and Games on Networks

As observed by Dyck and Zingales (2002), media attention affects not only the reputations of CEOs and board members among the shareholders who allegedly elect them or in the eyes of their future employers, but also their reputations in society at large and in so doing pressures them to behave according to societal norms. This pressure is exerted by their peers - friends, relatives, colleagues - to whose good opinion they attach value. In network theory peers are referred to as "neighbors". Peers (neighbors) exert enormous influence on behavior. Understanding how the structure of social networks influence behavior is the subject of network games. For example, if an individual is choosing a product and wants it to be compatible with a majority of neighbors, then this is a coordination game and behavior can change abruptly depending on neighbors' actions. On the other hand, an individual may want to buy a product or take an action only if his neighbors do not. These interactive considerations require game-theoretic reasoning in a network setting. Galeotti et al. (2008) and especially Morris and Shin (2003) provide a good overview from which this material is drawn.

In a range of social and economic interactions including public goods provision, job search, political alliances, trade, friendships, and information collection an agent's[6] well being depends on the agent's own actions as well as on the actions taken by neighbors. For example, the decision of an agent whether or not to buy a new product say, or to attend a meeting, is often influenced by the choices of friends and acquaintances (be they social or professional). The empirical literature identifying the effects of agents' social networks on behavior and outcomes has become voluminous over the past several decades (eg. Granovetter (1978), Hirshleifer (1983), Gould (1993), Chwe (2000)). The emerging empirical evidence motivates the theoretical study of network effects. We would like to understand how the pattern of social connections shape the choices that individuals make and the payoffs they can hope to earn.

Attempts at the study of these basic questions have been thwarted by a fundamental theoretical problem: even the simplest games played on networks have multiple equilibria, which display a bewildering range of possible outcomes. The literature on global games illustrates how the introduction of (a small amount of) incomplete information can sometimes resolve the problem of multiplicity as well as provide interesting and novel economic intuitions (See Morris and Shin (2003) for a survey). Recently, this approach has faced the critique that the equilibrium selection achieved depends on the specifics of the incomplete information that is assumed Weinstein and Yildiz (2007). However, in the context of network games there is a natural way to introduce incomplete information that eliminates this ambiguity - private and incomplete information about the network. The key insight is that when players have limited information about the network they are unable to condition their behavior on its fine details and this leads to a signicant simplication.

There are two other important aspects that should be stressed. One is allowing individuals to have beliefs about the beliefs of their neighbors. Many economic problems are naturally modelled as a game of incomplete

[6]The economics literature often refers to economic actors as economic agents. I use the terms "member" and "agent" interchangeably when the economic agents are also members of a social network.

information, where a player's payoff depends on his own action, the actions of others, and some unknown economic fundamentals. For example, many accounts of currency attacks, bank runs and liquidity crises give a central role to players' uncertainty about other players' actions. Because other players' actions in such situations are motivated by their beliefs, the decision maker must take account of the beliefs held by other players. We know from the classic contribution of Harsanyi (1967-68) that rational behavior in such environments depends not only on economic agents' beliefs about economic fundamentals, but also depends on beliefs of higher order - that is, players' beliefs about other players' beliefs, players' beliefs about other players' beliefs about other players' beliefs, and so on. In principle, optimal strategic behavior should be analyzed in the space of all possible infinite hierarchies of beliefs; however, such analysis is highly complex for players and analysts alike and is likely to prove intractable in general. It is therefore useful to identify strategic environments with incomplete information that are rich enough to capture the important role of higher order beliefs in economic settings, but simple enough to allow tractable analysis. Global games, first studied by Carlsson and Van Damme (1993), represent one such environment. Uncertain economic fundamentals are summarized by a state θ and each player observes a different signal of the state with a small amount of noise. Assuming that the noise technology is common knowledge among the players, each player's signal generates beliefs about fundamentals, beliefs about other players' beliefs about fundamentals, and so on.

A second important aspect is allowing alternative scenarios on how a players payoffs are affected by the actions of others. This is motivated by the desire to understand how payoffs interact with the network structure. A contribution of Galeotti et al. (2008) is to focus on two canonical types of interaction: strategic complements and strategic substitutes. Strategic complements arise whenever the benefit that an individual obtains from buying a product or undertaking a given behavior *increases* as more of his partners do the same. This might be due to direct effects of having similar or compatible products (such as in the case of fax machines), peer pressures (as in the case of drug use), and so forth. The strategic substitutes case, where the benefit to an individual of taking an action *decreases* as others do the same, encompasses many scenarios that allow for free riding or have a public-good structure of play, such as costly experimentation or information collection. These two cases cover many of the game-theoretic applications studied by the economic literature. One such application is Sundararajan (2007), from which the cost of negative media is derived.

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