Corporate Board Dynamics

A THESIS
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

Steven Maurice Schmeiser

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
Doctor Of Philosophy

June, 2009

Corporate Board Dynamics

by Steven Maurice Schmeiser

ABSTRACT

This dissertation is composed of two chapters which examine the dynamic aspects of the corporate board of directors.

In the first essay, I propose a dynamic model in which corporate directors perform firm tasks (such as monitoring management) and choose new directors. Previous literature has focused on the board composition that statically optimizes firm tasks. I incorporate features of these models and give directors the additional task of hiring new directors. This introduces an important dynamic element: the board must consider both how new directors will perform in firm tasks and how new directors will try to change board composition in future hiring rounds. I find that the optimal board composition in the dynamic model differs from that of the static model. Additionally, lack of a commitment mechanism means directors do not always choose board compositions that maximize shareholder value. This creates an opportunity for policy to benefit shareholders. In 2003, the NYSE and Nasdaq exchanges implemented two new rules. First, boards must be composed of a majority of outside directors. Second, director selection must be done by a nominating committee composed of outside directors. I use the model to analytically and numerically investigate the effects of these new regulations on shareholder value. I find that the regulations may benefit shareholders of a firm in the dynamic environment, but never benefit shareholders in the static environment.

In the second essay, I examine the response of corporate boards to the majority independent outsider policy of the NYSE and Nasdaq stock exchanges. I estimate a two period model of the board composition choice before and after the regulatory change. In this model, boards stray from the expected optimal independence and board size in

response to the quality of individual director candidates. I use the model to investigate the counterfactual experiment of no majority outsider regulation. The model predicts that nearly 59% of firms not in compliance with the majority outsider rule would have moved into compliance even in the absence of the majority regulation. Factors other than the static response to majority outsider rules account for 60% of the observed increase in board independence among non-compliant firms over the years of regulation. These factors may be contemporaneous changes in committee requirements, general trends in corporate governance, or the dynamic considerations examined in the first essay.

Acknowledgements

Many people graciously offered their time, advice and ideas throughout the process of writing this dissertation. In particular, I would like to thank Thomas Holmes, Erzo G.J. Luttmer, Jan Werner, and Rajesh Aggarwal for their continued help and support. Many thanks to Katherine Schmeiser and participants of the Applied Micro Workshop at the University of Minnesota for their patience, valuable comments, and suggestions.

I also thank Caty Bach, Kara Kersteter and the staff of the Department of Economics whose hard work proved invaluable to my completion of the program.

Contents

List of Tables

List of Figures

Chapter 1

Introduction

This thesis is composed of two essays. The goal of the dissertation is to increase our understanding of the mechanics and incentives that underly the selection of a corporation's board of directors. Through this we also gain a deeper understanding of how corporate boards respond to policy changes. The collapse of several large corporations in the early 2000s led to a renewed interest in corporate governance and many changes in the regulatory environment in which corporations operate. The new regulations highlighted the central role that the board of directors plays in the governance and monitoring of a corporation. The chapters within investigate dynamics involved in the selection of a board. The first chapter models the selection of individual directors when incumbent directors themselves choose new board members. The second chapter focuses on boards' reactions to the regulatory changes that occurred between 2002 and 2004. I estimate a two period model and use the estimates to conduct a counterfactual policy experiment.

In the first essay, I propose a dynamic model in which corporate directors perform firm tasks (such as monitoring management) and choose new directors. Previous literature has focused on the board composition that statically optimizes firm tasks. I incorporate features of these models and give directors the additional task of hiring new directors. This introduces an important dynamic element: the board must consider both how new directors will perform in firm tasks and how new directors will try to change board composition in future hiring rounds. I find that the optimal board composition in the dynamic model differs from that of the static model. Additionally, lack of a commitment mechanism means directors do not always choose board compositions that maximize shareholder value. This creates an opportunity for policy to benefit shareholders. In 2003, the NYSE and Nasdaq exchanges implemented two new rules. First, boards must be composed of a majority of outside directors. Second, director selection must be done by a nominating committee composed of outside directors. I use the model to analytically and numerically investigate the effects of these new regulations on shareholder value. I find that the regulations may benefit shareholders of a firm in the dynamic environment, but never benefit shareholders in the static environment.

In the second essay, I examine the response of corporate boards to the majority independent outsider policy of the NYSE and Nasdaq stock exchanges. I estimate a two period model of the board composition choice before and after the regulatory change. In this model, boards stray from the expected optimal independence and board size in response to the quality of individual director candidates. I use the model to investigate the counterfactual experiment of no majority outsider regulation. The model predicts that nearly 59% of firms not in compliance with the majority outsider rule would have moved into compliance even in the absence of the majority regulation. Factors other than the static response to majority outsider rules account for 60% of the observed increase in board independence among non-compliant firms over the years of regulation. These factors may be contemporaneous changes in committee requirements, general trends in corporate governance, or the dynamic considerations examined in the first essay.

These two chapters make contributions to the theoretical and empirical study of the board of directors. These contributions are useful not only in a retrospective sense as we look back at decisions made by boards, but will help provide a rich framework in which to study and evaluate future policy considerations. The recession of 2008-2009 has led to discussion about possible changes to the regulatory framework in which corporations operate. For example, the Securities and Exchange Commission is exploring the possibility of opening the director nomination process to shareholders.[1] This would directly address the dynamic concern of directors voting for directors presented in the first essay.

Additionally, the first chapter contributes to the growing study of the dynamics of organizations in which incumbent members choose new members, who in turn take part in future membership decisions. This is an exciting area with many applications outside of corporate finance.

[1] http://www.reuters.com/article/governmentFilingsNews/idUSN0248901020090302.

Chapter 2

Voting for Voters

2.1 Introduction

The board of directors performs many functions for a firm. Primarily, the board acts on behalf of shareholders to monitor management and ensure that those in control of the firm are taking actions that maximize shareholder value. In addition to monitoring, the board assists management in long term strategic decision making. Both of these duties are "firm tasks" – the outcomes directly affect the firm and shareholder value.

Directors perform another task related to the board itself: choosing new directors. Formally, shareholders choose new directors in annual elections. In practice, incumbent directors almost always nominate one candidate and shareholders vote in an uncontested election. The institutional details leading to this arrangement are discussed below. The assumption that directors choose new directors leads to several dynamic considerations that have not been studied in previous literature and are the focus of this paper. First, once the firm goes public, shareholders no longer have control of the board's composition. When shareholders set up the initial board, they must consider both how the directors will perform in firm tasks and how the directors will change the board composition once control is handed over. If directors cannot commit to maintain a particular board composition, shareholders may choose an initial composition that does not maximize the value of firm tasks. Second, once the board is in control, incumbent directors face these same commitment problems when choosing new directors.

Directors are commonly grouped into two types: independent outsiders that have no financial ties to the firm (other than director remuneration) and insiders that lack this financial independence.[1] In the dynamic setting, a board may find it myopically optimal to hire one additional insider to maximize the value of firm tasks, but that insider may try to hire additional insiders in the future.

As another example, consider a "management friendly" board composed of inside directors. Because of their financial ties to management, the inside directors have incentive to not monitor and will not hire outside directors that will enforce monitoring. The board is then entrenched in an insider dominated state, potentially at the detriment of shareholder value. Instances of lax boards not monitoring management led to several recent regulatory changes. In 2003, the NYSE and Nasdaq stock exchanges implemented two new regulations. First, boards of member firms must be composed of a majority of independent outside directors. This rule acts as a commitment mechanism by not allowing directors to take the board into a majority insider state. Second, the NYSE requires the board to have a nominating committee composed of independent outside directors for the purpose of choosing new directors. This rule targets the director selection process and delegates control to outsiders, thus eliminating the concern that inside directors will hire additional insiders.

In this paper I propose a dynamic stochastic game in which directors perform firm tasks and choose new directors. Before the game begins, shareholders set initial conditions by choosing the first board composition. Each period is split into two stages. First, directors perform firm tasks in a simple static game. Second, anticipating that one director will retire at the end of the period, the board receives an inside and outside

[1] For formal definitions, see NYSE Listed Company Manual, section 303A.02 and Rule 4200(a)(15) of the Nasdaq exchange.

candidate to fill the open seat. Besides differing in their insider/outsider designation, candidates also differ in quality. The incumbent directors choose one of the candidates to join the board through majority voting. The combination of the type of director that retires and the type of the newly hired director determines next period's board composition.

I find that the board composition that optimizes shareholder value in the static model may not be the same as the composition that maximizes shareholder value in the dynamic model. As a result, shareholders will choose different initial board compositions in the static and dynamic models. Additionally, directors are not perfectly aligned with shareholders and do not always choose board compositions that maximize shareholder value. This creates an opportunity for regulation to increase shareholder value. In the static model, the majority outsider regulation and the nominating committee regulation never increase shareholder value and may even decrease it. In the dynamic model, both rules have the potential to benefit shareholders. The rules are not perfect though. The majority outsider regulation helps solve a commitment problem, but at the cost of reducing the flexibility of the board in responding to short run needs of the firm. The nominating committee regulation grants director selection rights to outsiders that are more closely aligned to shareholders than insiders. But when outsiders are not perfectly aligned with shareholders, the regulation may remove a barrier that prevents outsiders from hiring inside candidates that shareholders do not want.

This paper lies in the intersection of several areas of current research. First, it contributes to the literature on corporate governance and the endogenous determination of corporate boards. Second, it contributes to the small but growing literature on dynamic stability in clubs.

Many papers theoretically model the board of directors and explore the effects of board composition on shareholder value. Harris and Raviv (2008), Adams and Ferreira (2007), Raheja (2005) and Hermalin and Weisbach (1998) all explore how board composition affects the outcome of firm tasks. A common theme in these papers is that the optimal board includes both insiders and outsiders and the specific composition depends on firm and environment specific parameters. Unlike these papers, in my model I do not provide a rich micro-foundation of firm tasks. Instead, I include firm tasks as a static game and focus on the dynamic problem of directors choosing new directors. This paper is closest in nature to Hermalin and Weisbach (1998) in that incumbent directors play a significant role in the selection of new directors. Moving to a dynamic framework allows me to capture important aspects of boards, such as entrenchment and commitment, that do not occur in the environment of Hermalin and Weisbach. In addition, the new regulations discussed here target aspects of the board that are only fully revealed in a dynamic environment.

The idea of voters voting for voters and dynamic stability in clubs has been investigated in a small but growing literature. Roberts (1999) and Barbera et al. (2001) consider environments in which club members vote for new members that participate in future membership votes. These papers put heavier restrictions on preferences and the set of potential members. Acemoglu et al. (2008) also develop this literature with axiomatic and game theoretic approaches. My model allows greater flexibility and stochastic elements at the cost of analytical tractability.

I now address the institutional details of how new directors are chosen. In the model, incumbent directors select new directors. In reality, directors of a public corporation are chosen for a seat on the board via annual elections in which shareholders vote (usually one vote per share owned) on a ballot containing one or more candidates per open seat (Jr 2007). In practice, several obstacles prevent this mechanism from effectively transmitting shareholder preferences into the board's composition. First, director candidates are usually nominated by the incumbent board. Shareholders may nominate candidates via a shareholder proxy, but SEC rules make this difficult.[2] Recent efforts have been made to grant shareholders easier access to the election ballot, but the SEC ruled in

[2] Rule 14a-8(i)(8) under the Securities Exchange Act of 1934 permits exclusion of shareholder proposals related to the election of directors.

2008 to keep the barriers in place (Securities and Comission 2008). Second, nearly all candidates run in uncontested elections (Fischer et al. 2008). Paired with the plurality voting mechanism employed by many corporations, it is possible for a candidate to be voted onto the board with only a single affirmative vote. The resulting system is one in which the incumbent board chooses new directors and shareholders have little input in director selection.

The paper continues as follows. Section 2 presents the model. Section 3 presents analytical results from various simplifications of the general model. Section 4 presents numerical results from a more general model and section 5 concludes.

2.2 Model

A shareholder owned firm consists of a board of directors. The board is fixed in size and each director is designated as an insider or an outsider. The state of the firm in each period is simply the composition (number of insiders and number of outsiders) of the board. When taking a firm public, shareholders set initial conditions by choosing the initial composition of the board. After that, shareholders have no further role in managing the firm: all decisions are made by the board. Each period is divided into two stages. First, in the work stage, directors perform firm tasks (monitor management, make policy decisions) that generate payoffs to both the shareholders and directors. These payoffs depend on the composition of the board. Second, directors choose new directors. Unlike shareholders, directors are not infinitely lived: each period one director is selected for retirement and needs to be replaced. Anticipating that a seat will open up at the end of the period, the board receives one inside and one outside candidate and chooses one to fill the open seat. Each incumbent votes for the candidate they prefer and a final decision is made through majority voting. The combination of the type of the replacement director and the type of the retiring director determines next period's board composition.

The model is set in discrete time with an infinite horizon. All agents discount at a common factor $\beta \in [0,1)$. There is one firm consisting of a board of directors of fixed size N. An individual director i may be in one of two states: $\omega_i \in \Omega = \{I, O\}$, corresponding to whether the director is an insider or outsider and a director's state may not change over time. A board of size N is then characterized by the list of states of the individual directors: $\omega = (\omega_1, ..., \omega_N)$. I focus on symmetric and anonymous strategies with a fixed board size, so at any period t it is sufficient for a director to know his own type and the number of insiders on the board. Let $s_t \in S = \{0, ..., N\}$ be the number of insiders on the board at time t. For notational simplicity, I suppress time subscripts for the remainder of the paper.

2.2.1 Work stage

In the work stage, the board performs firm tasks. I keep the work stage specification simple in order to focus most analysis on the dynamic decision of replacing directors. I model the work stage as a simple static game among directors in which all Nash equilibria generate identical payoff profiles to directors and the firm. With board s, the game pays $w_S(s)$ to shareholders, $w_I(s)$ to each inside director and $w_O(s)$ to each outside director. Actions made in the work stage do not directly affect the distribution of future states of the firm and the $w(\cdot)$ functions are taken as primitives in the full stochastic dynamic game.

In this section I construct the static game that generates these work stage payoffs. Each director makes a left/right decision by choosing an action $x_i \in \{L, R\}$. These individual actions are aggregated to a board level action $x \in \{L, R\}$ through the majority rule. In the event of a tie, a fair coin toss determines the outcome. Payoffs are determined by the board level decision, so I abstract from the formal definition of the game and look at how payoffs depend on the number of votes in each direction. Let $|L|$ denote the number of directors that vote for left and $|R|$ denote the number that vote for right. The firm is not able to contract on the work stage and agency costs may result in insiders preferring a different outcome than outsiders and shareholders.

Left provides a strictly positive payoff to the firm, while right pays nothing. I allow the payoff of left to depend on the composition of the board through the function $\phi(s) > 0$.

$$w_S(s) = \begin{cases} \phi(s) & \text{if } |L| > |R| \\ 0 & \text{if } |L| < |R| \\ \frac{1}{2}\phi(s) & \text{if } |L| = |R| \end{cases} \tag{2.1}$$

Outside directors' work stage payoffs are perfectly aligned with shareholders:

$$w_O(s) = w_S(s) \tag{2.2}$$

It is clear that shareholder and outside directors always prefer $x = L$. This is not necessarily the case for insiders. Insiders receive a private benefit $B \geq 0$ when the board chooses $x = R$. This private benefit is a measure of the agency cost present in the firm.

$$w_I(s) = \begin{cases} \phi(s) & \text{if } |L| > |R| \\ B & \text{if } |L| < |R| \\ \frac{1}{2}\phi(s) + \frac{1}{2}B & \text{if } |L| = |R| \end{cases} \tag{2.3}$$

If B is large enough, insiders will prefer R.

While somewhat stylized and mechanical, this specification of work stage payoffs is flexible enough to capture the effects of composition on firm task outcomes as suggested in the literature.

For example, in monitoring the CEO, the decision to go left represents active monitoring and right represents no monitoring. The value of not monitoring will naturally be higher for insiders than outsiders and shareholders, and $B > 0$. If the board chooses to monitor the CEO, it is valuable to have insiders on the board as they have more precise information about the quality of the CEO. This is captured by choosing a $\phi(s)$ that is increasing in s. This specification is in accordance with the notion that if the board commits to work (i.e. choose left), then the first best board composition is all insiders. Without commitment to choose left, a board of all insiders will instead choose to capture the private benefit B and move right. Therefore, the second best composition is a mix such that there are enough outsiders to keep the board monitoring management, but also includes insiders to benefit from their more precise knowledge.

2.2.2 Director replacement stage

I now turn to the dynamic aspects of the model. Each period, directors perform firms tasks and choose one new director. At the end of the period, an incumbent director is chosen at random for retirement and is replaced by the newly hired director. The outcome of the director replacement decision and retirement draw determine the next period's board composition.

Each period, the board draws two candidate board members: one insider and one outsider. Besides their designations as an insider or outsider, if hired, a candidate brings a randomly drawn and publicly observed one time quality benefit to the firm and incumbent directors. The candidate of type $k \in \{I, O\}$ brings one time benefit ν_k drawn i.i.d. across time and candidates from distribution $F_k(\cdot) = N[\mu_k, \sigma_k^2]$ with density functions $f_k(\cdot)$. Let $\nu = (\nu_I, \nu_O)$ be the profile of benefit draws. These public benefits have several interpretations. First, it allows individual directors to differ in quality. Exogenous retirement results in all directors having the same expected tenure on the board and any persistent quality component of a director may be wrapped up into a one time expected benefit. Second, since each hiring round brings exactly one inside and one outside candidate, these benefits also capture any current period idiosyncratic preference the firm has for an insider or outsider that is not captured by the work stage payoffs. For expositional clarity, I will refer to this term as a candidate's quality.

Each incumbent director i also has a private individual preference ϵ_{ik} for each candidate. The ϵ_{ik} are drawn from a continuous distribution $G(\cdot)$ with mean ν_ϵ, variance

σ_ϵ^2 and are i.i.d. across incumbent directors, candidates and time. Let $\epsilon_i = (\epsilon_{iI}, \epsilon_{iO})$ be director i's profile of individual preference shocks. This shock captures any individual preference a director may have for a candidate from sources outside the model, such as social relations.

After observing the current state of the board s, the candidate quality draws ν, and individual shocks ϵ_i each director i votes for the candidate they prefer. The board level decision is determined by majority voting among the incumbent directors.

2.2.3 Equilibrium

Throughout, I use j to denote the type of an incumbent and k to denote the type of a candidate. Let $V_j(s,\nu,\epsilon)$ be the expected present value for a director of type $j \in \{I, O\}$ sitting on board s with candidate draws ν and individual shocks ϵ. A director of type j will vote for the candidate k that provides a higher expected present value $V_j^k(s,\nu,\epsilon)$. Expectations are unconditional over the i.i.d. ν' and ϵ'.

$$
\begin{aligned}
V_O^I(s,\nu,\epsilon) &= w_O(s) + \beta\left(1-\frac{1}{N}\right) \\
&\quad \left[\nu_I + \epsilon_I + \frac{s}{N-1}E[V_O(s,\nu',\epsilon')] + \left(1-\frac{s}{N-1}\right)E[V_O(s+1,\nu',\epsilon')]\right] \\
V_O^O(s,\nu,\epsilon) &= w_O(s) + \beta\left(1-\frac{1}{N}\right) \\
&\quad \left[\nu_O + \epsilon_O + \frac{s}{N-1}E[V_O(s-1,\nu',\epsilon')] + \left(1-\frac{s}{N-1}\right)E[V_O(s,\nu',\epsilon')]\right] \\
V_I^I(s,\nu,\epsilon) &= w_I(s) + \beta\left(1-\frac{1}{N}\right) \\
&\quad \left[\nu_I + \epsilon_I + \frac{s-1}{N-1}E[V_I(s,\nu',\epsilon')] + \left(1-\frac{s-1}{N-1}\right)E[V_I(s+1,\nu',\epsilon')]\right] \\
V_I^O(s,\nu,\epsilon) &= w_I(s) + \beta\left(1-\frac{1}{N}\right) \\
&\quad \left[\nu_O + \epsilon_O + \frac{s-1}{N-1}E[V_I(s-1,\nu',\epsilon')] + \left(1-\frac{s-1}{N-1}\right)E[V_I(s,\nu',\epsilon')]\right]
\end{aligned}
$$

If hired, a candidate enters an incumbent's value function in three places. Consider $V_O^I(s,\nu,\epsilon)$, the value of an outside director when the inside candidate is hired. First, the director gets the work stage payoff $w_O(s)$ that only depends on today's board composition. With probability $\frac{1}{N}$, the director will retire at the end of the period and receive a payoff of zero. With probability $1-\frac{1}{N}$, the director continues to next period, which he discounts by β. Next period, the incumbent gets the new insider's quality draw ν_I and the new insider's individual component ϵ_I. Conditional on the outsider surviving, the probability that an insider retired is $\frac{s}{N-1}$. In this case, the new insider replaces a retiring insider and the board composition remains constant at s. With probability $1-\frac{s}{N-1}$, an outsider retired and was replaced by the new insider. In this case, the board composition changes to $s+1$. The expressions for the other three cases are constructed in a similar manner.

Let $q_j(s,\nu;k)$ be the beliefs of a type j director voting for the type k candidate that the inside candidate is hired. Then the value function for a director of type j is

$$V_j(s,\nu,\epsilon) = \max_{k\in\{I,O\}} q_j(s,\nu;k)V_j^I(s,\nu,\epsilon) + [1-q_j(s,\nu;k)]V_j^O(s,\nu,\epsilon) \quad (2.4)$$

$$h_j(s,\nu,\epsilon) = \operatorname*{argmax}_{k\in\{I,O\}} q_j(s,\nu;k)V_j^I(s,\nu,\epsilon) + [1-q_j(s,\nu;k)]V_j^O(s,\nu,\epsilon) \quad (2.5)$$

From the functions defined in (2.5), it is clear that in state s, a director of type j will vote for the inside candidate when

$$V_j^I(s,\nu,\epsilon) \geq V_j^O(s,\nu,\epsilon)$$

which is equivalent to

$$(\nu_I+\epsilon_I)-(\nu_O+\epsilon_O) \geq V_j^O(s,0,0)-V_j^I(s,0,0)$$

Let

$$\hat{\nu}_j(s) = V_j^O(s,0,0)-V_j^I(s,0,0) \quad (2.6)$$

be the minimum advantage in quality and individual draws that an inside candidate needs to have over an outside candidate for an incumbent of type j to vote for the inside candidate. These cutoff values are a more convenient and more illustrative way of expressing the policy functions.

Given policy of insiders and outsiders, beliefs for a type j incumbent voting for the type k candidate are constructed as follows. Let $p_j(s,\nu)$ be the probability that a type j incumbent gets ϵ draws such that he votes for the inside candidate.

$$p_j(s,\nu) = \int [1 - G(\hat{\nu}_j(s) - \nu_I + \nu_O + \epsilon_O)] g(\epsilon_O) d\epsilon_O$$

Then construct the probability $p_j(s,\nu,m)$ that the inside candidate gets m votes from the $N-1$ directors that remain after removing a type j incumbent. Sum over the possible combinations of the m votes coming from insiders and outsiders.

$$\begin{aligned} p_I(s,\nu,m) &= \sum_{i=0}^{m} \left\{ \binom{s-1}{i} p_I^i (1-p_I)^{s-1-i} \binom{N-s}{m-i} p_O^{m-i} (1-p_O)^{N-s-(m-i)} \right\} \\ p_O(s,\nu,m) &= \sum_{i=0}^{m} \left\{ \binom{s}{i} p_I^i (1-p_I)^{s-i} \binom{N-s-1}{m-i} p_O^{m-i} (1-p_O)^{N-s-1-(m-i)} \right\} \end{aligned}$$

The final beliefs $q_j(s,\nu;k)$ are the sum over m such that the insider receives more votes than the outsider. In the event of a tie, a fair coin toss determines the outcome.

$$q_j(s,\nu;k) = \sum_{m:m+\delta_{kI} > N-m-\delta_{kI}} p_j^m(s,\nu) + \frac{1}{2} \sum_{m:m+\delta_{kI} = N-m-\delta_{kI}} p_j^m(s,\nu) \qquad (2.7)$$

Definition 1 *A Markov perfect equilibrium in anonymous and symmetric strategies is*

- *Value functions* $V_I(s,\nu,\epsilon), V_O(s,\nu,\epsilon)$ *as defined in (2.4)*
- *Policy functions* $\hat{\nu}_I(s), \hat{\nu}_O(s)$ *as defined in (2.6) that solve the value functions*
- *Beliefs* $q_I(s,\nu;k), q_O(s,\nu;k)$ *as defined in (2.7) that are consistent with the policy functions*

2.2.4 Shareholder value

The expected value to shareholders of the board choosing the type k candidate in state (s,ν) is

$$\begin{aligned} V_S^I(s,\nu) &= w_S(s) + \beta \left[\nu_I + \frac{s}{N} E[V_S(s,\nu')] + \left(1 - \frac{s}{N}\right) E[V_S(s+1,\nu')] \right] \\ V_S^O(s,\nu) &= w_S(s) + \beta \left[\nu_O + \frac{s}{N} E[V_S(s-1,\nu')] + \left(1 - \frac{s}{N}\right) E[V_S(s,\nu')] \right] \end{aligned}$$

where the expectation is unconditional over ν'. Given the policy functions of directors, the shareholder value function is

$$V_S(s,\nu) = q(s,\nu)V_S^I(s,\nu) + (1 - q(s,\nu))V_S^O(s,\nu) \tag{2.8}$$

where $q(s,\nu)$ is the probability of an insider being voted in at state (s,ν). Once a board has been established, shareholders play no strategic role in the model. However, when taking the firm public, shareholders choose the initial composition of the board. For simplicity, I assume that shareholders do not get quality draws for the initial members of the board. The shareholders' problem is

$$\max_{s_0 \in S} E[V_S(s_0,\nu)] \tag{2.9}$$

where the expectation is unconditional over ν.

2.2.5 Regulation

Majority outsider regulation is easily implemented in the model. The regulation states that a board must be composed of a majority of outsiders. In the model, this puts a cap on s. The set of states allowed under regulation is

$$S^{maj} = \{s : s \in \mathcal{Z}_+, s < N - s\}$$

Let $V_S^{maj}(\cdot)$ be the shareholder value function under majority outsider regulation.

The nominating committee regulation is also easily implemented with the addition of the requirement that $\sigma_\epsilon^2 = 0$. By taking randomness out of the individual shocks, all outside directors have the same preferences for candidates. With this assumption, all nominating committees composed entirely of outsiders are identical. The nominating committee requirement is then implemented in my model by having the outside directors' preferences determine which candidate is chosen. Let $V_S^{nom}(\cdot)$ be the shareholder value function under nominating committee regulation.

2.3 Analytical results

2.3.1 Static model

In the static version of the model with $\beta = 0$, directors and shareholders only receive the work stage payoffs and no directors are hired or retire. The shareholder problem is simply to choose the board composition that maximizes the work stage payoff.

Theorem 1 *In the static model, neither the majority outsider regulation nor the nominating committee regulation can increase shareholder value.*

Proof In the static model, the shareholder problem is

$$\max_{s \in S} w_S(s)$$

Because $S^{maj} \subset S$, majority regulation only reduces the set of compositions that shareholders choose from when setting up the board and can only hurt shareholder value. Because no new directors are hired in the static model, the nominating committee regulation does not change the shareholder problem.

It is clear that the majority policy will not benefit shareholders in the static model. Majority policy reduces the number of admissible compositions and will hurt shareholder value if the board that maximizes work stage payoffs is composed of a majority of insiders.

2.3.2 Director and shareholder comparison

From the work stage specification, it is clear that inside directors have preferences that differ from outsiders and shareholders. Shareholders and outside directors are not always in agreement either. First, outside directors have individual preference shocks over the candidates. Second, directors retire. In absence of carefully constructed retirement packages, the possibility of retirement changes a director's preferences for the future. In the case of no retirement payments (as considered here), directors put less weight on the future than shareholders. To see these effects, fix outsider and shareholder continuation values at $V_S(s) = V_O(s) = V(s)$ with the i.i.d. shocks integrated out of the continuation values. At composition s, when will an outsider prefer an insider, but the shareholders prefer an outsider? An outsider prefers the inside candidate when

$$\nu_I - \nu_O > \epsilon_O - \epsilon_I + \frac{s}{N-1}\left[V(s-1) - V(s)\right] + \left(1 - \frac{s}{N-1}\right)\left[V(s) - V(s+1)\right]$$

and shareholders prefer the outside candidate when

$$\nu_I - \nu_O < \frac{s}{N}\left[V(s-1) - V(s)\right] + \left(1 - \frac{s}{N}\right)\left[V(s) - V(s+1)\right]$$

It is immediate that outsiders and shareholders differ in their distribution over future board compositions and outsiders have the individual ϵ preference shocks. The right hand side of the firm's condition minus the right hand side of the outsider's condition reveals that disagreement occurs when

$$\frac{s}{N(N-1)}\left[2V(s) - V(s-1) - V(s+1)\right] + (\epsilon_I - \epsilon_O) \neq 0 \qquad (2.10)$$

Even with fixed continuation values, outside directors may want to take a one-shot deviation from the actions preferred by shareholders. Retirement issues may be resolved by paying incumbent directors a retirement package that eliminates the first term. Then in the absence of individual shocks, outside directors and shareholders are identical.

Suppose that outside directors and shareholders are identical. This would be the same as having shareholders choose replacement directors when the board is composed of a majority of outsiders. In this case the majority outsider regulation can only hurt shareholders by restricting the directors they are allowed to hire.

In the remaining analysis, I set the value of retirement to zero and fix the individual preference shocks at 0. Retirement is left as the only driver of shareholder and outsider divergence.

2.3.3 An analytically tractable case

In this section I present an analytically tractable version of the model that provides some intuition for the full model. In this version of the model, I shut down all randomness except for retirement. There are no individual shocks, and the quality draws are deterministic. I fix the outside candidate quality at 0 and let the inside candidate quality $\nu_I > 0$ vary. Additionally, I'm interested in the case where there is work stage conflict between inside and outside directors, so I let $B > \phi(s)$ for all s. I also take $\phi(\cdot)$ to be increasing in s, implying $w_O(0) = w_S(0) > w_O(1) = w_S(1)$. Last, for simplicity, I relax the requirement that the board contain one director of each type and allow boards composed of all insiders or all outsiders.

$$\begin{aligned} N = 3, \beta \in (0,1) \\ B > \phi(s) \quad \forall s \\ \phi(s) \text{ strictly increasing in } s \\ \mu_O = \sigma_O^2 = \sigma_I^2 = 0, \mu_I = \nu_I > 0 \\ \mu_\epsilon = \sigma_\epsilon^2 = 0 \end{aligned} \tag{2.11}$$

If the board is ever composed of a majority inside directors ($s \in \{2, 3\}$) it will stay that way forever. Insiders get work stage payoff of B in both states and $\nu_I > 0$, so they will always hire the inside candidate. In these states shareholders and outside directors get work stage payoff 0, but they do receive the quality component of the new insider that are hired.

If the board has no insiders ($s = 0$), both outsiders and shareholders would like to add an insider. First, the insider provides $\nu_I > 0$ and second, $w_O(1) > w_O(0)$. The question then, is what happens when there is already an insider on the board. If outsiders hire another insider, they get $\nu_I > 0$, but risk sending the board to insider control where outsiders get work stage payoffs of 0 until retirement. If ν_I is high enough, it is worth the risk of moving to insider control. Because directors retire and shareholders do not, the outside directors put less weight on the future and are more willing than shareholders to grab the ν_I today and let the board move to insider control.

Theorem 2 *Fix any parameters that satisfy (2.11). Then there exist cutoffs $\hat{\nu}_O, \hat{\nu}_S$ such that*

1. *With $s = 1$, outsiders hire the inside candidate iff $\nu_I > \hat{\nu}_O$*
2. *With $s = 1$, the firm prefers the inside candidate iff $\nu_I > \hat{\nu}_S$*
3. *$\hat{\nu}_O < \hat{\nu}_S$*

Proof See section 2.6.

For the range $\nu_I \in (\hat{\nu}_O, \hat{\nu}_S)$, outsiders and shareholders disagree about which candidate to hire. Since outsiders make the decision, there is room here for policy to improve shareholder value. I return to this thought below.

If shareholders take a firm public with an initial board in state s_0, how will the composition evolve over time? Construct the 4×4 transition matrix M where entry m_{ij} gives the probability of moving from state $s = i$ to state $s' = j$. Rows of M^t give the distribution of board compositions after t periods given that the board started in the state corresponding to the current row. Letting $t \to \infty$ produces the invariant distribution.

Suppose $\nu_I > \hat{\nu}_O$. Then both outside and inside directors will always vote for the inside candidate.

$$M = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 0 & \frac{1}{3} & \frac{2}{3} & 0 \\ 0 & 0 & \frac{2}{3} & \frac{1}{3} \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad , \quad \lim_{t\to\infty} M^t = \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

The first row of M shows that if the board starts with zero inside directors and an insider is hired, the board moves to one insider with probability one. In the second row, the board starts with one insider and another insider is hired. With probability $\frac{1}{3}$ the incumbent insider retires and the board remains at one insider. With probability $\frac{2}{3}$ an outsider retires and the board has two insiders in the next period. Notice that as time passes, no matter where shareholders start the board it will move to insider dominance. There is only one ergodic set, $E = \{3\}$.

If $\nu_I < \hat{\nu}_O$, then outsiders will stop voting for the inside candidates once there is already an insider on the board.

$$M = \begin{pmatrix} 0 & 1 & 0 & 0 \\ \frac{1}{3} & \frac{2}{3} & 0 & 0 \\ 0 & 0 & \frac{2}{3} & \frac{1}{3} \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad , \quad \lim_{t\to\infty} M^t = \begin{pmatrix} \frac{1}{4} & \frac{3}{4} & 0 & 0 \\ \frac{1}{4} & \frac{3}{4} & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Now shareholders can prevent the board from falling into insider control by starting the board with outsider control. Here there are two ergodic sets: $E_1 = \{0, 1\}$ and $E_2 = \{3\}$. Set E_1 is reached when the board is started with outsider control and set E_2 is reached when the board is started in insider control.

Intuitively, if $\nu_I > \hat{\nu}_O$, shareholders know that the inside candidate will always be hired and the board will eventually move to insider dominance no matter the initial composition. Therefore shareholders want to start the board in outsider control in order to get work stage payoffs for as long as possible. If $\nu_I < \hat{\nu}_O$, shareholders still want to start with a majority outside board. In this case the board will stay in outsider control.

Theorem 3 *Fix any parameters that satisfy (2.11). Let s_0 be the initial board state that maximizes shareholder value.*

$$s_0 = \underset{s\in S}{\operatorname{argmax}}\, V_S(s)$$

Then $s_0 \in \{0, 1\}$.

Proof See section 2.6.

2.3.4 Majority outsider regulation

Majority regulation prevents the outside directors from voting in another insider when $s = 1$. Without any randomness (other than retirement), the majority policy does not alter behavior for small ν_I. The outsiders will never vote in an insider when there is already one on the board and the policy never binds. On the other hand, if ν_I is very large and both shareholders and outsiders want to always hire an insider, policy forces an outsider and hurts firm value. The only time policy can help is when there is disagreement between outsiders and insiders: when $\hat{\nu}_O < \nu_I < \hat{\nu}_S$. In this case, policy prevents outsiders from hiring the extra insider and the shareholders benefit.

Theorem 4 *Fix any parameters that satisfy (2.11). Suppose shareholders set up a new firm and are able to choose the initial board state.*

1. *If $\nu_I < \hat{\nu}_O$, majority policy does not change shareholder value.*
2. *If $\hat{\nu}_O < \nu_I < \hat{\nu}_S$, majority policy increases shareholder value.*
3. *If $\hat{\nu}_S < \nu_I$, majority policy decreases shareholder value.*

Proof See section 2.6.

Transition dynamics with majority policy are similar to the small ν_I case with no policy, except that the board may never be in insider control. For all $\nu_I > 0$,

$$M = \begin{pmatrix} 0 & 1 & 0 & 0 \\ \frac{1}{3} & \frac{2}{3} & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \quad , \quad \lim_{t\to\infty} M^t = \begin{pmatrix} \frac{1}{4} & \frac{3}{4} & 0 & 0 \\ \frac{1}{4} & \frac{3}{4} & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

With regulation, the stationary distribution shows that the board will have zero insiders with probability $\frac{1}{4}$ and one insider with probability $\frac{3}{4}$. Whether or not this benefits shareholders depends on ν_I.

2.4 Model with random quality

The analytical model provides good intuition, but it leaves out an important aspect of the model. Making director quality deterministic precludes any shocks that would make a firm temporarily prefer one candidate over another. If quality deterministically depended on the type of a candidate, it could be represented in the work stage and shareholders would like a policy that fixes the board composition at the composition that maximizes the firm's work stage payoff. In reality, the board requires discretion to respond to short run needs of the firm and will receive candidates of differing quality. When the board's decisions cannot be contracted on, giving directors discretion results in the possibility of the board making decisions that hurt shareholders. The need for flexibility is represented by increasing the variance of the distribution of quality draws. Adding this to the model comes at a cost: analytical solutions are no longer feasible. To study the more flexible model, I move to the computer and solve for numerical results.

In this section I follow recent trends in the industrial organization literature that use numerical techniques to analyze models that are not analytically tractable. See Judd (1997) for discussion of the validity and usefulness of numerical techniques in economic analysis. Doraszelski and Markovich (2007) use techniques similar to mine in their study of dynamic advertising competition.

In this section, I set $\mu_I = \mu_O = 0$ and $\sigma_I^2 = \sigma_O^2 = \sigma^2$ and study how the variance of candidate quality affects firm value and director actions. In addition, I allow B to vary in order to include cases where agency costs are low and there is no conflict between inside and outside directors.

2.4.1 Option value

Increasing σ^2 increases the importance of short run flexibility to the firm. But it is not always the case that the board can respond to these needs. Besides the quality draws, new directors affect value by changing the distribution of future board compositions though $E[V_j(s',\nu')|s,k]$. When choosing among candidates, there is an option value of having two quality draws, but it may be tempered by the compositional effects. In the extreme case where the compositional value does not change between candidate types, incumbents are free to hire the candidate with the maximum ν_k. As the compositional value of one candidate becomes greater than the other, this option value is diminished.

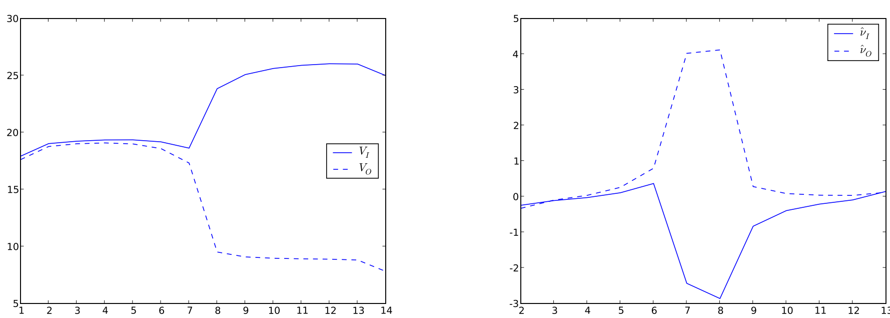
This effect may be seen clearly by looking at the expected quality of the candidate actually chosen as a replacement. The exogenous ν draws are not affected by policy and are i.i.d. across time, so I integrate them out of the value function and analyze the value functions with the expected quality draw of the candidate eventually hired. This reveals the relationship between the compositional and option value aspects of the value functions. Let $\hat{\nu}(s)$ be the policy function for the type in majority on board s. The expected quality of the new director is

$$\frac{\sigma}{\sqrt{\pi}} exp\left\{-\frac{\hat{\nu}(s)^2}{4\sigma^2}\right\} \tag{2.12}$$

There are a few interesting observations to be made here. First, as σ^2 approaches 0, the option value goes to zero. If the board is drawing identical quality candidates, there is no benefit in having multiple draws. Second, the option value is decreasing the cutoff function $\hat{\nu}(s)$ moves away from zero. Recall that this cutoff function gives the minimum advantage in quality an insider needs to have over the outsider for the board to choose the inside candidate. In other words, this is the compositional advantage of the outside candidate over the inside candidate. As this value moves away from zero, the board favors one candidate over the other and diminishes the option value of drawing multiple candidates. The option value reaches its maximum when $\hat{\nu}(s) = 0$ and the board is free to pick the maximum quality candidate. When $\hat{\nu}(s) = \infty$, such as when regulation prevents the hiring of an insider, the option value is zero as the board must choose the outside candidate.

2.4.2 No policy

I now solve the model for some example firms in order to see the results discussed so far in action. The most interesting and illustrative case is B large enough to cause work stage conflict between insiders and outsiders. Let $B > \phi(s), \forall s \in S$. An insider controlled board will always choose right in the work stage and an outsider controlled board will always choose left. Naturally an insider controlled board is very reluctant to let the board tip over to outside control and vice versa. Consider a firm with $N = 15$, $B = 2$, $\sigma^2 = 4$ and $\phi(\cdot) = 1 + 0.05s$. Director value functions and cutoff functions are shown in Figure 2.1. The value function for each type of director shows the expected present value of sitting on board s before the candidates are drawn. The most dramatic feature occurs at the transition from outsider dominance to insider dominance. Board $s = \frac{N-1}{2} = 7$ is outsider controlled, but replacing an outsider with an insider would tip the board to insider control. If this happens, the value for an outsider decreases dramatically while the value for an insider rises sharply. Outsiders are only willing to vote for the inside candidate when the difference between candidates $\nu_I - \nu_O$ is high enough to offset the loss in majority from moving to an insider controlled board. This is revealed as a spike in the cutoff value $\hat{\nu}_O(s)$ at $s = 7$.



(a) Value functions (b) Policy functions

Figure 2.1: Director value and policy functions

At boards heavily composed of one type of director, the board is in less danger

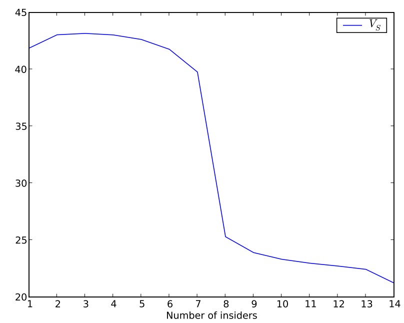


Figure 2.2: Shareholder value function

of tipping over to the opposite type and the difference in compositional values of the candidates is not so dramatic. Consider a board with only one insider. The outside directors are in the majority and their preference determines the candidate hired. Hiring an insider still leaves the board solidly in outsider control and the continuation value of hiring an insider is very close to that of hiring an outsider. With only two insiders on the board, the outsiders slightly prefer hiring an insider over an outsider: $\hat{\nu}_O(2)$ is negative, meaning that outsiders will hire an insider that has a slightly lower quality draw than an outsider.

The importance of the option value of candidates is especially clear when looking at the value function of inside directors in an outsider controlled board. As the composition increases from no insiders to seven insiders, we might expect insider value to monotonically increase as the insiders get closer to taking control of the board. But the value function reveals that insider value begins decreasing as the board nears even composition. As equation 2.12 shows, the high cutoff value at $s = 7$ reduces option value. In this case the reduced option value outweighs the value to insiders of a higher probability of gaining majority control and the work stage benefit of an extra insider.

The shareholder value function is shown in Figure 2.2. The shareholder value function is very similar to the outsider value function in that shareholders experience a sharp drop in value when the board moves to insider control. The state that maximizes the shareholder value function is also the solution to the shareholders' problem when taking a firm public. In this case, shareholders would start the firm with three inside directors. This is in sharp contrast to the static version of this model in which the shareholders would choose a board with seven insiders. By starting the firm with fewer insiders, shareholders allow the board to respond to the randomly drawn quality component of candidates. Additionally, since the outsiders are not perfectly aligned with shareholders, there is room for outsiders to hire a few insiders that shareholders may not want without sending the board to a majority insider state.

Iterating on the 16×16 board state transition matrix M reveals the distribution of board states as the board evolves through time. Row j of M^t specifies the distribution of board compositions after t periods starting from an initial board with $j - 1$ insiders. Figure 2.4 shows the distribution after one, five and twenty periods. The invariant distribution is also shown and does not depend on the initial board – the only ergodic set is S. Because the quality draws have infinite support, there is always positive probability on a sequence of candidates that will lead to any admissible board composition. Convergence is slow though. Even after twenty periods, a board that begins with a majority of insiders is still controlled by insiders with very high probability.

2.4.3 Majority outsider regulation

Figure 2.3 shows the firm value function with the majority outsider requirement and with no policy. With policy, board compositions with $s > 7$ are not allowed so shareholder value is not defined for these states. We see here that majority policy benefits shareholders at every admissible board composition.

Figure 2.5 shows the distribution of board compositions after one period, five periods, twenty periods and the invariant distribution. Here, there is zero probability that the board is composed of a majority of insiders.

Majority policy clearly benefits the shareholders of our example firm, but is this

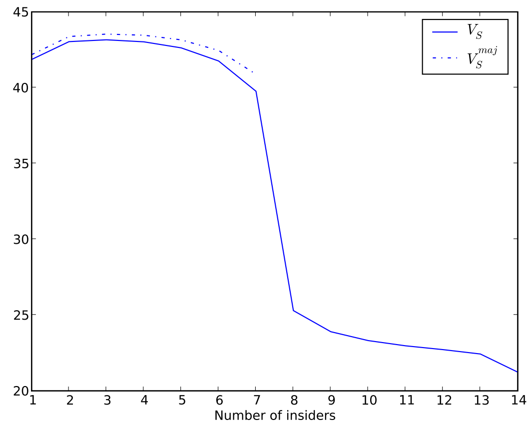
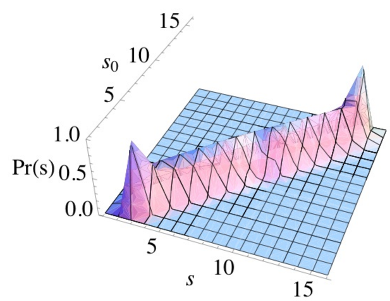


Figure 2.3: Shareholder value function with majority outsider regulation and no regulation

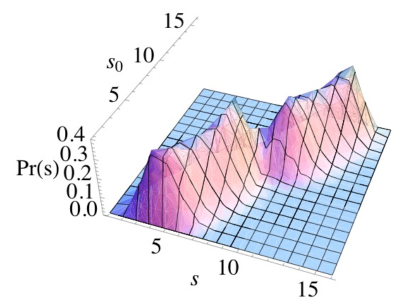
always the case? Similar to the nominating committee analysis, I let $V_S^{maj}(s)$ be the firm's value function with the majority outsider policy. I vary σ^2 and B over a fine grid to see where $\max_{s \in S^{maj}} V_S^{maj}(s) \geq \max_{s \in S} V_S(s)$. Results are shown in Figure 2.6.

If B is small enough that a board with a majority of insiders is optimal, then the majority outsider policy will clearly hurt the firm. When B is large, there is an endogenous barrier that dissuades outsiders from hiring enough insiders that the board tips to insider control. When σ^2 is small, it is very unlikely to draw candidates such that outsiders are willing to move to insider control. In this case, majority policy only changes behavior with low probability. When σ^2 is higher, it is more likely that outsiders will tip the board to insider control and the policy has more bite. An interesting feature of the diagram is that as σ^2 increases, the minimum B for policy to benefit shareholders is also increasing. The combination of high variance of candidate quality and low B (but still high enough to cause work stage conflict) mean that it is more likely that an insider controlled board will return to outsider majority. When B is low, insiders do not give up much by losing control and the high variance increases the probability of getting a high quality outsider. In these cases, shareholders prefer no majority regulation so

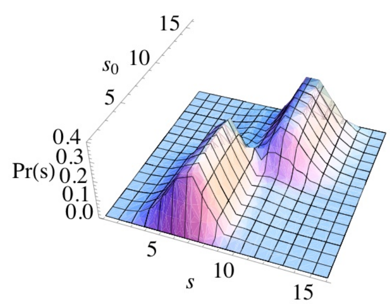
Figure 2.4: Transition matrix M^t with no regulation



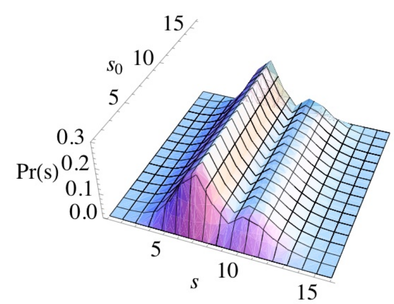
(a) $t = 1$



(b) $t = 5$

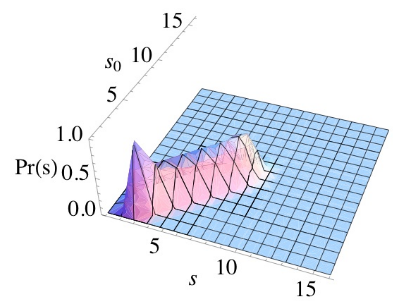


(c) $t = 20$

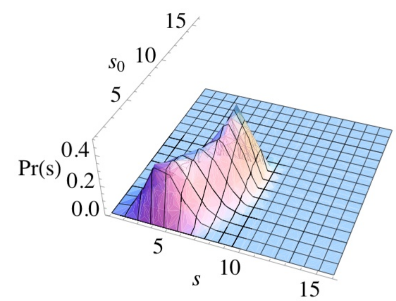


(d) $t \to \infty$

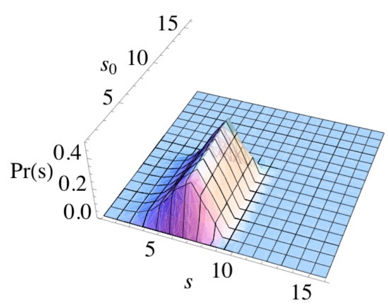
Figure 2.5: Transition matrix M^t with majority outsider regulation



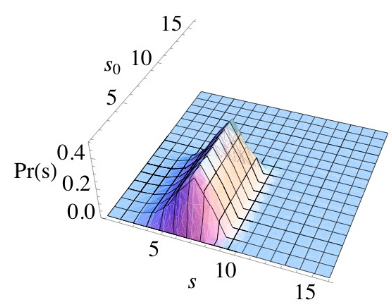
(a) $t = 1$



(b) $t = 5$



(c) $t = 20$



(d) $t \to \infty$

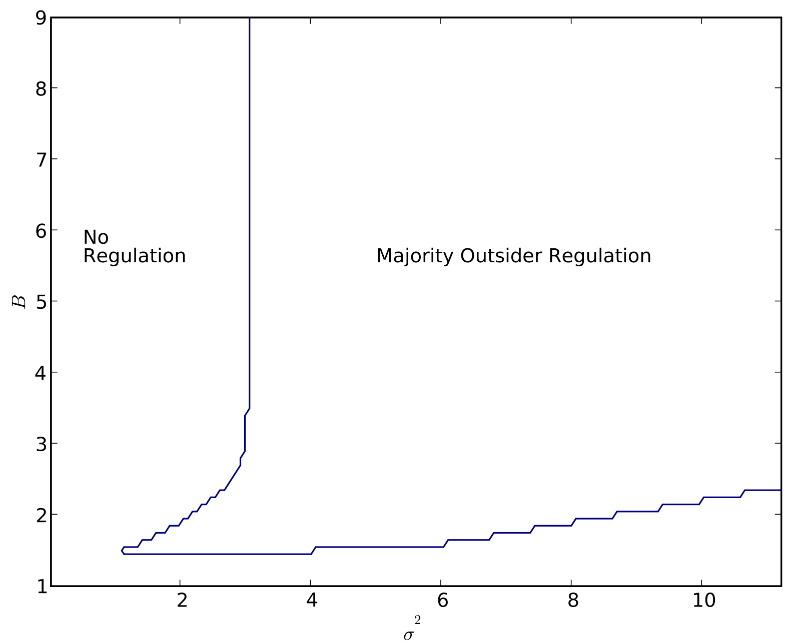


Figure 2.6: Maximum shareholder value: Majority outsider regulation vs. No regulation

that the board can remain flexible and capture the high option value that comes with a high variance. As σ^2 increases the benefits of being flexible increase and offset the negative effects of insider control with a higher B.

2.4.4 Alternative regulations

In 2003 the NYSE and Nasdaq exchanges also implemented a nominating committee regulation. This new rule states that replacement directors must be selected by a committee composed of outside directors. The optimal nominating committee would be shareholders themselves, but as that is not possible, outside directors are the second best. In my model this rule is implied by the majority outsider regulation, but it is also interesting to see how this regulation would affect shareholders in the absence of the majority regulation. I implement the nominating committee requirement by letting outsider preferences determine the hiring decision. Let the firm's value function under the nominating committee requirement be denoted by $V_S^{nom}(s)$.

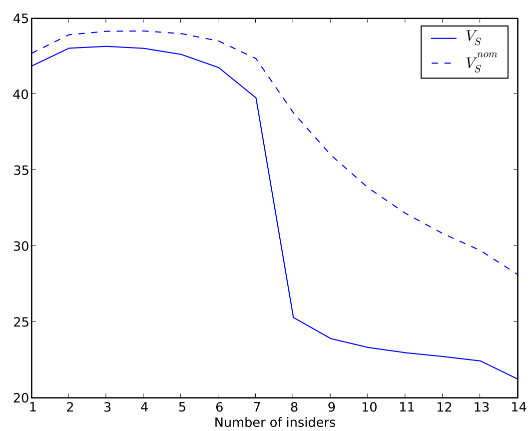
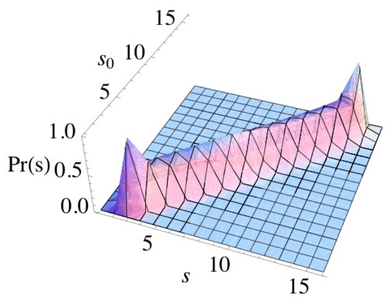


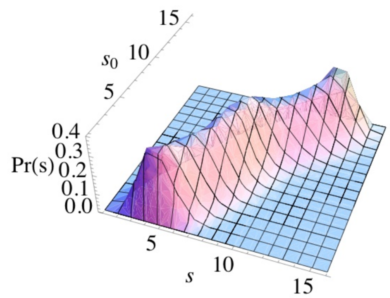
Figure 2.7: Shareholder value function with nominating committee regulation and no regulation

Figure 2.7 shows the firm value function of the example firm with a nominating committee and without. Without policy, moving from seven to eight insiders causes a large drop in firm and outsider value. The nominating committee reduces the penalty of letting the board go to a majority of inside directors as outsiders remain in control of the hiring decisions and are more likely than insiders to hire directors that return the board to outside majority. This reduces $\hat{\nu}_O(7)$, which in turn increases the option value of quality draws at $s = 7$.

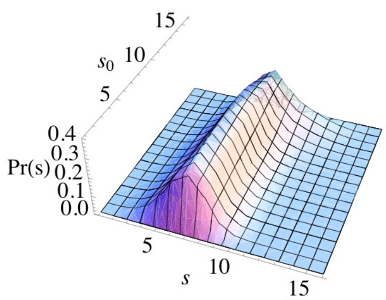
Figure 2.8 shows the distribution of board compositions after one period, five periods, twenty periods and the invariant distribution. Compared to the firm without regulation, the nominating committee keeps the board in outsider control with higher probability. If the board is started with a majority of insiders, it is very likely that a board with a nominating committee has moved to a board with a majority of outsiders after twenty



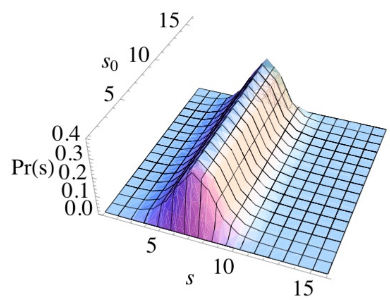
(a) $t = 1$



(b) $t = 5$



(c) $t = 20$



(d) $t \to \infty$

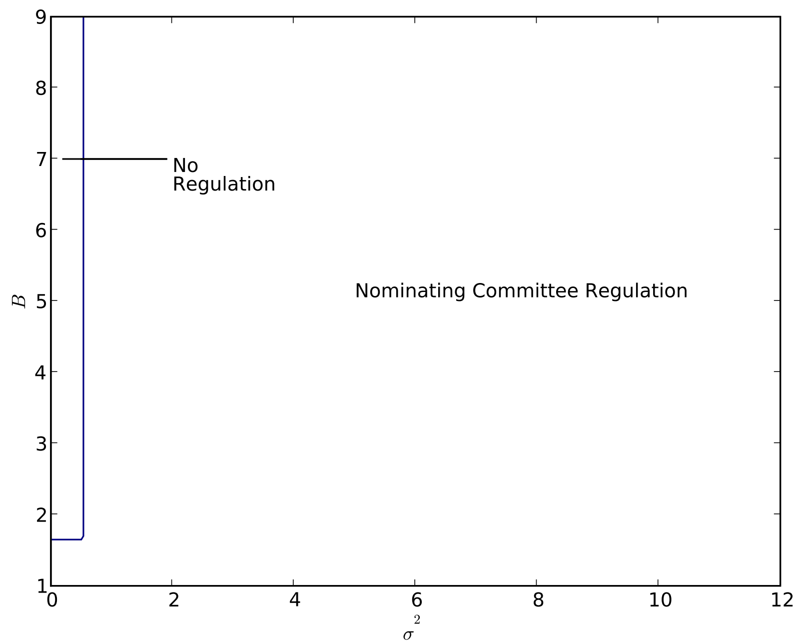
Figure 2.8: Transition matrix M^t with nominating committee regulation

periods. Without a nominating committee, the board is more likely to be in insider control than outsider control.

In our example firm, nominating committees increase firm value at all compositions and shareholders would rather take a firm public in the nominating committee environment rather than the no policy environment. Is this always the case? Let $V_S^{nom}(s)$ be the firm's value function with the nominating committee policy. I vary $\sigma^2 \in [0, 11]$ and $B \in [1, 9]$ over a fine grid to see where $\max_{s \in S} V_S^{nom}(s) \geq \max_{s \in S} V_S(s)$. This experiment has been performed with various board sizes and discount factors and results are similar. Figure 2.9 shows the results.

Over most of the parameter space the nominating committee policy benefits shareholders. This is intuitive as the policy does not limit permissible board compositions and outsiders are more closely aligned with shareholders than insiders and outsiders

Figure 2.9: Maximum shareholder value: Nominating committee vs. No regulation



retain control over hiring decisions in all states. A nominating committee composed of shareholders would always be better than no regulation, but that is not the case when the nominating committee is composed of outside directors. There is a range of the parameter space where shareholders prefer the no regulation environment. When σ^2 is small, two things happen. First, since the variance of the quality draws is low, it is unlikely that the board receives candidates that make the outsiders want to take the board to insider control and the hiring control benefits of the nominating committee are rarely realized. Second, we have seen that a benefit of the nominating committee is that it increases the option value of drawing two candidates when the board is near even composure. When σ^2 is small, this option value is small to begin with and there is not much to be gained with the nominating committee. The magnitude of the difference in shareholder value with and without policy is explored below.

2.4.5 Regulation Comparison

How do the two regulations compare to each other? Intuitively, the nominating committee policy preserves flexibility in composition while helping to align incentives in hiring decisions. The majority policy also aligns incentives, but does so at the cost of limiting admissible compositions.

Figure 2.10 compares nominating committees and majority policy in the example firm. In all states, shareholders prefer the nominating committee policy to the majority policy and no policy.

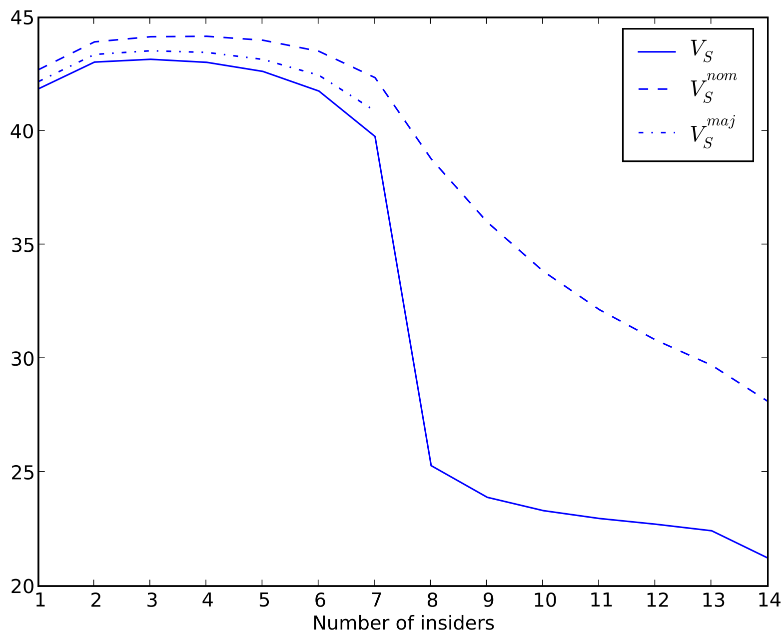


Figure 2.10: Shareholder value functions with no regulation, majority outsider regulation and nominating committee regulation

It is not always the case that the nominating committee regulation alone is better than the majority outsider policy. I find that when the nominating committee policy is not optimal, implementing it will not hurt shareholders very much. When the nominating committee is optimal, it has the potential to greatly increase shareholder value. To explore the magnitude of regulation's affects on shareholder value, I fix B and plot the maximum firm value as σ^2 varies. Two examples are shown below.

When B is low (Figure 2.11), agency costs are low and there is no tension between insiders and outsiders. Majority policy prevents the board from choosing a composition with a majority of insiders and shareholders suffer. The difference between no policy and nominating committees is small. When B is large(Figure 2.12), we see that the nominating committee almost always outperforms majority policy. In the small range of σ^2 where the majority policy is better, the difference is small. Not much is lost in this case. On the other hand, as σ^2 increases, nominating committees have the potential to give shareholders large gains over no policy and majority policy. For both B, we see that nominating committees are preferable to no policy and majority policy.

2.5 Conclusion

The notion that directors choose their own board is of great importance when modeling the board and performing policy analysis. It introduces a dynamic aspect to the director selection problem and allows the endogenous determination of composition. By including the task of hiring new directors to the list of board functions, I am able to model entrenchment and other board dynamics. This is especially important for analyzing policies that target board composition and director hiring decisions.

This type of model is easily adapted to analyze other dynamic aspects of the board. Bebchuk et al. (2002) examine how staggered boards reduce the probability of a hostile takeover by increasing the time necessary for a hostile bidder to gain a majority of seats on a board. My model may be extended to include director term lengths and used to study staggered and annually elected boards and their effects on shareholder value.

The idea of incumbent committee members determining the future composition of the committee is not unique to corporate boards. For example, an economics department hiring a new faculty member considers both how the candidate will contribute to the output of the department and how the new faculty member will vote in future hiring rounds. A department may receive a very high quality macroeconomist, but hiring the candidate would result in giving too much weight to the macroeconomists in future hiring decisions. The ideas in my model may be adapted to these other environments.

There is also interesting work to be done in studying the response of firms to the policies discussed in this paper. Analysis here is limited to a new firm entering one of three policy regimes. Transition dynamics of incumbent firms is another avenue of exploration. The majority policy is seen to reduce the option value of picking among candidates. Firms affected by this could regain option value by increasing the size of their board. When there is uncertainty over how directors will vote in hiring decisions, the majority outsider policy may also act as a commitment mechanism. In this case, firms may actually increase the number of insiders on their board and they are able to get closer to the statically optimal level of insiders without the the possibility of the board tipping to insider majority.

2.6 Proofs

2.6.1 Proof of Theorem 2

By assumption, if insiders take control of the board ($s \in \{2, 3\}$), then insiders always vote in the inside candidate and the board never returns to outsider control. We have

$$\begin{aligned}
V_O^I(0) &= w_S(0) + \frac{2}{3}\beta\,[\nu + V_O(1)] \\
V_O^O(0) &= w_S(0) + \frac{2}{3}\beta\,[V_O(0)] \\
V_O(0) &= \max\{V_O^I(0), V_O^O(0)\} \\
V_O^I(1) &= w_S(1) + \frac{2}{3}\beta\left[\nu + \frac{1}{2}V_O(1) + \frac{1}{2}V_O(2)\right] \\
V_O^O(1) &= w_S(1) + \frac{2}{3}\beta\left[\frac{1}{2}V_O(0) + \frac{1}{2}V_O(1)\right] \\
V_O(1) &= \max\{V_O^I(1), V_O^O(1)\} \\
V_O(2) = V_O(3) &= \frac{\nu}{1 - \frac{2}{3}\beta} \\
V_S(2) = V_S(3) &= \frac{\nu}{1 - \beta}
\end{aligned}$$

Suppose parameters are such that outsiders prefer to hire an insider with $s = 1$. Then

$$\begin{aligned}
\nu + \frac{1}{2}V_O(1) + \frac{1}{2}V_O(2) &> \frac{1}{2}V_O(0) + \frac{1}{2}V_O(1) \\
\nu &> \frac{1}{2}\left[V_O(0) - \frac{\nu}{1 - \frac{2}{3}\beta}\right]
\end{aligned}$$

Additionally, $V_O(1) = V_O^I(1)$ and is now one equation with one unknown.

$$\begin{aligned}
V_O^I(1) &= w_S(1) + \frac{2}{3}\beta\left[\nu + \frac{1}{2}V_O^I(1) + \frac{1}{2}V_O(2)\right] \\
V_O^I(1) &= \frac{\beta[(9 - 4\beta)\nu - 6w_O(1)] + 9w_O(1)}{9 + \beta(2\beta - 9)}
\end{aligned}$$

If the outsiders vote in an insider with $s = 1$, what do they do when $s = 0$? They vote for the insider if

$$\begin{aligned}\nu &> V_O(0) - V_O(1) \\ \nu &> V_O(0) - \frac{\beta[(9-4\beta)\nu - 6w_O(1)] + 9w_O(1)}{9+\beta(2\beta-9)} \\ \nu &> \frac{V_O(0)}{1+\frac{\beta(9-4\beta)}{9+\beta(2\beta-9)}} - \frac{3w_O(1)(2\beta-3)}{2\beta^2-9}\end{aligned}$$

This is a less restrictive condition than the $s = 1$ condition, meaning that is outsider vote for the insider with $s = 1$ then they also do so for $s = 0$. This is intuitive. It also tells us that in this case $V_O(0) = V_O^I(0)$ and is now solved for.

$$\begin{aligned}V_O(0) &= w_O(0) + \frac{2}{3}\beta(\nu + V_O(1)) \\ &= w_O(0) + \frac{2}{3}\beta\left(\nu + \frac{\beta[(9-4\beta)\nu - 6w_O(1)] + 9w_O(1)}{9+\beta(2\beta-9)}\right)\end{aligned}$$

So we have all of the outsider value functions solved for. By looking where the outsiders are indifferent between hiring an insider and an outsider with $s = 1$, we get the cutoff $\hat{\nu}_O$.

$$\begin{aligned}\hat{\nu}_O &= \frac{1}{2}\left[V_O(0) - \frac{\nu}{1-\frac{2}{3}\beta}\right] \\ \hat{\nu}_O &= \frac{6\beta w_O(1) + 3(3-\beta)w_O(0)}{27-\beta(9+2\beta)}\end{aligned}$$

Because the outside director determines the hiring outcome when $s = 0, 1$, we know that if the outsider want an insider when $s = 1$, then $V_S(0) = V_S^I(0)$ and $V_S(1) = V_S^I(1)$. Then, similar to the procedure for the outsiders, we can calculate $\hat{\nu}_S$ and get

$$\hat{\nu}_S = \frac{3(\beta+1)w_S(1) - (\beta-3)w_S(0)}{(5+\beta)(3-2\beta)}$$

Now, check to see that $\hat{\nu}_S - \hat{\nu}_O > 0$. Since $w_S(0) = w_O(0)$ and $w_S(1) = w_O(1)$, I replace the work stage functions with $w(0)$ and $w(1)$.

$$\begin{aligned}
& \frac{3(\beta+1)w_S(1)-(\beta-3)w_S(0)}{(5+\beta)(3-2\beta)} - \frac{6\beta w_O(1)+3(3-\beta)w_O(0)}{27-\beta(9+2\beta)} \\
= & \frac{w(0)(54\beta-4\beta^3-54)+3w(1)(27+\beta(\beta(3+2\beta))-12)}{(5+\beta)(3-2\beta)(27-\beta(9+2\beta))}
\end{aligned}$$

The denominator is positive. The first term with $w(0)$ is negative and the term with $w(1)$ is positive. By assumption, $w(0) \leq w(1)$, so if the nominator is positive with $w(1) = w(0)$, then the result holds.

$$\begin{aligned}
& \frac{w(0)(54\beta-4\beta^3-54)+3w(0)(27+\beta(\beta(3+2\beta))-12)}{(5+\beta)(3-2\beta)(27-\beta(9+2\beta))} \\
= & \frac{w(0)(3+\beta)(9+\beta(3+2\beta))}{(5+\beta)(3-2\beta)(27-\beta(9+2\beta))}
\end{aligned}$$

2.6.2 Proof of Theorem 3

Case 1: Suppose $\nu > \hat{\nu}_O$ and all directors will always vote in the inside candidate. Then shareholders get ν in every period regardless of where the board starts. If the board starts in insider control, then shareholders never get any work stage payoff. If the board starts in outsider control then the board gets a positive work stage payoff in at least one period. Therefore $s_0 \in \{0, 1\}$.

Case 2: Suppose $\nu < \hat{\nu}_O$ and outside directors will hire the outside candidate when $s = 1$. If $\nu < \hat{\nu}_O$, then it must be that $\nu < \hat{\nu}_S$. For shareholders to prefer the outside candidate when $s = 1$, it must be the case that

$$\begin{aligned}
\nu + \frac{1}{3}V_S(1) + \frac{2}{3}V_S(2) &< \frac{1}{3}V_S(0) + \frac{2}{3}V_S(1) \\
\nu &< \frac{1}{3}\left(V_S(0) + V_S(1) - 2V_S(2)\right)
\end{aligned}$$

Since ν is positive, it must be that either $V_S(0) > V_S(2)$ or $V_S(1) > V_S(2)$ or both and the result follows.

2.6.3 Proof of Theorem 4

Outline of proof...

Case 1: If $\nu < \hat{\nu}_O$, then the board starts in outsider control and outsiders hire the outside director when $s = 1$ even without regulation. In this case, regulation never changes agent behavior and values remain constant.

Case 2: If $\nu < \hat{\nu}_O$, outside directors would like to vote in an inside director when $s = 1$ but shareholders prefer the outsider. Then $V_S^I(1) < V_S^O(1)$, but $V_S(1) = V_S^I(1)$. With regulation, $V_S(1) = V_S^O(1)$ and shareholders are better off.

Case 3: If $\nu > \hat{\nu}_S$, both shareholders and directors would like to vote in the inside candidate when $s = 1$. Regulation prevents this, and all agents are worse off.

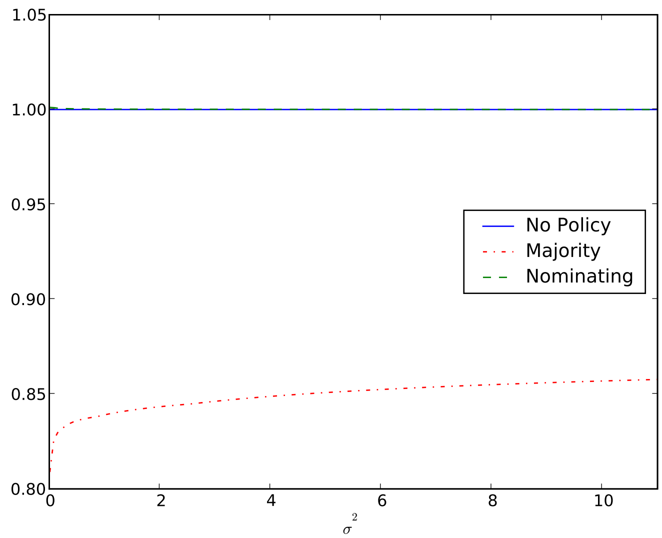


Figure 2.11: $B = 1$

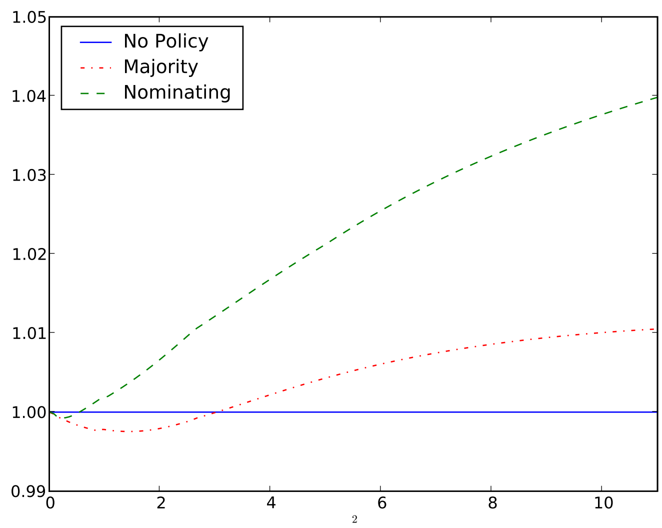


Figure 2.12: $B = 5$

Chapter 3

Board Transitions

3.1 Introduction

In the early 2000s the Securities and Exchange Commission, the New York Stock Exchange, the Nasdaq Stock Exchange, and the Sarbanes-Oxley Act made several regulatory changes to the operation of the board of directors of Unites States corporations. First was a requirement that boards listed on the two exchanges have boards that are composed of a majority of independent outside directors. Second, boards were required to have several new committees composed of outside directors. In particular, audit and nomination/governance committees were mandated by the NYSE and Nasdaq exchanges. All of these policies led to an acceleration in the move towards higher independence (share of outside directors) on boards.

In this paper, I investigate how corporate boards responded to these policy changes. In particular, I estimate a simple model of the board in order to see how much of the observed increase in independence is due to the majority outsider policy. The model predicts that 59% of the boards that were in violation of the majority outsider policy would have moved into compliance even in the absence of the majority regulation. 60% of the observed change in average independence among firms in violation of the majority outsider policy occurs even in the absence of a majority outsider rule. These findings are consistent with the data in that firms that were not in compliance with the majority outsider regulation "overshot" the minimum necessary change in independence needed to comply with the new rule. I posit two explanations for the movement and accelerated independence in the absence of majority policy. First, the committee requirements and general trends in corporate governance may account for the movement. Second, even though the majority policy may not account for a majority of the movement in a *static* model, it may have a larger effect in a *dynamic* setting. As in the first chapter, the majority policy tips the board into an outsider dominated state. With more power in the director selection process, outside directors will tend to hire additional outside directors.

Several other papers have studied the response of corporate boards to the aforementioned regulatory changes. In particular, Linck et al. (2008) examine the effect of Sarbanes-Oxley and firm characteristics on board size and composition. They find a sharp increase in the independence of boards resulting from the regulatory changes. Additionally, they find that the increase is larger for firms that were not in compliance with the majority outsider policy. Here, I take a different, but complementary approach. Rather than using firm characteristics and cross-sectional variation to examine board responses, I estimate a model in which identical firms choose boards. Variation among boards is the result of a randomly drawn quality component of individual director candidates. In the model presented here, a firm draws a pool of inside director candidates and a pool of outside director candidates. As the firm hires directors, they take the highest quality candidates first. The optimal board composition is then a balance between board characteristics and individual director quality. By keeping the pool of candidates constant across time, boards exhibit persistence in their observed board size and independence, as well persistence in their deviation away from average board independence. While my findings are consistent with theirs, my goal differs, in that I decompose the effects of the different policies in order to gain a better understanding of how different regulations affect board composition decisions.

The paper proceeds as follows. Section 2 outlines the majority outsider rule enacted by the New York Stock Exchange and the Nasdaq Stock Exchange. Section 3 details the data and gives a descriptive view of the movements in board composition during the period of regulatory change. Section 4 presents the model and empirical specification and section 5 presents results. Last, section 6 concludes.

3.2 Regulation

In early 2002, as a response to several corporate scandals, the Securities and Exchange Commission (SEC) called on the New York Stock Exchange (NYSE) and Nasdaq Stock Market (Nasdaq) to review corporate governance listing standards[1] . The exchanges responded by submitting amended standards to the SEC in late 2002, which were accepted by the SEC in 2003.[2] In the revised listing standards, NYSE states, "effective boards of directors exercise independent judgment in carrying out their responsibilities. Requiring a majority of independent directors will increase the quality of board oversight and lessen the possibility of damaging conflicts of interest."

The exchanges set forth criteria for determining whether a director may be considered an independent outsider. The NYSE's requirements are outlined in section 303A.02 of the NYSE Listed Company Manual. Nasdaq's requirements are similar to the NYSE's and are defined in section 4200(a)(15) of the Nasdaq Manual. NYSE's definition of independence states, "No director qualifies as 'independent' unless the board of directors affirmatively determines that the director has no material relationship with the listed company (either directly or as a partner, shareholder or officer of an organization that has a relationship with the company). Companies must identify which directors are independent and disclose the basis for that determination." Additionally, the manual offers some guidelines, partially reproduced here. A director is not independent if:

[1] SEC press release 2002-23.
[2] SEC press release 2003-150.

- The director is, or has been within the last three years, an employee of the listed company, or an immediate family member is, or has been within the last three years, an executive officer of the listed company.

- The director has received, or has an immediate family member who has received, during any twelve-month period within the last three years, more than $120,000 in direct compensation from the listed company, other than director and committee fees and pension or other forms of deferred compensation for prior service (provided such compensation is not contingent in any way on continued service).

Additional rules disallow independent directors form having conflicts of interest related to the firm's audit, tax compliance and compensation activities.

The new regulations were announced in 2002, but compliance was not mandatory for several years. The NYSE required that firms comply by the first annual meeting after January 15, 2004, but before October 31, 2004. An exception is made for firms with classified boards that do not have enough inside directors with terms ending before October 31, 2004. These boards have until December 31, 2005 to move into compliance.[3]

Additionally, foreign private issuers and controlled companies[4] are not required to comply with the majority outside director rule.

3.3 Data

I use data from the RiskMetrics Directors dataset. Data on board composition, along with director classification is available for years 1996 through 2007 for firms in the S&P 500, S&P Midcap 400, and S&P Smallcap 600 indices. In order to examine how boards respond to the majority outsider regulation, I exclude financials and utilities and only use firms that were in data in 2002, 2003, and 2004.

[3] However, if a classified board is able to move into compliance by the 2004 date, it must.

[4] A firm for which more than 50% of the voting power is held by a single individual, group, or company is considered a controlled company.

Table 3.1: Summary of director data.

Year	Count	Size	Independence
1996	535	10.09	0.76
1997	651	9.62	0.75
1998	736	9.52	0.76
1999	780	9.46	0.77
2000	847	9.21	0.77
2001	911	9.09	0.78
2002	990	9.00	0.79
2003	990	9.02	0.81
2004	990	9.07	0.82
2005	904	9.12	0.83
2006	833	9.32	0.84
2007	749	9.24	0.84

RiskMetrics classifies each director-board appointment as *employee*, *linked*, or *independent*. RiskMetrics's definition of independence is similar, but stricter than that of the exchanges. Directors that do not qualify as independent in the RiskMetrics dataset but are not employees are classified as *linked*. RiskMetrics classifies as *linked*, "any directory who is a former employee; is an employee of or is a service provider, supplier, customer; is a recipient of charitable funds; is considered an interlocking or designated director; or is a family member of a director or executive." Following Linck et al. (2008), I classify *employee* directors as insiders and non *employee* directors as outsiders.

As seen in Table 3.1, independence is steadily increasing through time. There is an acceleration in independence starting in 2002 with the announcement of regulatory changes. Part of this movement is due to the fact that boards that do not meet the majority outsider requirement must adjust independence in order to comply with the new rules. The goal of this paper is to pin down how much of the observed change is in fact due to the majority outsider regulation. Figure 3.1 shows graphically the time trend in average independence.

I group firms into two categories: compliant firms that already had a majority of

Figure 3.1: Average independence.

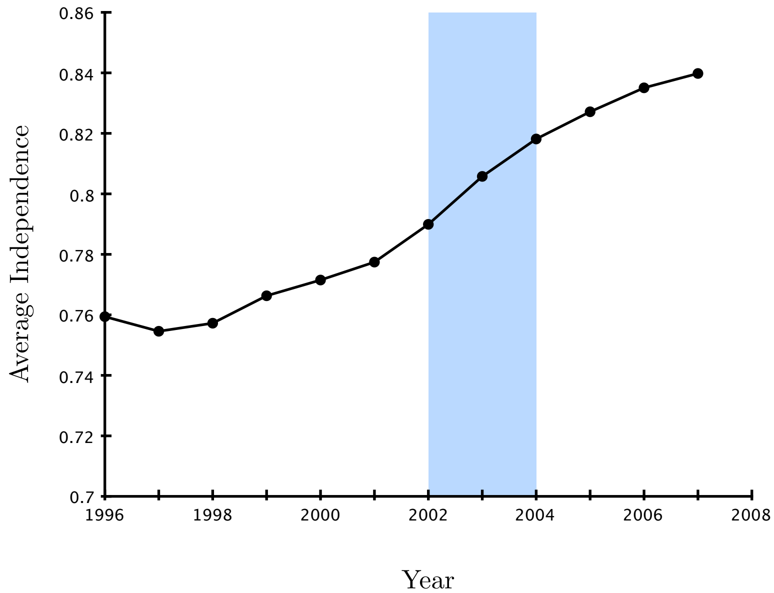


Figure 3.2: Average independence for compliant and non-compliant boards.

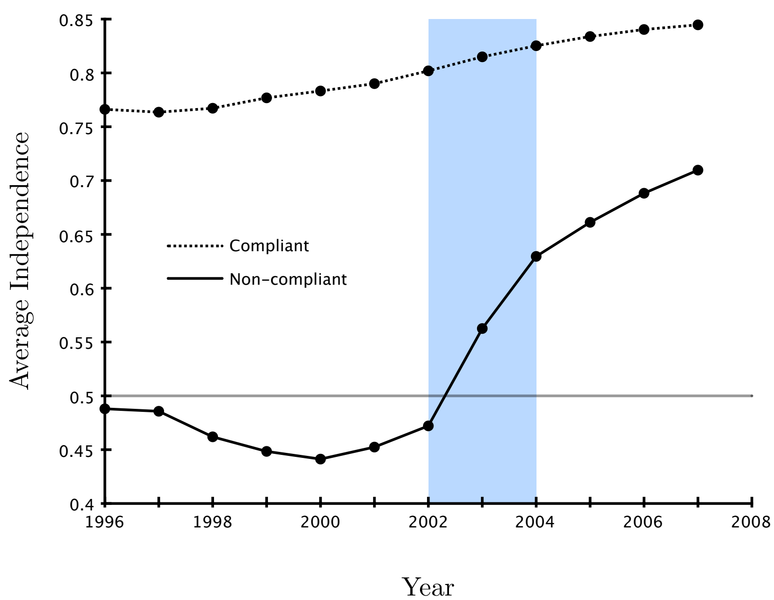


Figure 3.3: Average board size.

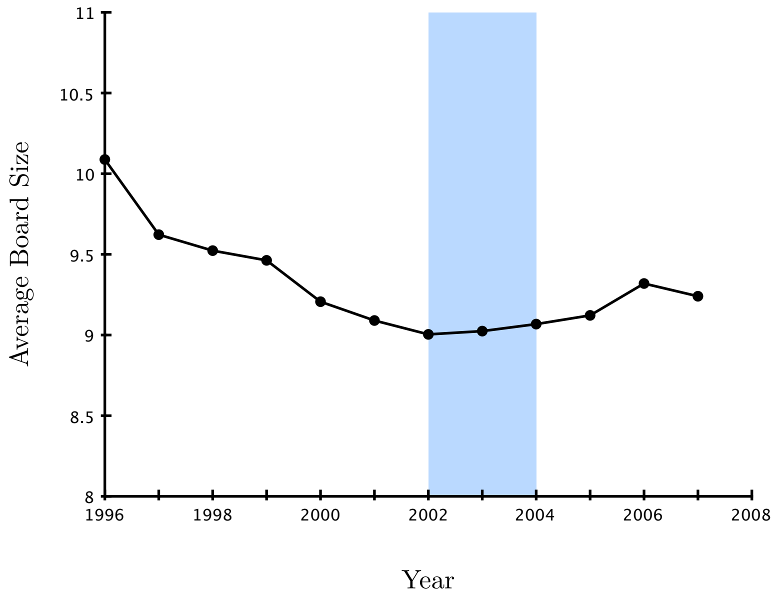
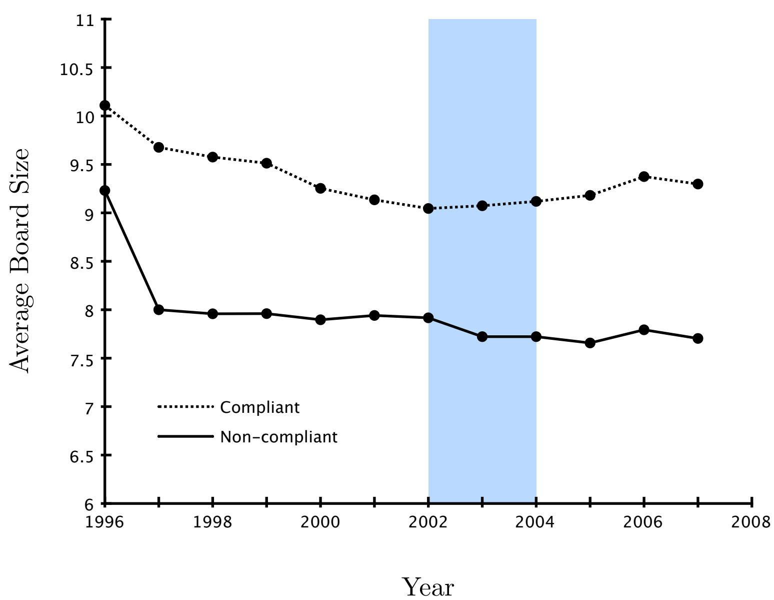


Figure 3.4: Average board size for compliant and non-compliant firms.



outside directors in 2002 and non-compliant firms that were in violation of the majority regulation in 2002. Of the 990 boards in the data set, 36 were in violation of the majority outsider requirement as of their 2002 annual meeting. Of these 36 firms, 32 were in compliance by the 2004 meeting, leaving four still not in compliance by 2004. Figure 3.2 plots the average independence for each of these groups. We see that the acceleration in independence appears to be due to non-compliant firms changing their independence. On average, non-compliant firms did not make the minimum necessary adjustment in independence needed to comply with the majority outsider policy. Instead, the average is much higher than the 50% cutoff required by regulation. Part of this phenomenon may be explained by the discrete nature of the board and the strict majority requirement. Still, many firms added more outsiders or dropped more insiders than necessary for complying with the majority rule. This movement suggests that there were other forces contributing to the increase in independence besides the majority regulation. First, the new committee requirements require outside directors. Boards with a low independence are less likely to have the outsiders needed to occupy the committees, ad therefore less likely to already be in compliance with the committee requirements. Additionally, as noted in the first chapter, as the board moves from below 50% independence to above 50%, the board is more likely to hire additional outsiders.

The rate of change for compliant firms appears to be consistent with the time trend.

Table 3.1 also reveals that board size is steadily decreasing from 1996 to 2002. After the announcement of new regulations, board size increases in each subsequent year until 2007. Figure 3.3 shows this trend graphically. More interesting is that this reversal is larger for compliant firms than non-compliant firms. Non-compliant firms actually decrease average board size during the period of adjustment. This suggests that non-compliant firms are not moving into compliance by adding outside directors alone.

Table 3.2 details how the 32 non-compliant boards moved into compliance. The most frequent response (seven firms) was to add one outside director. Only firms that had the

Table 3.2: Responses of non-compliant boards (in 2002) that were in compliance in 2004.

Count	$I_{2004} - I_{2002}$	$O_{2004} - O_{2002}$
7	0	1
4	-1	1
4	-3	1
3	-1	0
2	-1	3
2	-1	2
2	-2	1
2	-4	1
1	0	2
1	-2	4
1	-2	0
1	-3	3
1	-3	0
1	-4	3

same number of insiders as outsiders chose this action. Nearly all of the remaining firms either removed insiders or made some choice involving swapping insiders for outsiders. Rather than adding outsiders until the independence requirement is met, many boards tended to stay near or below the unconstrained efficient scale chosen before regulation. There is a trade-off between moving from the unconstrained scale and minimizing the change in composition. For example, a firm with five insiders and five outsiders can move into compliance by adding a single outside director and not losing any incumbent directors. A firm with a larger "complaince gap," with five inside directors and four outside directors would have to add two outside directors to comply with regulation and not lose any incumbents – resulting in a larger move away from efficient scale. Alternatively, this firm could swap one insider for an outsider and be in compliance without altering scale. These trade-offs caused by the discrete nature of directors prove to be a valuable source of information for uncovering information about the costs and decreasing returns associated with growing a board and play an important role in the model.

3.4 Model

A board's value to the firm depends on several factors: scale, independence, and the quality of individual directors. First, the board has an efficient scale. As additional directors are added to the board, each director brings more knowledge and experience. Each director must be compensated, which is a constant marginal cost. As in Raheja (2005), in addition to compensation, as the board grows, the marginal cost of coordination and communication increases and creates decreasing returns. The optimal scale is determined by the trade-off between these benefits and costs. Second, there is an optimal board independence. As noted in literature, a board with only insiders would not be an effective monitor of management, and a board with only outsiders would not have access to the information needed to properly advise and monitor management.[5] Third, the board may wish to move away from the optimal scale and independence as a response to the quality of individual director candidates. The firm chooses directors from a set of inside and outside candidates and each candidate has an individual quality or board matching component. The firm's objective is to choose the optimal board given the set of candidates and optimal scale and independence.

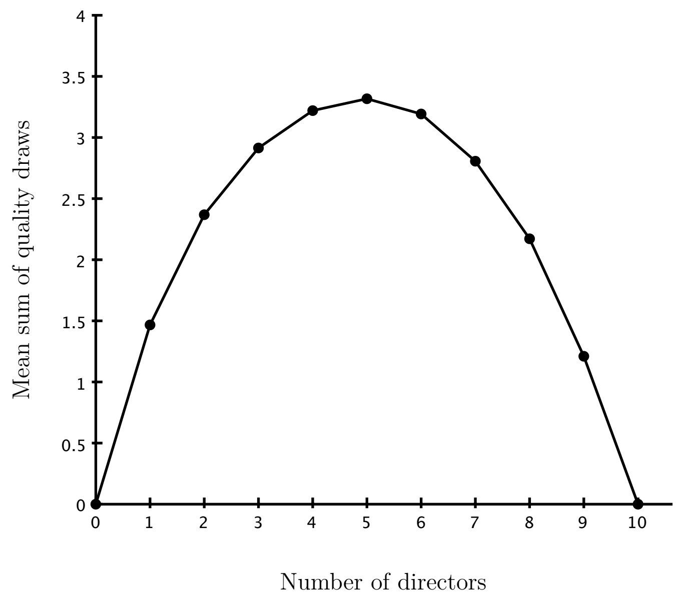
Each firm draws a set of N inside candidates $(x_1, ..., x_N)$ and M outside candidates $(y_1, ..., y_M)$. Each x_i and y_i are i.i.d. draws from a distribution $F(\cdot)$. Without loss of generality, I assume that the set of candidates of each type are ordered by decreasing quality: $x_1 \geq x_2 \geq ... \geq x_N$. Additionally, let x and y be the number of directors of each type chosen to sit on the board. While a firm's pool of director candidates may change over time, there would be a high degree of serial correlation and for simplicity I assume the board's candidate pool remains constant. Each year, an individual firm's problem is

[5] Schmeiser (2009), Harris and Raviv (2008), Raheja (2005), Adams and Ferreira (2007)

$$\max_{x,y} Ax^{\alpha}y^{\beta} - c(x+y) + \gamma\left(\sum_{i=1}^{x} x_i + \sum_{i=1}^{y} y_i\right) \tag{3.1}$$

In this specification, the board is similar to a production function with constant factor prices. The parameters α and β determine the optimal independence absent the quality components of directors, as well as the amount of curvature or decreasing returns due to communication and coordination costs. The compensation cost of each director is c and the total productivity of a board is represented by A. The parameter γ measures the importance of director quality. The firm's problem under majority outsider regulation remains the same, except for the additional constraint that $x < y$.

Figure 3.5: Sum of quality draws for one type of director. Draws are from a $N(0,1)$ distribution.



It is important to note that the director quality draws introduce another source of curvature to the model. Since the best directors get chosen first, the marginal quality of a particular type of directors is decreasing as more of that type are added to the board. Figure 3.5 demonstrates this curvature for a pool of ten candidates drawn from a $N(0,1)$ distribution. The total curvature is then determined by both the decreasing returns represented by α and β and decreasing marginal quality. Because of the quality component, it is possible then that the parameters α and β may take on negative values while directors still provide a positive marginal contribution to the board. Therefore, I do not impose the usual restriction that α and β are positive.

3.4.1 Empirical Specification

To estimate the model, I use data from board composition decisions made in 2002 (before regulation) and 2004 (after regulation). Given a firm specific set of randomly drawn candidates, each firm i picks a pre-regulation board (x, y) and post-regulation board (x', y') to solve

$$\begin{aligned} \max_{x,y,x',y'} \quad & Ax^{\alpha}y^{\beta} - c(x+y) + \gamma\epsilon_{ixy} + \\ & Ax'^{(\alpha-\tau)}y'^{(\beta+\tau)} - c(x'+y') + \gamma\epsilon_{ix'y'} + \epsilon_{ixyx'y'} \\ & \text{subject to} \quad x' < y'. \end{aligned} \tag{3.2}$$

The parameters α, β, A,c, and γ are common to all firms. The error terms ϵ_{ixy} and $\epsilon_{ix'y'}$ are the sum of quality draws of individual directors, where each director's quality is drawn independently from a $N(0,1)$ distribution. The board draws a set of candidates of each type and ranks the candidates according to their quality draws. If x insiders are selected for the board, the x highest quality directors will be chosen. More specifically, let $(x_{i1}, ..., x_{iN})$ be the profile of inside candidate draws for firm i. The ordered draws are then $(x_{i(1)}, ..., x_{i(N)})$ where $x_{i(k)}$ is the kth highest draw. For a given firm i, the sum of director quality of hiring x insiders and y outsiders is given by

$$\epsilon_{ixy} = \sum_{j=1}^{x} x_{i(j)} + \sum_{j=1}^{y} y_{i(j)}.$$

The last error term, $\epsilon_{ixyx'y'}$, is drawn from an extreme value distribution and is i.i.d. among all firms and board combinations. This last error term includes values of particular groups of directors, ease of movement between various board compositions and measurement error arising from the possible misclassification of a director's type. This specification is a mixed logit model where the structure put on the director quality component creates correlation among the different board choices. Train (2003) discusses this class of model and its different interpretations.

After regulation, the parameters $\alpha, \beta, A, c, \gamma$ remain the same as pre-regulation, but the share parameters are shifted by τ. This parameter captures the changes in optimal independence caused by the contemporaneous changes in committee requirements as well as more general trends in corporate governance. As τ increases, the optimal independence increases. The curvature due to coordination and communication, $\alpha + \beta$, remains constant. Additionally, the board chooses directors from the same pool of candidates before and after regulation, meaning that the error term associated with each choice (x, y) is constant across time. Drawing a fixed number of candidate qualities from a $N(0, 1)$ distribution serves as a normalization and all parameters must be interpreted relative to this. While this hinders the interpretability of some parameters, it still allows for counterfactual experiments.

The parameters to be estimated are $\Theta = (\alpha, \beta, \tau, A, c, \gamma)$ and each observation in the data is $z_i = (x_i, y_i, x'_i, y'_i)$. I use the 983 firms that were in compliance with policy by 2004. I choose $N = M = 20$ as 20 is the most directors of one type chosen by any board in the data. Additionally, I set the number of draws of each type equal so that the curvature in the error terms is the same in expectation for insiders and outsiders and that any expected shift away from a board with the same number of insiders and outsiders is driven by α and β.

I estimate the model using maximum simulated likelihood estimation. To simulate choice probabilities, I first draw many observations of ϵ_{ixy} as described above. Because the data consists only of choice variables, I can calculate choice probabilities

$P(x, y, x', y'|\Theta)$ for each possible board combination and store the probabilities in memory. More specifically, for each simulated pool of candidate qualities i, I let

$$P_i(x, y, x', y'|\Theta) = \frac{\exp\{V(x, y, x', y', \epsilon_{ixy}, \epsilon_{ix'y'}|\Theta)\}}{\sum_{j,k,j',k'} \exp\{V(j, k, j', k', \epsilon_{ijk}, \epsilon_{ij'k'}|\Theta)\}}$$

where

$$V(x, y, x', y', \epsilon_{ixy}, \epsilon_{ix'y'}|\Theta) = Ax^{\alpha}y^{\beta} + Ax'^{\alpha-\tau}y'^{\beta+\tau} - c(x + y + x' + y') + \gamma(\epsilon_{ixy} + \epsilon_{ix'y'}).$$

Then, given n sets of simulated errors, I average the probabilities for each set of errors to obtain the simulated choice probability

$$P(x, y, x', y'|\Theta) = \frac{1}{n}\sum_{i=1}^{n} P_i(x, y, x', y'|\Theta).$$

The log likelihood of the data z is then computed as

$$LL(\Theta|z) = \sum_{i=1}^{983} log(P(z_i|\Theta)).$$

3.5 Results and Counterfactual Experiment

Results of the estimation are presented in Table 3.3. The shift parameter τ is positive, indicating a general trend towards increased independence of boards, whether constrained by majority regulation or not. The share parameters α and β, indicate that absent individual director quality, a board will have more outsiders than insiders. The curvature due to α and β is more difficult to interpret because it must be considered relative to the normalization made in the error term. Likewise, A, c, and γ may be interpreted relative to each other, but move together to weight against the logit error.

Figure 3.6 plots the expected value of a pre-regulation board as a function of the number of inside and outside directors given the estimated parameters. In expectation, the optimal board will have between one and two insiders and between seven and eight outsiders. Figure 3.7 shows pre and post regulation levels of independence for both

Table 3.3: Parameter estimates.

Parameter	Estimate	Std. Error
α	-0.0177	(0.0053)
β	0.9668	(0.0216)
τ	0.0135	(0.0017)
A	8.5669	(0.5463)
c	10.4397	(0.4310)
γ	7.7576	(0.3338)

Figure 3.6: Expected value of pre-regulation board.

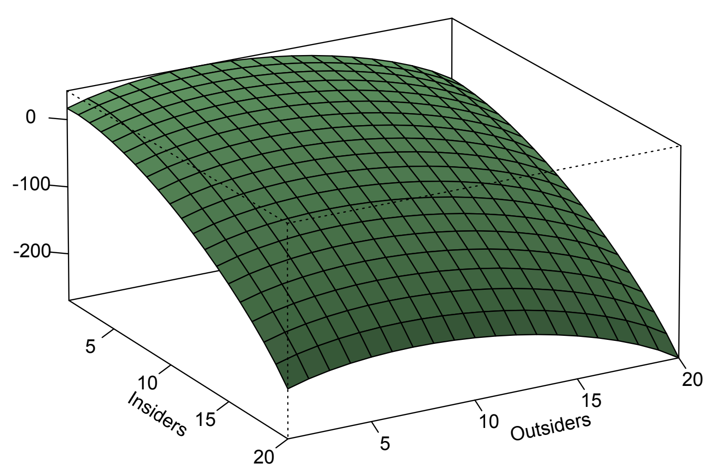
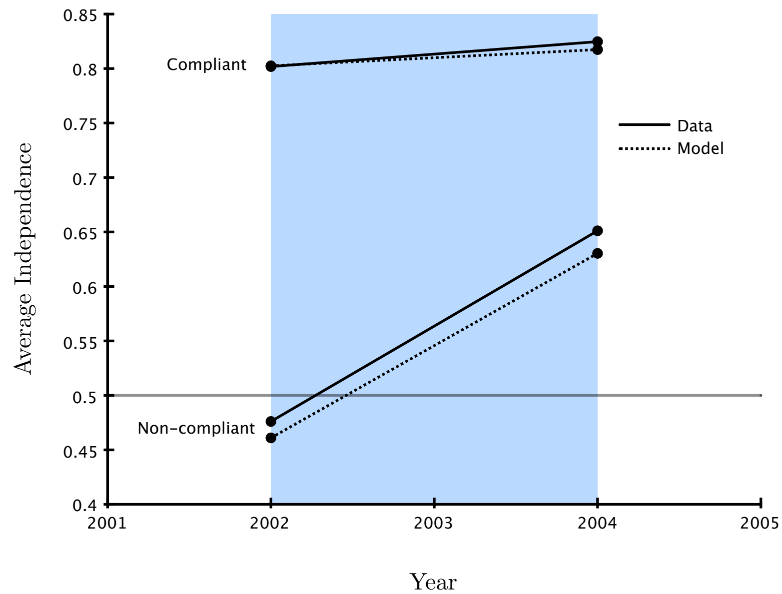


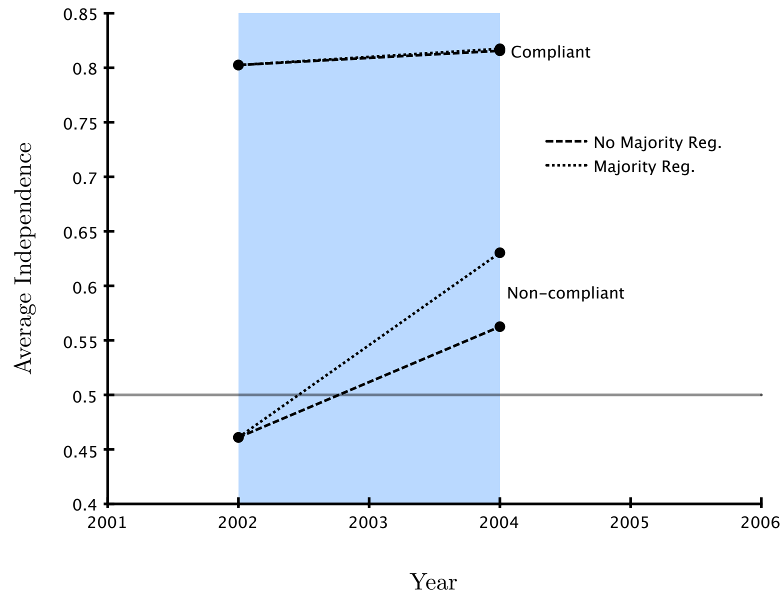
Figure 3.7: Average independence of compliant and non-compliant firms in model and data.



compliant and non-compliant firms. For non-compliant firms, the model predicts average independence of 0.461 before regulation and 0.630 after regulation, compared to 0.476 and 0.651 in the data. For compliant firms, the model predicts average independence of 0.803 before regulation and 0.817 after regulation, compared to 0.802 and 0.825 in the data.

As mentioned earlier, there is a marked acceleration in independence at the time of policy – especially among non-compliant firms. As a counterfactual experiment, I investigate what happens to average independence with no majority outsider regulation. Figure 3.8 plots the average independence of simulated compliant and non-compliant firms with majority outsider regulation and without the majority regulation. Even without majority outsider regulation, the average independence of previously non-compliant firms rises above the 50% mark to 0.563, compared to 0.630 with regulation. Therefore, the model predicts that 60% of the movement in average independence among

Figure 3.8: Average independence of simulated firms both with and without majority outsider regulation.



non-compliant firms would have occurred even in the absence of the majority outsider regulation. Of the simulated non-compliant firms, 59% moved into compliance in the absence of majority regulation. Among compliant firms, the model predicts nearly the same path whether or not majority policy is in effect. This is expected, as the already compliant firms do not face a constrained decision in the post regulation board decision.

These results suggest that a significant part of the observed shift in board composition from 2002 to 2004 was due to factors other than the majority outsider regulation. This is further supported by the continued increase in board independence after 2004. If non-compliant firms only increased independence to satisfy the majority outsider requirement, we would see a grouping of the boards just above the compliance requirement. Dynamic considerations also provide alternative explanations for why non-compliant firms would increase independence more than necessary. Before 2002, insiders sitting on non-compliant boards had a lot of decision making power in the selection of new directors. As in Chapter 1, the insiders enjoy the power of majority and keep the board in insider control. After the new regulations however, the board necessarily moves into outsider majority. Even if the insiders would like the board to stay just on the edge of compliance, outside directors now have more power in the selection of new directors and will bring more outsiders onto the board.

3.6 Conclusion

By estimating a model of the board, I am able to run counterfactual experiments and increase our understanding of how corporate boards responded to the many regulatory changes in the early 2000s. As with previous studies of boards' responses to regulation, I observe firms that are not compliant with the majority outsider regulation increasing independence at a faster rate than already compliant firms. I find that in a static setting, a large part of this movement would have occurred even in the absence of the majority outsider policy. Other contemporaneous regulations such as the requirement of a nominating and audit committee composed of outside directors, general trends in corporate governance, and dynamic considerations from the first chapter are enough to lift nearly 60% of non-compliant firms above the 50% independence requirement.

Still, there is room to extend the model presented here into a much richer picture of the board. The assumption of identical firms is not ideal, but serves as a first cut at estimating a model of the board. In planned work, I incorporate firm attributes such as firm size, firm complexity, director remuneration, and committee composition. Lehn et al. (2004), Linck et al. (2004), and Boone et al. (2007) analyze how board composition depends on these and other firm characteristics. Additionally, as specified, movement by non-compliant firms caused by the restricted choice set (regulation) may affect the estimate of τ. With the addition of firm characteristics, a better estimate of τ could be obtained without using data from non-compliant firms.

Bibliography

Acemoglu, D., G. Egorov, and K. Sonin (2008). Dynamics and Stability of Constitutions, Coalitions, and Clubs. *Working Paper*.

Adams, R. and D. Ferreira (2007). A Theory of Friendly Boards. *Journal of Finance 62*(1), 217–250.

Barberà, S., M. Maschler, and J. Shalev (2001). Voting for Voters: A Model of Electoral Evolution. *Games and Economic Behavior 37*, 40–78.

Bebchuk, L., J. C. IV, and G. Subramanian (2002). The Powerful Antitakeover Force of Staggered Boards: Theory, Evidence and Policy. *NBER* (8974).

Boone, A., L. C. Field, J. Karpoff, and C. Raheja (2007). The determinants of corporate board size and composition: An empirical analysis. *Journal of Financial Economics 85*(1), 66–101.

Bryan, S., L. Hwang, A. Klein, and S. Lilien (2000). Compensation of Outside Directors: An Empirical Analysis of Economic Determinants. *Working Paper*.

Chhaochharia, V. and Y. Grinstein (2009). CEO Compensation and Board Structure. *Journal of Finance LXIV*(1), 231–261.

Doraszelski, U. and S. Markovich (2007). Advertising dynamics and competitive advantage. *The Rand Journal of Economics 38*(3), 557–592.

Ericson, R. and A. Pakes (1995). Markov-Perfect Industry Dynamics: A Framework for Empirical Work. *Review of Economic Studies 62*, 53–82.

Fischer, P., J. Gramlich, and B. Miller (2008). Uncontested Director Election Results and Board Performance. *Working Paper*.

Harris, M. and A. Raviv (2008). A Theory of Board Control and Size. *Review of Financial Studies 21*(4), 1797–1832.

Hermalin, B. and M. Weisbach (1998). Endogenously Chosen Boards of Directors and Their Monitoring of the CEO. *American Economic Review 88*(1), 96–118.

Hermalin, B. and M. Weisbach (2003). Boards of Directors As an Endogenously Determined Institution: A Survey of the Economic Literature, Economic Policy Review. *Federal Reserve Bank of New York 9*, 7–26.

Jr, W. S. (2007). The Case Against Mandatory Annual Director Elections and Shareholders' Meetings. *Tennessee Law Review 74*(2), 199–199.

Judd, K. (1997, Jun). Computational economics and economic theory: Substitutes or complements? *Journal of Economic Dynamics and Control 21*(6), 907–942.

Kieschnick, R. and R. Moussawi (2004). The Board of Directors: A Bargaining Perspective. *Working Paper*.

Lehn, K., S. Patro, and M. Zhao (2004). Determinants of the Size and Structure of Corporate Boards: 1935-2000. *Working Paper*.

Linck, J., J. Netter, and T. Yang (2007). The Determinants of Board Structure. *Journal of Financial Economics Forthcoming*.

Linck, J., J. Netter, and T. Yang (2008). The Effects and Unintended Consequences of the Sarbanes-Oxley Act on the Supply and Demand for Directors. *Review of Financial Studies Forthcoming*.

Nasdaq (2007). Nasdaq Listed Company Manual. *Nasdaq Listed Company Manual*.

NYSE (2004). 303A.02 Independence Tests. *NYSE Listed Company Manual*.

Raheja, C. (2005). Determinants of board size and composition: A theory of corporate boards. *Journal of Financial and Quantitative Analysis 40*(2), 283–306.

Roberts, K. (1999, Jan). Dynamic Voting in Clubs. *Mimeo*.

Rodrigues, U. (2007). The Fetishization of Independence. *SSRN*.

Securities and E. Comission (2008). SEC Release 34-56914.

Train, K. E. (2003). Discrete Choice Methods with Simulation. *Cambridge University Press*.

Weber, J. (2005). The Merc's Bad Example. *Business Week*.