Board Monitoring and Firm Risk

Ivan E. Brick and N. K. Chidambaran
Rutgers University

Working Paper Series WCRFS: 06-05
Board Monitoring and Firm Risk*

Ivan E. Brick
Rutgers Business School - Newark & New Brunswick
Rutgers University
Newark, NJ 07102
(973) 353-5155
ibrick@andromeda.rutgers.edu

N. K. Chidambaran
Rutgers Business School - Newark & New Brunswick
Rutgers University
Piscataway, NJ 08854
(732) 445-4446
chiddi@rci.rutgers.edu

JEL Classification Code: G34

First Version: June 2004
Current Version: July 2005
Comments Welcome

*We thank Matthew Clayton, Shari Gifford, Kose John, Simi Kedia, Michael Long, Darius Palia, Oded Palmon, Charu Raheja, S. Abraham Ravid, seminar participants at University of Massachusetts, Amherst, Rutgers University and Villanova University, and conference participants at the 12th Annual PBFEA Conference and the Center for Corporate Reporting and Governance conference, for their comments. This research was supported in part by the Whitcomb Center for Research in Financial Services, Rutgers University and by a Faculty Research Grant from the Rutgers Business School - Newark and New Brunswick.
Board Monitoring and Firm Risk

Abstract

An extensive finance literature has suggested that independent (outside) directors monitor firm management and thereby increase firm value. Monitoring by a firm’s independent directors is, however, costly and the level of board monitoring should be endogenously determined as a function of firm characteristics. We show that a negative relationship between board monitoring and uncertainty is a direct implication of principal-agent models and arises because monitoring is less efficient in uncertain environments. Our model also shows that there is a positive relationship between the level of board monitoring and the output of the firm. We empirically examine the relationship between board monitoring and firm risk using a broad sample of firms over a five year period from 1997 to 2000. We find that board independence and monitoring is negatively related to firm risk and is positively related to output level. We also find a strong time trend with the level of board monitoring increasing over the sample period from 1997 to 2001. Firms, therefore, have responded to shareholder demands for increased board oversight even before the formal requirements imposed by the Sarbanes-Oxley act of 2002. In our empirical analysis we control for the CEO’s bargaining power and the level of shareholder rights. We find that firms in which the CEO has longer tenure and greater equity ownership, have less board monitoring activity. We also find that board monitoring and shareholder rights are substitutes and there is a negative relationship between the level of board monitoring and shareholder rights. Overall, our theoretical and empirical results support the notion that the board of directors and its composition is endogenously determined as a function of firm characteristics.
1 Introduction

An extensive finance literature argues that independent (outside) directors of the firm play an important role in monitoring management. Cotter, Shivdasani, and Zenner (1997), McWilliams and Sen (1997), and Shivdasani (1993), show that independent outside directors enhance target shareholder gains from tender offers. Uzun, Szewczyk, and Varma (2004) find that as the number of independent outside directors on a board increases, the incidence of corporate fraud decreases. On the public policy front, the Code of Best Practice issued by the Cadbury Committee recommends that boards of U.K. corporations include at least three outside directors as it would lead to improved board oversight. The independent monitoring role of outside directors also underlies the intended governance reforms of the Sarbanes-Oxley act of 2002 requiring more outside representation on the board. The implicit assumption in these public policy prescriptions is that firm value increases with the number and percentage of independent directors who monitor firm management.

Demsetz and Lehn (1985) and Smith and Watts (1992), however, argue that optimal level of monitoring and board composition are endogenously determined to maximize firm value. Theoretically, the optimal level of monitoring is determined by the tradeoff between the costs and benefits of monitoring. For example, Prendergast (2000) argues that monitoring is less desirable in uncertain environments because of information costs. The implications of a negative relationship between board monitoring and firm risk also arises in a theoretical principal-agent framework. Using a principal-agent model with limited liability, we show that the level of board monitoring is endogenously determined and the level of board monitoring and firm risk are negatively related. The inverse relationship arises because of a tradeoff between salary/control benefits and incentive features in determining the optimal compensation contract. In risky environments, it is cheaper to reduce the level of board
monitoring and allow the manager to consume salary/control benefits\(^1\) in order to reach the reservation wage.

We empirically test our hypothesis by examining board characteristics of a broad panel of firms in the five year period from 1997 to 2001. We excluded data for fiscal year 2002 and beyond, as board monitoring is directly affected by the provisions of the Sarbanes-Oxley act of 2002. We use three proxies for the level of board activity and monitoring based on the number and activity of the independent directors. Our proxies are – the number of independent (outside) directors, the percent of independent directors on the board, and the product of number of independent directors and the number of board meetings. We also develop an alternate set of board committees based monitoring proxies using data on the number of independent directors and meeting frequency of the audit, compensation, and nominating committees, for a subset our sample period, viz. for fiscal year 1999.

We use stock volatility as our primary proxy for firm risk. We find that all three of our board monitoring proxies are significantly negatively related to firm risk. The negative relationship continues to hold for monitoring by board committees. As a robustness check, we use the standard deviation of the residual from Fama-French three factor model regressions as an alternate measures of firm risk. The negative relationship between board monitoring and firm risk holds for this alternate measure of risk as well. We also find that the level of board monitoring is positively related to the level of firm output as predicted by our model. In our regressions we use the firm’s market capitalization as a proxy for the level of the firm’s

\(^1\)Salary and control benefits are clearly not perfect substitutes. On the one hand, the manager derives higher utility from salary as compared to control benefits, because salary can be used by the manager to purchase consumption goods and services not available with control benefits. On the other hand, since salary is personally taxable to the manager while control benefits are not, salary imposes additional costs on the manager. The optimum mix of salary and control benefits are beyond the scope of this paper.
output and show that the relationship between market capitalization and board monitoring is positive.

We control for other factors that can affect board characteristics in our empirical analysis. The level of board monitoring can be impacted by other governance features, such as the level of stockholder rights and the level of bargaining power of the CEO (see Hermelin and Weisbach 1998 and Kieschnick and Moussawi 2004). It is therefore important to control for the relationship between board monitoring and stockholder rights and the bargaining power of the CEO. We use percentage managerial ownership and tenure of the manager to measure the bargaining power of the CEO and the Gompers-Ishii-Metric G−Index to measure the level of stockholder rights in the firm; and year dummy-variables to capture potential time trends in corporate governance. In addition to the negative relationship between board monitoring and firm risk, we find that all three of our board monitoring proxies are significantly negatively related to the bargaining power of the CEO, and the level of stockholder rights. Taken together, our results indicate that there is an optimal level of board monitoring, as proposed by Demsetz and Lehn (1985), Hermelin and Weisbach (2000), and John and Senbet (1998).

Corporate governance has received increasing attention by the business press and community beginning in the late 1990s, with a high emphasis placed on board monitoring and board independence. To capture potential time trends we include year dummy variables in our regressions. We find that the coefficient on the year dummy variables are significantly higher for the latter years in our sample implying that board monitoring has significantly increased in our sample period. Our evidence is consistent with the notion that the increasing attention and focus on corporate governance has led companies to increase board independence and board monitoring in 2000 and 2001. We note that these changes were instituted even prior to the formal regulatory changes of the 2002 Sarbanes-Oxley act.
In our empirical analysis we correct for potential endogeneity problems. Specifically, we control for the effect of board monitoring on proxies of firm performance, e.g. TOBIN’s Q, which can arise for several reasons. First, the bargaining power of the manager is positively related to how well the company is doing. Second, board monitoring activity is negatively related to ex-post firm performance as shown by Adams (2000). Third, board monitoring may itself serve to change firm value. Indeed, Gertner and Kaplan (1996) and Yermack (1996) find that the size of the board impacts negatively on TOBIN’s Q. We use two approaches to correct our empirical specifications for the potential endogeneity problem arising from these effects. First, we use lagged Q and Return on Assets (ROA) as alternative measures of firm performance. Second, we implement a two-stage least squares methodology. Our results hold in these alternate specifications and, therefore, do not appear to be biased by potential endogeneity problems.

Our paper contributes to the literature by studying the ex-ante choices shareholders make in determining the level of board monitoring activity in contrast to previous literature that has emphasized the board’s role in disciplining the CEO after periods of poor performance. Warther (1998) models board actions assuming that unsuccessful attempts by directors to challenge the management’s direction leads to their dismissal. His model predicts that boards will become active in monitoring and questioning management only when it is apparent to the majority of investors and board members that management must be replaced. Mace (1986) also argues that boards fail to monitor as, in general, board of directors are reluctant to dissent. Hermalin and Weisbach (1998) present a model that also focuses on the CEO replacement decision and using a game theoretic model show that board size and composition are based upon the bargaining power between the CEO and the board. Our paper, on the hand, shows that expected economic benefits of board monitoring has an impact upon board composition and the level of board monitoring activities. We demonstrate that other factors,
in addition to expected firm performance, determine both board composition and the level of board monitoring.

Our paper also contributes to the literature by conducting a broad cross-sectional analysis on a large sample – our sample consists of 2841 firm-years over a five year period from 1997-2001. Recent empirical literature has primarily focused on the evolution of the board over the life of the firm. Lehn, Patro and Zhao (2003) examine a limited sample of 81 firms that have survived for the entire period of 1935-2000. They find that board size and composition are closely related to firm size and the firm’s growth opportunity. Boone, Field, Karpoff and Raheja (2005) examine the evolution of the board over ten years from the date on which the firm went public. In contrast to these studies, our emphasis is on the cross-sectional variation in the monitoring role of the board and offers insights on the impact of firm characteristics and governance structure on the level of board monitoring. Our research design allows us to examine the determinants of board characteristics across evolving, maturing, and declining firms. We are also able to show that the level of board monitoring and independence has a secular time trend, independent of the evolutionary history of any particular firm. We find that the level of board monitoring increases in 2000 and 2001, perhaps in response to shareholder demands for improved board oversight.

In the next section we present the principal-agent model we use and develop its implications. Section 3 presents our empirical analysis, the data, and the methodology used to test our hypothesis. Section 4 concludes.

2 Model

Shareholders elect a board of directors in practice to act as their agents, to monitor managerial activity, and set managerial compensation. We use a principal-agent framework to
model the role of the board of directors, assuming that there exists no moral hazard between shareholders and the board of directors. As in Hermalin and Weisbach (1998) the objective of the board of directors is to maximize firm value. The board of directors, therefore, maximize the same objective function as the shareholders and serve as the principal in our framework.\(^2\) The board chooses the level of monitoring and a managerial compensation contract that is equivalent to a profit-sharing rule that induces the optimal effort given the managers incentives and disutility for effort. These two roles of the board reflect discussions in the literature (see for example Fama and Jensen 1983, Jensen 1993, and Adams and Ferreira 2003) regarding the activities of the board of directors of a firm.

### 2.1 Framework

Our model framework parallels the model of Holmstrom and Milgrom (1987). We model a firm that generates a random output over one period. Firm output is given by \(x + \epsilon\), where \(x\) is the mean and \(\epsilon\) is distributed uniformly between \((-\theta, \theta)\). Output is augmented by the efforts of the manager. The manager’s choice of effort will be a function of incentive features in his compensation contract as discussed below. The firm’s total output, is given by the following equation:

\[
\bar{\Pi}(a) = x + a + \epsilon \cdots \epsilon \sim U(-\theta, \theta)
\]  

The level of effort chosen by the manager is denoted by \(a\), which is non-negative. As in Holmstrom and Milgrom (1987), we assume that each unit of managerial effort creates one unit of output (i.e. the effect of effort on output is linear and, in particular, non-diminishing).

\(^2\)An interesting extension of the paper would be to consider the agency conflicts between board members and shareholders driven by, for example, the potential free rider problems in a setting where there are multiple monitors.
In a departure from the Holmstrom and Milgrom (1987) framework, we model the firm as being subject to default risk with shareholders having limited liability. Further, we assume that both the principal and the agent are risk neutral. In traditional principal-agent models, default risk is not formally modeled and the impact of risk is reflected in the risk averse utility function of the manager. In our model, default and limited liability act in conjunction as a substitute mechanism to risk aversion as in Innes (1990). Moreover, unlike the traditional principal-agent models, wherein only the agent is impacted by risk through his risk aversion, our framework allows for risk to impact both the agent and the principal’s objective functions. This allows us to capture the option like feature of incentive compensation and equity, which impacts on firm value to principal shareholders.

Given that the principal and the manager have limited liability, the distributed output must be non-negative. Consequently, the firm is insolvent when stochastic output given by Equation (1) is less than 0, or equivalently when $\epsilon < -(x + a)$. The expected output of the firm, denoted as $E[\Pi(a, m)]$, is given by,

\[
E[\Pi(a)] = \int_{-(x+a)}^{\theta} (x + a + \epsilon) \, df(\epsilon) = \frac{1}{4\theta} (x + a + \theta)^2 \quad (2)
\]

### 2.2 Agent’s Problem

The role of the board of directors is to monitor the manager’s consumption of control benefits and determine the terms of the incentive compensation contract. We assume that there exists no moral hazard between shareholders and that the objective of the board of directors is to maximize firm value (see Hermalin and Weisbach 1998).

The principal awards the manager $\alpha$ fraction of the output in solvent states as compensation for his efforts. In addition the manager receives salary/control benefits, which
we assume that the manager consumes regardless of the solvency status of the firm. These
terms of the managerial compensation mirrors that of Holmstrom and Milgrom (1987). The
manager chooses his level of effort to maximize his expected utility given the profit-sharing
rule and the level of monitoring chosen by the board. We assume that the utility function of
the manager is linear in expected output and control benefits, consistent with our assump-
tion that the managers is risk neutral with respect to wealth. The utility function is concave
in effort \(a\), to account for the disutility of effort. Specifically, the utility function we use is:

\[
E[U(a)] = \int_{-(x+a)}^{\theta} \alpha \Pi(a, m) \ df(\epsilon) + (B - km) - a^2
\]

The second component, \((B - km)\), is the salary and non monetary control benefits, which we
assume the manager consumes regardless of the solvency status of the firm. The maximum
level of salary/control benefits that the manager can consume is \(B\). Monitoring by the board
reduces the manager’s control benefits by a factor \(k \cdot m\), where \(m\) is the amount of resources
devoted to monitoring and \(k\) is the efficiency of the monitoring process, which we assume is
exogenous and constant.

Given \(\alpha\) and \(m\), the manager will choose effort level \(a\) to maximize his utility. Taking
the partial derivative of \(E[U]\) with respect to \(a\), we find that the optimal effort level \(a^*\) is
given by,

\[
a^* = \frac{\alpha(x + \theta)}{4\theta - \alpha}
\]

Sufficient conditions for \(a^*\) and \(E[U(a^*)]\) to be positive are \((4\theta - \alpha) > 0\).
2.3 The Principal’s Problem

As in Holmstrom and Milgrom (1987), shareholders receive \((1 - \alpha)\) fraction of expected output, \(E[\Pi(m)]\), bear the cost of salary/control benefits consumed by the manager. We augment their model by incorporating a monitoring role for the board that reduces the level of salary/control benefits consumed by the manager. The level of board monitoring is denoted by \(m\) and each unit of monitoring has a constant cost \(c\). The board optimally chooses the sharing rule and the level monitoring to maximize the principal’s value, given the optimal response function of the manager.

The principal’s problem is,

\[
\text{Max } Z(\alpha, m) = (1 - \alpha) E[\Pi(m)] - (B - km) - cm
\]

s.t. \(E[U(a)] \geq \bar{U}\)

and can be rewritten as,

\[
\text{Max } L(\alpha, m) = (1 - \alpha) E[\Pi(m)] - (B - km) - cm - \lambda(E[U(a)] - \bar{U})
\]  

where, \(\alpha\) is the manager’s share of firm output, \((B - km)\) is the amount of salary and control benefits consumed by the manager, and \(cm\) is the cost for each unit of board monitoring \(m\).

Solving the first order conditions of the principal’s problem at \(a = a^*\), we find that,

\[
\lambda^* = -\frac{(4\theta + \alpha - 2)}{(4\theta - \alpha)}
\]  

\[
\alpha^* = \frac{(2k - 4c\theta)}{(2k - c)}
\]  

\[
m^* = \frac{\bar{U}}{k} - \frac{B}{k} - \frac{(\alpha x^2 + \alpha\theta^2 + 2\alpha x\theta)}{(\alpha - 4\theta)k}
\]
We begin by analyzing the impact of risk, as measured by $\theta$, for a given level of the manager’s reservation utility, on the key decision variables. Equation 8 demonstrates that $\alpha$, the sharing rule, is inversely related to risk. This result is consistent with the implications of standard agency problems such as Holmstrom (1978) and Holmstrom and Milgrom (1987).  

We also find, from Equation 9, that the optimal level of board monitoring is inversely related to risk. A sufficient condition for the inverse relationship is that $k < c(3\theta + x)$. The economic intuition of this result is as follows. As risk increases, it is optimal to shift the compensation risk from the manager to the principal in order to maintain a constant reservation utility. The manager must, therefore, be allowed to increase consumption of control benefits to meet the reservation wage and the level of board monitoring will decline as risk increases. The implication of the principal agent setting of Holmstrom and Milgrom (1987) for board monitoring are thus consistent with the implications of Prendergast (2000).

---

3There has been extensive empirical evidence in the literature on the relationship between pay-performance sensitivity and firm risk, consequently, we do not include empirical tests for this relationship. Note that the reported results of the relationship between pay-performance sensitivity and firm risk are mixed. On the one hand, Aggarwal and Samwick (1999), Garen (1994), Cichello (2004) find that the optimal risk sharing rule between a risk-neutral principal and a risk-averse manager is to provide less equity based incentives as firm risk increases. On the other hand, Core and Guay (2002) and Coles, Daniel, and Naveen (2005) show that firm risk is significantly positively associated with pay-performance sensitivity and Tufano (1996) shows that managers with more option based compensation are less likely to hedge risk.

4Taking the derivative of $m^*$ with respect to $\theta$ yields,

$$\frac{\partial m^*}{\partial \theta} = \frac{-k(\alpha - 4\theta)(x + \theta)(\frac{2\theta}{\alpha} + 2\alpha)}{(\alpha - 4\theta)^2k^2} + \frac{k\alpha(\frac{2\theta}{\alpha} - 4)(x + \theta)^2}{(4\theta - \alpha)^2k^2}$$

The second term is always negative and the first term is negative if $k < c(3\theta + x)$. Note that this condition is a weak constraint and simulations indicate that the inverse relationship holds even for parameter values that violate the sufficient condition.
that monitoring is less desirable in increasing uncertain environments. A major empirical objective of our paper is to test the hypothesis that there is a negative relationship between risk and board monitoring.

Finally, we also find from Equation 9 that the level of monitoring is positively related to the level of output $x$. The economic intuition of this result is as follows. As output and thereby firm profit increases, the amount of compensation that the manager receives for a given $\alpha$ increases. Holding the reservation wage, $\bar{U}$, fixed, it is optimal to reduce the level of control benefits consumed by the manager. The empirical implication of this result is as follows. Assuming that the firm’s output and size are positively correlated, we should find that the level of monitoring is positively related to firm size.

3 Empirical Analysis

In this section, we empirically examine the relationship between board monitoring and firm characteristics. Demsetz and Lehn (1985), Smith and Watts (1992), and Prendergast (2000) argue that optimal level of monitoring and incentive compensation are endogenously determined and that monitoring is less desirable in uncertain environments. We have shown in the previous section that a similar result obtains in standard principal agent framework such as Holmstrom and Milgrom (1987). In addition we find that board monitoring is positively related to firm output.

Our first hypothesis, therefore, is that board monitoring is negatively related to firm risk and our second hypothesis is that board monitoring is positively related to firm output. In our empirical design, we control for the level of shareholder rights, bargaining power of the CEO, and other firm characteristics that should impact on the optimal level of board
monitoring. We also include year dummies to capture secular time trends that might be occurring.

### 3.1 Data and Methodology

We begin by describing the dependent and independent variables for our regressions and the data for our empirical tests.

We obtain data on board size and composition from IRRC and The Corporate Library for the five years from 1997 to 2001. We obtain compensation data from EXECUCOMP and firm accounting data from COMPUSTAT. From these sources, we are able to obtain a complete set of data for 2841 firms (494 in year 1997, 565 in year 1998, 564 in year 1999, 565 in year 2000, and 653 in year 2001). We do not add data for sample years 2002 and beyond in order to keep the data sample free from any effects that arise from the Sarbanes-Oxley Act (1992). Table 1 shows the mean (median) sample values and distributional characteristics of the variables that we use in our regressions and empirical analysis.

We use three proxies for the level of board monitoring. Shareholders determine the composition of the board on an annual basis in anticipation of the board’s optimal monitoring activity levels and is a function of the shareholders’ expectation of future cash flows and future cash flow risk. We posit that the level of monitoring is positively related to the number of independent directors on the board (see Dennis and Sarin 1999, Shivdasani 1993). Consequently, we use the number of independent directors (BDIND) and the percent of independent directors (PctBDIND) as proxies for the level of board monitoring. Our third proxy for board monitoring seeks to measure the intensity of the boards monitoring activity. It is possible that boards of similar composition spend variable amounts of time in monitoring management across different firm types. One might use the number of board meetings per
year as a measure of the expected time and effort that board members take to monitor the firm. However, this variable will not properly measure the total man hours devoted by board members to monitor management as board size varies across firms. Consequently, our third measure for monitoring activities of the board (MONITOR) is determined by multiplying the number of independent directors (BDIND) with the number of times the board meets in the year, which captures the intensity with which the board monitors the firm. We note, however, that the number of board meetings is not determined by shareholders but is instead determined by the board members themselves and is also a function of unanticipated firm specific events such as poorer than expected performance, new merger activity, and other legal events. We also use size and structure of board committee variables as alternate board monitoring proxies for fiscal year 1999. We discuss these variables in more detail in Section 3.4 where we discuss our robustness checks.

The mean (median) board size is 9.58 (9). The mean (median) number of independent directors is 6.72 (7) and the percentage of independent directors is 69.55% (72.7%). The number of board meetings reported by EXECUCOMP is the number when the board as a whole met and does not include meetings of committees (e.g. audit, compensation, nomination). The mean (median) number of meetings is 7.17(7). No firm had less than one meeting per year and the maximum number of times the board is 27. The mean (median) of MONITOR, which is equal to the number of independent directors multiplied by the number of board meetings, is 49.19 (42).

We use the volatility of stock returns reported by EXECUCOMP, denoted as VOL, as our measure of firm risk. The mean (median) VOL is 38.9% (35.7%). As shown in the previous section, we expect board monitoring to be inversely related to firm risk. We also use another proxy for firm risk as discussed in Section 3.4.
The other independent variables are as follows. To proxy for firm size we use the logarithm of the firm’s equity capitalization (in billions) at the end of the firm’s prior fiscal year denoted as LEQUITY. Larger firms have greater output and it is optimal for shareholders to reduce the level of control benefits as predicted by our model. Further, larger firms are more complex and, therefore, may require more monitoring (Crutchley, Garner, Marshall 2005, Lehn, Patro, and Zhao 2003 and Smith and Watts 1992). The mean (median) equity capitalization in our sample is $8.55 billion ($1.87 billion). In contrast to Lehn et al (2004) and Boone et al (2004) that focus on the evolution of the board over the life of the firm, our study has a broad sample of firms that includes firms both large (with a maximum equity value $508.33 billion) and small firms (with a minimum equity value $15.6 million). The sample of firms in Lehn et al (2004) is dominated by very large firms that have survived for the entire sample period 1935 to 2000. In their sample the mean (median) equity capitalization is $32.07 billion ($6.87 billion). On the other hand, the sample of firms in Boone et al (2004) is dominated by small IPO firms. The mean (median) equity capitalization in their sample is $150.2 million ($76.4 million).

Our next independent variable is LEVERAGE, defined as the firm’s long-term debt divided by total assets. Since leverage can give rise to agency problems (see Jensen and Meckling 1976) that require additional monitoring, the coefficient on LEVERAGE can be positive. On the other hand, monitoring by debtholders or the elimination of free cashflow could substitute for board monitoring, which would imply a negative coefficient. The mean (median) LEVERAGE is 24.88% (25.00%).

We distinguish between firm performance, which is a flow variable (i.e. profit per dollar of assets), and firm output, which is a stock variable as discussed above. Both firm performance and firm output may have independent impact on the level of monitoring. We would expect that there should be an inverse relationship between the level of board monitoring and firm performance since firms with superior performance need less monitoring (see Adams 2000).
We use TOBIN’s Q as the performance control variable. We calculate Q as the ratio of the total market value of the firm (defined as the market value of the equity plus the book value of total debt) to the book value of the firm’s total assets. Some papers have used Q as a measure of firm performance (see for example Himmelberg, Hubbard, and Palia 1999, Palia 2001, McConnell and Servaes 1990, Morck, Shleifer, and Vishny 1988). In this interpretation, we would expect a negative relationship between the level of monitoring and Q since firms that do well need less monitoring (Adams 2003). In contrast, Q has also been interpreted as a measure of future growth opportunities implying potentially higher agency problems in the firm (Barclay and Smith 1995 and Titman and Wessels 1988). In this case, the coefficient on Q can be expected to be positive. One potential issue with using Q as a control variable is that the relationship between Q and the level of board monitoring may be endogenously determined (see Yermack 1996). To reduce the level of potential endogeneity we use 1-year lagged Q, denoted as LagQ, in our regressions. The mean (median) LagQ is 1.97 (1.33). An alternate approach to handle endogeneity is to use a structural econometric model and estimate via a 2-stage regression approach. We discuss the structural model we implement in a subsequent section of the paper.

We expect the level of board activity and monitoring to be a function of the level of activity in the firm. We therefore include R&D and Capital Expenditure, each scaled by Total Assets, as control variables. The mean (median) R&D (as a percentage of assets) is 3.1% (0%). The mean (median) Capital Expenditure as a percentage of total assets, denoted as CAPEX, is 6.4% (5.1%).

We control for industry effects by classifying firms into New Economy and Old Economy firms. As shown by Murphy (2003), corporate governance is systematically different between these two types of firms. We use a dummy variable NEW, that is set equal to 1 if the firm belongs to SIC codes (3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, 7373), and 0 otherwise. In our sample, 11.97% of are classified as NEW.
Alternatively, we include individual 2-digit SIC code industry dummies to capture industry effects. The results are not affected by the industry proxy we use and, therefore, we report results with the variable NEW.

We include a control variable to capture the age of the firm as board monitoring can vary with the firm’s age (See Boone, Field, Karpoff and Raheja 2005). On the one hand, older firms are larger and more complex and can require more monitoring. On the other hand, young rapidly growing firms may benefit the most from board monitoring. We calculate the number of integer years since the firm was first listed on CRSP and denote it as FIRMAGE. If FIRMAGE is equal to zero, we set FIRMAGE equal to 0.5 years. The mean (median) FIRMAGE is 20.19 years (20 years). We use the log of the firm’s age, denoted as LFIRMAGE, in our regressions as the firm’s complexity and requirement for monitoring stabilizes as the firm matures.

We also control for other factors, such as CEO entrenchment, shareholder rights, and incentive features in the management compensation, that can be important in determining the level of board monitoring. Firms with weaker shareholder rights can be expected to require more monitoring by the board of directors. The impact of the other variables are, however, ambiguous. For example, firms with entrenched CEOs may require more board monitoring. On the other hand entrenched managers may have greater bargaining rights (Hermalin and Weisbach 1998) leading to less board monitoring.

We control for entrenchment effects by including a dummy variable, denoted as TITLE, that is equal to one when the CEO is also Chair of the Board of Directors. 72.69% of 2841 firms have the CEO serving both roles. We also expect that long-serving CEOs to be more entrenched (Chidambaran and Prabhala 2003), consequently, we include as a control variable, the TENURE of the CEO, denoted as TENURE. The mean (median) TENURE is 6.75 years (4.11 years).
Our model predicts that the level of board monitoring will be related to the incentive alignment of the manager (see Equation 9).\textsuperscript{5} We measure the incentive alignment of the CEO by the percentage of non-cash compensation relative to the CEO’s total compensation. We obtain data on total CEO compensation and the non-cash compensation components from EXECUCOMP. We define NONCASH as the ratio of the value of option and restricted stock grants to the total compensation of the CEO. The mean (median) NONCASH is 60.61% (62.21% years). Additionally, we use the percentage share ownership of the CEO as an alternative measure of managerial alignment with shareholder interests. We denote the percentage of shares held by insiders and directors by MGROWN. The mean (median) MGROWN is 1.77% (0.26%).

Finally, we use the Gompers, Ishii, and Metric (2003) governance index, denoted as $G$–Index, to capture the level of shareholder rights. Firms with high index values have weaker stockholder rights. The mean (median) $G$–Index is 9.49 (9.0).

Our dependent variable BDIND and MONITOR, that proxy for board monitoring, are discrete. Hence, we depart from ordinary least squares regressions and use limited dependent variable models and we use a LOGIT regression assuming a Negative Binomial distribution. While PctBDIND is truncated at 0% and 100%, we do not have unusual clustering of the data at the extreme values – there are six 0%-observations and eight 100%-observations out of 2841 firm-year observations. We also verify that we obtain similar results when we use double-censored TOBIT or OLS regressions. Consequently we only report OLS results in the tables.

\textsuperscript{5}Note that the reverse relationship does not exist as shown in Equation 8, i.e. managerial incentive alignment does not depend on the level of board monitoring.
3.2 Univariate Regression Results

Table 2 presents the univariate regression results between our proxies for board monitoring and other independent variables. Each column in the table presents 13 separate univariate pooled regressions for the particular monitoring proxy dependent variable. To conserve space, the table reports only the coefficients on each of the independent variables, i.e. the intercept of each regression is not reported.

The results reported in Table 2 are generally consistent with the notion that the firms’ cross sectional characteristics determine the extent of board monitoring as discussed in Section 3.1. We find that the coefficients for VOL are significantly negative when we use either BDIND or MONITOR as our dependent variable. These results support our hypothesis that the degree of monitoring is negatively related to firm risk and is consistent with the predictions of the information cost model of Prendergast (2000) and the principal agent model presented in Section 2.3. We note, however, the coefficient on VOL is insignificant when PctBDIND is the dependent variable and we examine this in more detail below.

The significant positive coefficient on EQUITY is consistent with the prediction that monitoring increases as firm’s output level and firm complexity increases. The negative relationship between board monitoring and TOBIN Q is consistent with the argument that better performing firms need less monitoring. The coefficient on LEVERAGE is significantly positive, consistent with the notion that board monitoring increases with agency costs. We also find that monitoring is negatively related to the firm’s capital expenditure rate (CAPEX). Finally, we find that board monitoring increases with firm age as also shown by Boone et al (2005).

Table 2 also demonstrates that the firm’s other governance characteristics impact on board composition and monitoring. We find that all our board monitoring dependent vari-
ables are positively associated with the $G$–Index. Recall that shareholder rights are inversely related to $G$–Index. Each of our board monitoring variables is thus inversely related to stockholder rights implying that stronger the level of stockholder rights, less is the need for monitoring activity. Board monitoring is also inversely related to MGROWN and TENURE. This is consistent with an entrenchment hypothesis wherein managers with greater control and bargaining power reduce the level of board independence and monitoring. These results are also consistent with lower monitoring requirements when the managerial interests are better aligned with that of shareholders or that less monitoring is required when uncertainty regarding managerial ability decreases. We also find that the level of board monitoring is greater when the CEO is also the Chairman of the board, suggesting that board monitoring increases to counteract entrenchment of the CEO. Finally, the level of board monitoring is positively associated with NONCASH, suggesting that board monitoring and equity based compensation are complements.

The statistical significance of the coefficients on the remaining variables are not as strong. We find that board monitoring as proxied by BDIND and MONITOR is negatively related to R&D, and NEW, indicating that board monitoring may be less effective in uncertain environments (Prendergast 2000).

Table 3 presents a more detailed analysis of the univariate relationship between the proxies of board monitoring and firm volatility. The table is divided into two panels. Panel A summarizes the relationship for each year and Panel B presents the pooled regression with yearly dummies. As shown in Panel A the coefficients of VOL are significantly negative for each board monitoring proxy for each year. Our results thus support our hypothesis that the degree of monitoring is negatively related to firm risk. Note that the percentage of independent directors (PctBDIND) is negatively related to firm risk in each year even though the relationship loses significance in the pooled regression presented in Table 2. This suggests that using a constant intercept across time may not be appropriate. In fact, we find
that the average PctBDIND and BDIND for our sample increases through time while board size more or less remains constant as shown in Fig. 1. In particular, the mean of PctBDIND in 1997 is 62.5% and increases to 82.01% in 2001. Hence, we include time dummy variables to capture any time trends and the results are presented in Panel B of Table 3. We find that the coefficients on VOL are negative and significant for all three proxies of board monitoring. In addition the time dummy coefficients increase, capturing the secular trend of increased monitoring over our sample period.

The increasing estimated coefficients of our time dummy variables is consistent with the notion that the increasing attention and focus on corporate governance has led companies to increase board independence and board monitoring in 2000 and 2001. We note that these changes were instituted even prior to the formal regulatory changes of the 2002 Sarbanes-Oxley act.

3.3 Multivariate Regression Results

We next turn to our multivariate specifications. We run separate regressions for each of our three proxies for board monitoring using the independent variables discussed in Section 3.1 and the time dummy variables.

We use TOBIN’s Q as a control variable in our empirical analysis. It is to be noted that there is a potential endogenous relationship between board monitoring and Q. Board monitoring can affect firm performance and, thereby, TOBIN’s Q. To reduce the level of potential endogeneity we use 1-year lagged Q, denoted as LagQ, as the performance measure in our reported results.\textsuperscript{6} We also use a structural econometric model and estimate the model

\textsuperscript{6}We checked if our results vary if we use a contemporaneous measure of firm performance. Our results do not change if we use contemporaneous Q or contemporaneous ROA as the measure of firm performance.
via a 2-stage regression approach. Our methodology is as follows. In the first stage regression, we regress $Q$ on the board monitoring proxy, an instrumental variable, and all other control variables. The instrumental variable that we use is 1-year lagged $Q$ ($LaqQ$). We use the predicted values of $Q$ ($QHAT$) in the subsequent regression of the board monitoring proxy on the control variables. As before, we implement an OLS model in the second stage regression when the independent variable is the percent of independent directors ($PctBDIND$) and a LOGIT model assuming a binomial distribution, when the independent variable is the number of independent directors ($BDIND$) or when the independent variable is the product of the number of independent directors and the number of board meetings ($MONITOR$).

Table 4 reports the regression results. Panel A reports results for BDIND, PctBDIND, and MONITOR, regressions when we use LagQ as the proxy for firm performance. Panel B reports the 2nd stage regression results for BDIND, PctBDIND, and MONITOR, when we use the two stage structural model.

The results in Table 4 show that the coefficient on VOL is negative and significant in all our regressions. Thus, our finding that board monitoring is negatively related to firm risk hold in the multivariate specification as well. The time dummy variables pick up the secular time trend in the board monitoring. The coefficient on the 1999, 2000, and 2001 dummy variables are increasingly positive and significant, suggesting that board monitoring has increased in the latter years. In addition, all three monitoring proxies are significantly positively related to EQUITY, i.e. the number and percentage of independent directors are significantly positively related to firm size and output, as measured by market capitalization, and so is the intensity with which the board monitors the managers. Thus, the positive association, as predicted by our model, between firm output and monitoring continues to hold in the multivariate specification.
BDIND, PctBDIND, and MONITOR are all significantly negatively related to LagQ and QHAT. This result suggests that board monitoring increases when firms perform poorly. In the first stage of the structural regressions model (not reported in the tables), we find that board monitoring negatively impacts on Tobin’s’ Q consistent with Gertner and Kaplan (1996) and Yermack (1996).

The significance of LEVERAGE in determining the level of board monitoring is mixed. The coefficient on LEVERAGE is negative and significant in the regressions where MONITOR is the dependent variable. The coefficient on LEVERAGE is also positive and significant for the regression with BDIND as the dependent variable. The coefficients on R&D is positive and significant in the two stage structural model and is also positive and significant in the single stage model when PctBDIND is the independent variable. The remaining firm characteristic variables capital expenditure, industry classification, and firm age do not exhibit consistent significant patterns.

Governance characteristics, G−Index, TITLE, TENURE, and MGROWN, are significant determinants of the level of board monitoring. In particular firms with weaker stockholder rights as measured by the G-Index have a great number of independent directors on their board. This result is consistent with the notion that greater board monitoring is optimal in firms with weaker stockholder rights. Additionally, the larger the managerial share ownership, the smaller is the number of independent directors. This result indicates that as managers have a greater percentage ownership of the firm, their interest are more aligned with shareholders and require less board monitoring. Alternatively, managers with a greater control over their firm are able to bargain for a less independent board and board monitoring (Boone et al 2004, Raheja 2005, and Warther 1998). We find that the percentage of non-cash compensation structure is not related to the amount of board monitoring. Lastly, there is a negative relationship between the number of independent directors and CEO tenure. Longer serving CEOs therefore may have greater bargaining power to reduce board moni-
toring or there is less uncertainty about CEO ability and behavior which requires less board monitoring.

We run all our regressions for a subsample of firms that are older than 10 years. The empirical results remain essentially unchanged to those reported in Tables 2-4 and we do not report these separately. We conclude that our results are not driven by the presence of younger firms in our sample.

In summary, our empirical results support the notion that the level of board monitoring activity is endogenously determined as proposed by Demsetz and Lehn (1985) and Hermalin and Weisbach (1998). In particular, our results strongly support our primary hypothesis that firm risk is an important determinant of board monitoring. Board monitoring also increases as firm output increases. Our results thus lend support to the empirical implications of our principal-agent model.

Finally, our results also indicate that board monitoring is affected by other governance characteristics and by market events. We find support for the argument that board monitoring is greater when shareholder rights are weaker, when the manager is entrenched. We also find support for the argument that board monitoring is greater when the level of asymmetric information between the manager and the shareholders are reduced.

### 3.4 Robustness Checks

We check for the robustness of our results by using alternate measures to proxy for the level of board monitoring and firm risk in our regression analysis.

companies for 1997, and argue that sub-committees composed of the board of directors have important monitoring roles. We therefore study the size and structure of the board committees for a subsample of our firms. We obtain data on the size and composition of the audit, compensation, and nominating committee for fiscal year 1999 from the IRRC. In cases where IRRC does not report data for a committee we set the data item equal to zero.

We obtain board committee data for a sample of 677 firms for which we also have data for our independent and control variables. The mean (median) size of the audit committee is 3.78 (4) and the mean (median) of the percentage of independent directors on the audit committee is 87.1% (100%). The mean (median) size of the compensation committee is 3.66 (3) and the mean (median) of the percentage of independent directors on the compensation committee is 89.3% (100%). The mean (median) size of the nominating committee is 2.81 (3) and the mean (median) of the percentage of independent directors on the nominating committee is 53.4% (66.7%). Based on the data above, we develop three proxies for the degree of monitoring, namely, the size of the committee, number of independent directors on the committee, and the monitoring intensity calculated as the number of independent directors multiplied by the number of committee meetings in fiscal year 1999. For the Audit committee the variables are ACIND, PctACIND, ACMONITOR, for the compensation committee the variables are CCIND, PctCCIND, CCMONITOR, and for the nominating committee the variables are NCIND, PctNCIND, and NCMONITOR. The variables we develop for the subcommittees parallel the variables for the full panel of independent directors.

Table 5 shows the results of multivariate regressions of the monitoring by board committees on firm characteristics. Panel A presents results when we use the number of independent variables as the dependent variable and Panel B presents the regression results when we use monitoring intensity as the dependent variable. As before we run Negative Binomial regressions using lagged Q as the proxy for firm performance. We do not run the structural model for the monitoring intensity variables because in our first stage regressions TOBIN’s q is
not significantly related to our variables measuring monitoring intensity by the committees. Our regression results for the structural model for the number of independent directors are similar to results presented in Panel A of Table 5. We find that all our results hold in all the models. We find that the coefficient on VOL is significantly negative and the coefficient on LEQUITY is significantly positive in our regressions. The level of monitoring by board committees is, therefore, also negatively related to firm risk and positively related to the level of firm output.

We do not use the percentage of independent directors on the committee as a proxy in our regressions because the distribution of the percentage of independent directors on the committees presents unusual features. Figure 2 presents a histogram of the percentage of independent directors in the Audit, Compensation, and Nominating committees, respectively. As Figure 2 shows, for a majority of firms the committees have only independent directors. Given the lack of variation in the percentage of independent directors, this proxy is therefore not representative of the level of monitoring by board committees. In contrast, the size of the committees varies substantially across firms even for the subsample of firms that have 100% independent directors on these committees. For our subsample of firms with 100% independent directors on these committees, the committees have a minimum of one member and a maximum of 11 members. In addition, the number of meetings also varies substantially for this subsample for firms, from a minimum of one to a maximum of 14. Thus, the level of monitoring by committees as proxied by the number of independent directors and the monitoring intensity, varies substantially across firms, including the subsample of firms with 100% independent directors, and motivates our use of these variables as a proxy for the level of board monitoring.

Our next robustness check relates to using an alternate measure of firm risk. For each firm-year in fiscal year 1999, we estimate the standard deviation of the residual from historical monthly Fama-French regressions and use the residual standard deviation as the proxy for
firm risk in our model. Our board monitoring regression results (not reported) are similar to results reported in Table 4 and Table 5 when we use residual standard deviation as our measure of firm risk. We note that it is not surprising that the results using a firm specific risk measure and a total risk are similar. As reported by other researchers (see Campbell et al (2000)) the firm specific component of risk has increased in the 1990s, which is consistent with our finding that the regression R-Squares are low. Thus returns volatility has a large firm specific component and the residual standard deviation and total volatility are highly correlated. In summary, we conclude that our results hold when we use an alternate measure of firm risk as well.

4 Conclusions

The board of directors, especially the independent (outside) directors, serve an important monitoring role in maximizing firm value, and it is natural that the level of board monitoring is determined endogenously and is related to firm characteristics. In this paper we present a theoretical model and empirical analysis to study the determinants of board monitoring.

Demsetz and Lehn (1985), Smith and Watts (1992), and Prendergast (2000), demonstrate that there should be a negative relationship between board monitoring and firm risk because monitoring is less efficient in uncertain environments. We show that such a negative relationship between monitoring and risk is also a direct implication of principal-agent models. In our model framework, there is an economic tradeoff between compensating the manager through salary/control benefits or through incentive features in the compensation contract. Our results arise because it is optimal for shareholders to reduce the level of board monitoring and allow greater consumption of salary/control benefits by the manager when firm risk is higher. Our model also show that the degree of monitoring is positively related
to the level of the firm’s output. Our results provide insight on the role of an optimally designed board of directors as part of the internal governance structure of firms.

We empirically test our hypothesis by examining a broad sample of firms in the five year period from 1997 and 2001. We use the number of independent board members, the percentage of independent board members, and the product of the number of independent directors and the number of board meetings, as proxies for the level of board monitoring. Our empirical results are consistent with our hypotheses. In particular, we find that the level of board monitoring activity is significantly inversely related to firm risk and positively related to firm output.

In our empirical analysis we include controls for the CEOs bargaining power and the level of shareholder rights in the firm. CEOs bargaining power is an important determinant of board characteristics as shown by Hermalin and Weisbach (1998). In their model, the greater the level of the CEO’s bargaining power, the less monitoring is performed. Firms with weaker shareholder rights will have greater board monitoring to ensure that firm value is maximized. Our empirical findings are consistent with these arguments. We find that the level of board monitoring is negatively associated with the CEO’s bargaining power and the level of shareholder rights. We also find that the level of board monitoring as proxied by the number and percentage of the independent directors on the board has increased in 2000 and 2001. Firms have, therefore, responded to shareholder demands in the late 1990s for greater board oversight even prior to the formal implementation of the Sarbanes-Oxley act of 2002. Finally, we also use alternative measures of board monitoring and firm risk as robustness checks. We use data on the number of independent directors on board committees, the number of meetings held by the board committees and committee meetings to develop alternative proxies for the level of board monitoring. The alternate risk measure that we use is the standard deviation of the residual from monthly Fama-French regressions. We obtain
strictly analogous results when we use the alternative proxies for board monitoring activity and when we use the alternate measure of risk in our regressions.

Our theoretical results and empirical findings, thus, support the notion that the composition of the board of directors is endogenously determined as a function of firm and CEO characteristics.
References


30


Table 1: Board and Firm Characteristics

Table 1 reports data on the board of directors and firm characteristics for a panel of 2841 firms for a five-year period from 1997 to 2001. For each variable, the table shows the mean, median, standard deviation, minimum, and maximum of the relevant characteristic. The table reports data for board size (BDSIZE), the number of independent directors (BDIND), the percent of independent directors (PctBDIND), the product of board size and the number of meetings (MONITOR), the volatility of the firm’s stock returns as reported in EXECUCOMP (VOL), the market value of the firm’s equity value in billions (EQUITY), the ratio of debt to total assets (LEVERAGE), the ratio of the book value of the firm’s debt and equity to the market value of the firm’s debt and equity (Q), the Q in the prior fiscal year (LagQ), the ratio of the debt to total assets (LEVERAGE), the ratio of R&D to total assets (R&D), the ratio of capital expenditure to total assets (CAPEX), a dummy variable identifying firms with SIC codes 3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, or 7373 as new economy firms (NEWECON), the number of integer years since the firm was first listed on CRSP (FIRMAGE), a dummy variable identifying firms where the CEO is also Chairman (TITLE), CEO tenure (TENURE), the amount of non-cash compensation as a percent of the CEO’s total compensation (NONCASH), the percentage share ownership of the CEO (MGROWN), and the Gompers, Ishii, and Metric (2003) governance index ($G$–Index).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Board Monitoring Variables:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDSIZE</td>
<td>9.58</td>
<td>9.00</td>
<td>2.65</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>BDIND</td>
<td>6.72</td>
<td>7.00</td>
<td>2.57</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>PctBDIND</td>
<td>69.55</td>
<td>72.70</td>
<td>17.26</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>NUMMTG</td>
<td>7.17</td>
<td>7.00</td>
<td>2.83</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>MONITOR</td>
<td>49.19</td>
<td>42.00</td>
<td>29.40</td>
<td>0</td>
<td>252</td>
</tr>
<tr>
<td><strong>Firm Characteristics:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOL</td>
<td>38.90%</td>
<td>35.70%</td>
<td>16.23%</td>
<td>12.00%</td>
<td>128.10%</td>
</tr>
<tr>
<td>EQUITY</td>
<td>8.55</td>
<td>1.87</td>
<td>26.25</td>
<td>0.016</td>
<td>508.32</td>
</tr>
<tr>
<td>LEVERAGE</td>
<td>0.25</td>
<td>0.25</td>
<td>0.18</td>
<td>0</td>
<td>1.52</td>
</tr>
<tr>
<td>Q</td>
<td>1.97</td>
<td>1.33</td>
<td>2.20</td>
<td>0.07</td>
<td>55.59</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.03</td>
<td>0.00</td>
<td>0.06</td>
<td>0</td>
<td>0.74</td>
</tr>
<tr>
<td>CAPEX</td>
<td>0.06</td>
<td>0.05</td>
<td>0.06</td>
<td>0</td>
<td>0.60</td>
</tr>
<tr>
<td>NEWECON</td>
<td>0.12</td>
<td>0.00</td>
<td>0.32</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>FIRMAGE</td>
<td>20.19</td>
<td>20.00</td>
<td>12.80</td>
<td>0.5</td>
<td>39</td>
</tr>
<tr>
<td><strong>CEO Characteristics &amp; Shareholder Rights:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TITLE</td>
<td>0.73</td>
<td>1.00</td>
<td>0.45</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TENURE</td>
<td>6.75</td>
<td>4.11</td>
<td>7.01</td>
<td>0</td>
<td>50.01</td>
</tr>
<tr>
<td>NONCASH</td>
<td>60.60%</td>
<td>62.21%</td>
<td>21.48%</td>
<td>0%</td>
<td>100.00%</td>
</tr>
<tr>
<td>MGROWN</td>
<td>1.77%</td>
<td>0.26%</td>
<td>4.37%</td>
<td>0%</td>
<td>42.37%</td>
</tr>
<tr>
<td>$G$–Index</td>
<td>9.49</td>
<td>9.00</td>
<td>2.64</td>
<td>2</td>
<td>17</td>
</tr>
</tbody>
</table>
Table 2: Board Monitoring Univariate Regressions

Table 2 reports the results of univariate regressions for each of the three board monitoring proxies. Columns 1, 2, and 3 report regressions for BDIND, PctBDIND, and MONITOR respectively. All regression for BDIND and MONITOR are LOGIT regressions assuming a Negative Binomial distribution, and all regressions for PctBDIND are TOBIT regressions. Each column in the table reports results for 15 separate regressions and each entry in the table is the coefficient on a particular independent variable. Each column shows the coefficients on the volatility of the firm’s stock returns (VOL), the logarithm of the firm’s market capitalization (LEQUITY), the ratio of debt to total assets (LEVERAGE), the ratio of the book value of the firm’s debt and equity to their market value (Q), lagged Q (LagQ), the ratio of the debt to total assets (LEVERAGE), the ratio of R&D to total assets (R&D), the ratio of capital expenditure to total assets (CAPEX), a dummy variable identifying new economy firms (NEWECON), the logarithm of firm age (LFIRMAGE), a dummy variable identifying firms where CEO is also Chairman (TITLE), CEO tenure (TENURE), the CEO’s percentage non-cash compensation (NONCASH), the percentage share ownership of insiders and directors (MGROWN), and the Gompers et al G−Index. Section (3.1) describes all variables in more complete detail. Intercepts are not reported to conserve space. *p*-values are reported in parentheses.

<table>
<thead>
<tr>
<th></th>
<th>BDIND</th>
<th>PctBDIND</th>
<th>MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOL</td>
<td>-0.827</td>
<td>0.837</td>
<td>-0.870</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.675)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>LEQUITY</td>
<td>0.095</td>
<td>1.275</td>
<td>0.129</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>LEVERAGE</td>
<td>0.390</td>
<td>6.007</td>
<td>0.734</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.001)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Q</td>
<td>-0.029</td>
<td>-0.532</td>
<td>-0.034</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>-1.254</td>
<td>3.586</td>
<td>-1.293</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.525)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>CAPEX</td>
<td>-0.690</td>
<td>-26.207</td>
<td>-0.876</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NEWECON</td>
<td>-0.279</td>
<td>-1.403</td>
<td>-0.186</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.160)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>LFIRMAGE</td>
<td>0.053</td>
<td>0.611</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.028)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>TITLE</td>
<td>0.164</td>
<td>3.874</td>
<td>0.179</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>TENURE</td>
<td>-0.012</td>
<td>-0.515</td>
<td>-0.018</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NONCASH</td>
<td>0.117</td>
<td>7.458</td>
<td>0.306</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>MGROWN</td>
<td>-0.029</td>
<td>-0.982</td>
<td>-0.034</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>G−Index</td>
<td>0.044</td>
<td>1.479</td>
<td>0.057</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>
Table 3: Board Monitoring and Firm Risk

Table 3 reports the results of regressions of VOL on each of the three board monitoring proxies. Panel A reports results for univariate regressions. Panel B reports results for the pooled sample when year dummies are included as independent variables. All regression for BDIND and MONITOR are LOGIT regressions assuming a Negative Binomial distribution, and all regressions for PctBDIND are OLS regressions. The columns report results for each year in our panel and for the entire sample. $p-$values are reported in parentheses.

### Panel A: Yearly Regressions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BDIND Regressions:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.297</td>
<td>4.292</td>
<td>2.313</td>
<td>4.286</td>
<td>2.358</td>
</tr>
<tr>
<td>VOL</td>
<td>-1.601</td>
<td>-1.679</td>
<td>-1.495</td>
<td>-1.382</td>
<td>-1.404</td>
</tr>
<tr>
<td><strong>PctBDIND Regressions:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>68.528</td>
<td>69.265</td>
<td>74.644</td>
<td>82.654</td>
<td>85.918</td>
</tr>
<tr>
<td><strong>MONITOR Regressions:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.409</td>
<td>4.448</td>
<td>2.463</td>
<td>4.371</td>
<td>2.219</td>
</tr>
<tr>
<td>VOL</td>
<td>-1.174</td>
<td>-1.216</td>
<td>-0.891</td>
<td>-0.819</td>
<td>-0.827</td>
</tr>
</tbody>
</table>

### Panel B: Pooled Regressions

<table>
<thead>
<tr>
<th></th>
<th>BDIND</th>
<th>PctBDIND</th>
<th>MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.228</td>
<td>2.174</td>
<td>69.223</td>
</tr>
<tr>
<td>VOL</td>
<td>-0.827</td>
<td>-1.184</td>
<td>0.837</td>
</tr>
<tr>
<td>DUM98</td>
<td>0.037</td>
<td>0.483</td>
<td>0.77</td>
</tr>
<tr>
<td>DUM99</td>
<td>0.104</td>
<td>4.102</td>
<td>0.144</td>
</tr>
<tr>
<td>DUM00</td>
<td>0.237</td>
<td>11.26</td>
<td>0.293</td>
</tr>
<tr>
<td>DUM01</td>
<td>0.416</td>
<td>22.32</td>
<td>0.405</td>
</tr>
</tbody>
</table>
Table 4: Board Monitoring and Firm Characteristics

Table 4 reports results of multivariate regressions of board monitoring on firm characteristics for 2841 firms over the five year period from 1997 to 2001. The dependent variables, BDIND, PctBDIND, MONITOR respectively, represent the level of board monitoring. Independent variables are the volatility of the firm’s stock returns (VOL), year dummy variables (DUM98, DUM99, DUM00, & DUM01), the logarithm of the firm’s market capitalization (LEQUITY), the ratio of debt to total assets (LEVERAGE), the lagged value of the ratio of the book value of the firm’s debt and equity to their market value (LagQ), the ratio of R&D to total assets (R&D), the ratio of capital expenditure to total assets (CAPEX), a dummy variable identifying new economy firms (NEWECON), the logarithm of firm age (LFIRMAGE), a dummy variable identifying firms where CEO is also Chairman (TITLE), CEO tenure (TENURE), the CEO’s percentage non-cash compensation (NONCASH), the percentage share ownership of the CEO (MGROWN), and the Gompers et al G−Index. Panel A reports single stage regression results using LagQ as the proxy for firm performance. Panel B reports results of the second stage of two-stage structural regression model with fitted Q (QHAT) as the proxy for firm performance. All regression for BDIND and MONITOR are Negative Binomial regressions and for PctBDIND are OLS regressions. \(p\)-values are reported in parentheses. The goodness of fit measures (Chi-Square) for the regression is highly significant at the 1% level for all models.

<table>
<thead>
<tr>
<th>Panel A - Single Stage</th>
<th>Panel B - Two Stage Structural Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BDIND</td>
</tr>
<tr>
<td>Constant</td>
<td>1.122</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
</tr>
<tr>
<td>VOL</td>
<td>-0.460</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
</tr>
<tr>
<td>DUM98</td>
<td>0.021</td>
</tr>
<tr>
<td></td>
<td>(0.398)</td>
</tr>
<tr>
<td>DUM99</td>
<td>0.069</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
</tr>
<tr>
<td>DUM00</td>
<td>0.172</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
</tr>
<tr>
<td>DUM01</td>
<td>0.319</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
</tr>
<tr>
<td>LEQUITY</td>
<td>0.080</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
</tr>
<tr>
<td>LEVERAGE</td>
<td>0.139</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
</tr>
<tr>
<td>LagQ</td>
<td>-0.029</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
</tr>
<tr>
<td>QHAT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

continues
Table 4: Board Monitoring and Firm Characteristics (continued)

<table>
<thead>
<tr>
<th></th>
<th>Panel A - Single Stage</th>
<th>Panel B - Two Stage Structural Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BDIND</td>
<td>PctBDIND</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.275</td>
<td>30.201</td>
</tr>
<tr>
<td></td>
<td>(0.113)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>CAPEX</td>
<td>-0.076</td>
<td>0.235</td>
</tr>
<tr>
<td></td>
<td>(0.585)</td>
<td>(0.962)</td>
</tr>
<tr>
<td>NEWECON</td>
<td>-0.139</td>
<td>-0.450</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.646)</td>
</tr>
<tr>
<td>LFIRMAGE</td>
<td>0.013</td>
<td>0.182</td>
</tr>
<tr>
<td></td>
<td>(0.048)</td>
<td>(0.446)</td>
</tr>
<tr>
<td>TITLE</td>
<td>0.072</td>
<td>4.919</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>TENURE</td>
<td>-0.006</td>
<td>-0.317</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>NONCASH</td>
<td>0.002</td>
<td>1.820</td>
</tr>
<tr>
<td></td>
<td>(0.069)</td>
<td>(0.220)</td>
</tr>
<tr>
<td>MGROWN</td>
<td>-0.013</td>
<td>-0.620</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>G−Index</td>
<td>0.022</td>
<td>0.896</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>
Table 5: Monitoring by Board Committees and Firm Characteristics

Table 5 reports results of multivariate regressions of monitoring by board committees on firm characteristics for fiscal year 1999. Panel A presents Negative Binomial regression results when the dependent variables represent the number of independent directors in the Audit Committee (ACBDIND), the Compensation Committee (CCBDIND), and the Nominating Committee (NCBDIND) respectively. Panel B presents Negative Binomial regression results when the dependent variable is the intensity of monitoring, defined as the product of the number of independent directors and the number of committee meetings, by the Audit Committee (ACMonitor), the Compensation Committee (CCMonitor), and the Nominating Committee (NCMonitor) respectively. Independent variables are the volatility of the firm’s stock returns (VOL), the logarithm of the firm’s market capitalization (LEQUITY), the ratio of debt to total assets (LEVERAGE), the lagged value of the ratio of the book value of the firm’s debt and equity to their market value (LagQ), the ratio of R&D to total assets (R&D), the ratio of capital expenditure to total assets (CAPEX), a dummy variable identifying new economy firms (NEWECON), the logarithm of firm age (LAGEFIRM), a dummy variable identifying firms where CEO is also Chairman (TITLE), CEO tenure (TENURE), the CEO’s percentage non-cash compensation (NONCASH), the percentage share ownership of the CEO (MGROWN), and the Gompers et al $G$–Index. $p$–values are reported in parentheses. The goodness of fit measures (Chi-Square) for the regression is highly significant at the 1% level for all models.

<table>
<thead>
<tr>
<th></th>
<th>Panel A Number of Independent Directors</th>
<th>Panel B Monitoring Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACBDIND</td>
<td>CCBDIND</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.7163</td>
<td>0.7044</td>
</tr>
<tr>
<td>VOL</td>
<td>-0.5148</td>
<td>-0.5018</td>
</tr>
<tr>
<td>LEQUITY</td>
<td>0.0327</td>
<td>0.0378</td>
</tr>
<tr>
<td>LEVERAGE</td>
<td>0.042</td>
<td>0.019</td>
</tr>
<tr>
<td>LEAGQ</td>
<td>0.0312</td>
<td>0.0363</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>-0.8050</td>
<td>-0.1149</td>
</tr>
<tr>
<td>CAPEX</td>
<td>0.054</td>
<td>0.0652</td>
</tr>
<tr>
<td>NEWECON</td>
<td>0.0296</td>
<td>-0.0585</td>
</tr>
<tr>
<td>LAGEFIRM</td>
<td>0.0765</td>
<td>0.0655</td>
</tr>
<tr>
<td>TITLE</td>
<td>0.1100</td>
<td>0.1076</td>
</tr>
<tr>
<td>TENURE</td>
<td>0.041</td>
<td>0.044</td>
</tr>
<tr>
<td>MGROWN</td>
<td>-1.316</td>
<td>-0.5534</td>
</tr>
<tr>
<td>NONCASH</td>
<td>0.016</td>
<td>0.074</td>
</tr>
<tr>
<td>$G$–Index</td>
<td>0.0648</td>
<td>0.0874</td>
</tr>
<tr>
<td></td>
<td>0.500</td>
<td>0.362</td>
</tr>
<tr>
<td></td>
<td>0.0169</td>
<td>0.0199</td>
</tr>
<tr>
<td></td>
<td>0.058</td>
<td>0.028</td>
</tr>
</tbody>
</table>
Fig 1. This figure shows the total number of directors in a firm, the number of independent directors (BDIND), the percentage of independent directors (PctBDIND) and the board monitoring intensity (MONITOR). The graphs show average values for each year over the five-year period from 1997 to 2001.
Fig 2. This figure shows the distribution of the percentage of independent directors in the audit committee, the compensation committee, and the nominating committee. Data are for fiscal year 1999.