Two Essays in Corporate Governance

by

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(Under the Direction of Jeffry M. Netter)

Abstract

A growing body of research suggests that in general, corporate governance varies across firms in ways that are consistent with value maximization. This implies that there should be no systematic causal relationship between firm value and governance structure. In the first essay, I argue that one reason prior studies have found such a cross-sectional correlation is that they ignore *dynamic endogeneity* – the idea that a firm's current performance affects both future governance and future performance. Since theory suggests that a firm's characteristics and environment affect both performance and governance, ignoring dynamic endogeneity may introduce bias into estimates of the relation between governance and performance. I show how incorporating dynamic endogeneity can improve empirical estimates of the relation between governance and performance. I then test my hypothesis by re-examining the relation between board structure and performance in a panel of over 6,000 firms between 1991 and 2003. I find that: (1) board structure and firm characteristics are systematically related to *past* performance, and (2) when I control for past performance, simultaneity and unobservable heterogeneity, I find no causal relation between board structure and *current* firm performance.

The Sarbanes-Oxley Act of 2002 and recently modified exchange listing requirements impose uniformly high levels of outside director monitoring on all firms. In the second essay, I examine the cross-sectional effect of these regulations given that firms generally choose value-maximizing governance structures that trade off the firm-specific costs and benefits of outside director monitoring. Using the relative costs and benefits of outside director monitoring as a benchmark, I find significant cross-sectional variation in the wealth effects around the announcement and passage of these regulations. I find that firms which have high monitoring costs and fewer benefits from outside monitoring benefited less from the regulations. In particular, I find that the wealth effects around the passage of these new regulations are positively related to firm size and age, and negatively related to growth opportunities and the uncertainty of the firm's operating environment. The results suggest that a blanket "one size fits all" governance regulation may be detrimental to certain firms, particularly young, small, growth firms.

INDEX WORDS: corporate boards, inside ownership, dynamic panel data estimation, endogeneity, Sarbanes-Oxley Act, securities regulation, corporate governance, event study

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B.S., Electrical Engineering, University of Lagos, 1997

A Dissertation Submitted to the Graduate Faculty
of The University of Georgia in Partial Fulfillment
of the
Requirements for the Degree

Doctor of Philosophy

Athens, Georgia

2008

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Dedication

To Oyin, my wife and partner, without your everlasting love and support, none of this would have been possible.

To Eni for going all those days and nights without her Dad.

To my parents for investing their entire lives in ensuring the success of their children.

To Yewande, Bimbo and Dipo – thanks for the support.

Acknowledgments

I would like to thank Jim Linck and Jeff Netter for the time, dedication and professional advice they have given me throughout the period of my graduate study and in the course of preparing the essays in this dissertation. I would also like to thank Chris Stivers for his extensive support as a member of my dissertation committee.

I would like to thank Tina Yang for helping me to acquire much of the data that I have used in my dissertation and for numerous comments, suggestions and words of encouragement.

I would like to thank Harold Mulherin for carefully reading and making extensive comments and suggestions on earlier drafts of the essays in the dissertation.

I would like to thank faculty members of the Department of Banking and Finance of the University of Georgia for attending seminars at which I presented earlier versions of my dissertation work and making many insightful comments. In particular, I would like to thank Paul Irvine and Annette Poulsen for numerous comments on earlier drafts.

I would especially like to thank my colleagues – Mihail, Ryan, Naresh and David – for their willingness to listen as I worked through my essays, as well as making comments on earlier drafts.

Finally, I would like to thank Mark Dawkins (who along with Jim) encouraged me to start this journey in the first place.

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Chapter 1

Introduction

Over the past two decades, there has been growing interest among academics, policy-makers, investors and regulators in corporate governance. At the most elemental level, corporate governance research is the study of those structures and institutions which ensure that all financial claimholders of a corporation get the fair or promised return on their investments in the company. However, separation of ownership and control means that there may be conflicts between the management and the shareholders of the company. This conflict is often magnified by the fact that ownership is often widely dispersed, creating a collective action problem. Corporate governance is the study of those institutions that have evolved over time to resolve the conflicts between the owners and the managers of a firm while mitigating the collective action problem. Corporate governance structures include, but are not limited to boards of directors, ownership structure, executive compensation etc.

Understanding the role of corporate governance in the value and performance of firms has taken on a particular urgency in recent years. Recent large corporate scandals (Enron, WorldCom etc.) have sharpened the interest of the general public in corporate governance issues. Even before these scandals, understanding corporate governance was a growing part of research in financial economics. Shareholders need to be assured of a fair return on their investment in order to invest in potentially value generating companies. Since the growth and overall welfare of the economy requires capital to be steered towards the most productive activities, corporate governance is intimately connected to the overall state of the economy.

My dissertation research involves the study of the relationship between particular governance structures and the value and performance of firms. Prior research in this area generally falls into two broad streams. One research stream implicitly starts with the assumption that firms tend to have inefficient governance structures that can be improved by broad regulation. Proponents of this view believe that particular governance structures are universally good for *all* firms. This certainly seems to be the prevalent view amongst some policymakers and regulatory bodies since the thrust of recent regulations (e.g. the Sarbanes-Oxley Act of 2002) is to impose particular governance structures on all firms. More recently however, another stream of research suggests that, even prior to the recent regulations, firms generally had governance structures that were efficient given their unique operating environments. This stream of research points out the fact that any governance structure, regardless of its benefits is also costly. The costs and benefits will vary from firm to firm depending on the operating and contracting environment of the firm. Thus firms will choose a governance structure that reflects the optimal trade-off between the costs and benefits.

The key thrust of my dissertation is to critically examine the viewpoints offered by these contending streams of research. I do this in my dissertation using two related but distinct empirical approaches. My research aims to provide answers to the following broad questions: (1) Do firms generally evolve efficient governance structures thus obviating the need for costly or blunt broad regulation?; (2) Do the costs of recent regulations exceed the benefits, at least for a subset of firms?

The first essay of my dissertation broadly examines the relationship between firm performance and corporate governance. My study is not the first to do this. A major problem with prior studies has been that the endogeneity of the relationship between governance and performance has not been adequately dealt with, potentially leading to biased inference from those studies. While both governance and firm performance are themselves observable, unobservable factors might affect both governance and performance and lead to a spurious correlation between the two. In addition, both governance and performance affect each other in complex ways and changes in one of them will affect the other over time. If governance structures evolve over time (at least partly in response to performance), it could also lead us to observe a spurious correlation between governance and performance. Indeed a number of prior studies have reported what would appear to be causal relationship between aspects of governance (e.g. board structure, ownership) and firm value although the results of the sign, direction and magnitude of these relationships has been mixed.

I focus on an aspect of governance that has received extensive attention in the literature: the relation between board structure and firm performance. I present both theoretical theoretical arguments and empirical evidence to show that the relationship between board structure and performance is endogenous. One aspect of the endogenous relationship that has received scant attention in the literature is *dynamic endogeneity* which arises because current board structure is systematically related to past firm performance. I show that this aspect of endogeneity can introduce systematic biases into estimates of the effect of board structure on firm performance. I then go on to argue that a system GMM estimator that controls for both dynamic endogeneity and the fact that board structure and firm performance are likely to be driven by similar unobservable factors, is appropriate for estimating the performance/governance relation. Using a sample of 6,000 firms, I find that when I control for past performance, simultaneity and unobservable heterogeneity using the system GMM estimator, there is no causal relation between board structure and *current* firm performance. I interpret these results as supporting the hypothesis that corporate governance structures are, in general, efficiently determined by firms in response to their specific contracting and competitive environments.

The second essay of my dissertation directly examines the effect of recent governance regulations (the Sarbanes-Oxley Act and new stock exchange listing rules) on the value of publicly traded firms in the U.S. I examine the cross-sectional effect of these regulations given that firms generally choose value-maximizing governance structures that trade off the firm-specific costs and benefits of outside director monitoring. If, as some people maintain, the imposition of certain governance structures on all firms is universally beneficial, then these regulations should have had a similar positive effect on value for all firms. If, on the other hand, the regulations remove the flexibility that firms need to choose the governance that is suitable for their particular needs, then we would expect to see significant cross-sectional variation in the effects of the regulations, with a more negative impact on the firms that are most constrained. The passage of the regulations offers a unique natural experiment to measure the effect of governance of firm value since they apply equally to all publicly traded firms. Using the relative costs and benefits of outside director monitoring as a benchmark, I find significant cross-sectional variation in the wealth effects around the announcement and passage of these regulations. I find that firms which have high monitoring costs and fewer benefits from outside monitoring benefited less from the regulations. In particular, I find that the wealth effects around the passage of these new regulations are positively related to firm size and age, and negatively related to growth opportunities and the uncertainty of the firm's operating environment. Again, the results suggest that boards are, in general, efficiently determined as a trade-off between the relative costs and benefits of outside monitoring and that recent regulations may have in fact imposed undue constraints on certain firms.

Chapter 2

Endogeneity and the Dynamics of Corporate Governance

2.1 Introduction

Research in corporate finance is complicated by the endogenous relation that exists between the control forces operating on a corporation and its financial decisions. Jensen (1993) classifies these control forces as capital markets, the regulatory system, product and factor markets and internal governance, although there are many possible classification schemes. The endogenous relation among these forces makes it difficult to identify the *strictly exogenous* instruments we need to analyze the determinants and effects of corporate finance decisions. While researchers have attempted to deal with endogeneity in many ways, often overlooked is the fact that the relations among a firm's observable characteristics are likely to be dynamic. That is, a firm's current actions will affect future governance and future performance, which will in turn affect the firm's future actions (Hermalin and Weisbach (2004)). We refer to this relationship as *dynamic endogeneity*.

In this paper, we examine how dynamic endogeneity impacts research efforts to measure the causal relation between governance and firm performance. First, we show, theoretically and numerically, that ignoring dynamic endogeneity can lead to biased inferences about the relation between governance and firm performance. Second, we show how to use dynamic endogeneity to appropriately estimate the relation between corporate governance and firm performance. Finally, we use this methodology to examine the relation between an extensively studied aspect of corporate governance – the relation between board structure and performance – for a sample of more than 6,000 firms over the period 1991–2003. We find that there is no causal relation between current board structure and current performance once we appropriately control for dynamic endogeneity. Further, we reconcile our results with existing literature that documents such a relation. We argue that accounting for dynamic endogeneity enables the researcher to better tie his/her empirics to underlying theory and improves the reliability of the empirics.

Most existing research that examines the effect of governance on firm performance estimates an empirical model in which firm performance in a certain period depends on governance in the same period. These studies either implicitly or explicitly assume that past performance has no effect on either current performance or current governance.[1] However, theory and empirical evidence suggests that this is probably not a reasonable assumption. For example, board structure – a commonly studied aspect of corporate governance – is dynamically endogenous with respect to performance in at least two ways.

First, past performance is a proxy for some of the unobservable factors that could affect both current performance and a firm's current governance structure. For example, Hermalin and Weisbach (1998) suggest that board composition arises as part of a bargaining process between shareholders and management based on the shareholders' perception of managerial ability, which is determined, at least in part, by past performance. Current performance is also likely to be affected by managerial ability (Kaplan, Klebanov, and Sorensen (2007); Baird and Rasmussen (2007)). If past performance proxies for managerial ability, then both performance *and* board structure are likely to be related to past performance. Indeed, both Hermalin and Weisbach (1988) and Denis and Sarin (1999) find empirical evidence that board independence is related to prior performance. Since managerial ability is difficult to observe, any estimate of the relation between governance and performance that ignores past performance may suffer an omitted variable bias.

Second, theory (Raheja (2005); Adams and Ferreira (2007); Harris and Raviv (2007)) suggests that board structure is determined, in part, by various factors in a firm's operating and contracting environment, which are also likely to affect firm performance. Following

[1]This is largely the approach taken by the studies we summarize in Table 1.

the framework applied in Demsetz and Lehn (1985) and using firm characteristics (e.g., firm size, age, growth opportunities, etc.) as proxies for the firm's contracting environment, empirical studies (Lehn, Patro, and Zhao (2004); Mulherin (2005); Boone, Field, Karpoff, and Raheja (2007), Coles, Daniel, and Naveen (2008); Linck, Netter, and Yang (2008)) find a systematic relation between board structure and these firm characteristics. Further, a firm's characteristics are systematically related to past performance. For example, board size is related to firm size, and firm size is related to past firm performance. This means that board size is related to past firm performance through the effect of performance on size. Thus, apart from the direct effect of past performance on board structure, past performance affects subsequent board structure because it affects the characteristics that determine board structure.

While incorporating past performance seems prudent, it is unlikely that past performance completely controls for all the unobservable factors that may affect both performance and board structure. Therefore, there remains some *unobserved heterogeneity* that we must consider. It is also possible that within any time period there is *simultaneity*, as the actors in the firm's nexus of contracts choose their board structure in anticipation of their expected performance.

In sum, we face three sources of endogeneity that we must control for in our empirical specifications: dynamic endogeneity, unobservable heterogeneity and simultaneity. To accomplish this, we estimate a *dynamic unobserved effects model* of performance and board structure using a *dynamic panel GMM estimator*. This estimator, originally developed in a series of papers by Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991), and further refined by Arellano and Bover (1995) and Blundell and Bond (1998), provides an appropriate econometric specification for dealing with the endogeneity issues we are likely to encounter when estimating the governance/performance relationship.

The basic steps of this estimation strategy are as follows. First, we explicitly write the regression specification as a dynamic model that includes lagged performance as an explanatory variable. Next, we first difference all the variables. Finally, we estimate this model via GMM using lagged values of the governance variables and performance as instruments. This method mitigates the major sources of endogeneity we face when estimating the governance/performance relation. First differencing controls for unobserved heterogeneity and eliminates potential omitted variable bias. Using the firm's history as an instrument for the present controls for potential simultaneity and reverse causality. Further, this estimation procedure allows all the explanatory variables – the entire set of governance and control variables – to be treated as endogenous. Intuitively, one can think of system GMM estimation as the estimation of a *dynamic simultaneous equations model*.

The validity of this approach depends on whether a firm's history is a valid instrument for its current governance structure. We argue that this is the case because if governance is dynamically endogenous, it must be correlated with the firm's historical performance and characteristics. In addition, if our empirical model is *dynamically complete* – i.e., if we include enough lags to control for dynamic endogeneity – then any older lags are exogenous with respect to current (or future) shocks to firm performance. In our empirical analysis, we include lags of performance of up to four years to allow a sufficient horizon for past performance to affect expectations of current performance. Any information from the firm's history beyond the time it takes for the information to be incorporated into current expectations is exogenous to current performance. We assert that in the absence of any clear natural experiments, the firm's past may provide the only theoretically justifiable instruments for identifying the relationship between governance and performance.

Before applying this approach to real data, we perform numerical simulations to illustrate how OLS and fixed effects estimates are biased due to unobserved heterogeneity and dynamic endogeneity, and how these biases can lead to incorrect inferences. We find that, in the presence of these sources of endogeneity, OLS and fixed effects estimators show a statistically significant relation between governance and performance when none exists. In fact, the direction of the bias is generally what we would predict given the theoretical impact of dynamic endogeneity. We also show how the dynamic panel GMM estimator yields powerful and unbiased estimates in this setting.

We then apply the dynamic GMM panel estimator in a setting that has received substantial attention in the literature: the relation between board structure and *current* firm performance. Our analysis is guided by two conflicting hypothesis. Our null hypothesis is what we term the *endogenous determinants* hypothesis. This hypothesis asserts that firms choose value-maximizing governance structures that trade-off the relative costs and benefits of various governance mechanisms, and predicts that there should be no relationship between firm performance and board structure. An alternative hypothesis is based on what Boone, Field, Karpoff, and Raheja (2007) call the *inefficiency* hypothesis. This hypothesis asserts that some board structures are sub-optimal and thus, predicts a causal relationship from board structure to firm performance. For example, Lipton and Lorsch (1992) suggest that due to high coordination costs, large boards will be ineffective monitors of management, and there will be a negative relation between board size and firm performance.

When we use the dynamic GMM panel estimator, we find no significant relation between board structure (board size, independence or leadership) and current firm performance. These results are robust to alternative measures of performance (return on assets, return on sales and Tobin's Q) as well as the inclusion of ownership variables. The results suggest that we cannot reject the endogenous determinants hypothesis in favor of the alternative inefficiency hypothesis. However, when we estimate the relation using a static model and a fixed effects regression that ignores dynamic endogeneity, we find a positive relation between board independence and firm performance, and a negative relationship between board size and firm performance, as was found in prior research.

Our results help reconcile some of the conflicting results in the prior literature and explain how some reported correlations could arise from ignoring one or more aspects of the endogeneity inherent in the board structure/performance relation. For example, we argue that a negative relation between board independence and past firm performance induces a positive bias when measuring the effect of board independence on current firm performance with a static fixed effects regression. Similarly, we predict and find a negative bias when measuring the effect of board size on firm performance from a fixed effects regressions given the positive relation we observe between board size and past performance.

Our results are consistent with the endogenous determinants hypothesis since the apparent biases in fixed effects regressions capture the dynamic endogeneity inherent in the determinants of board structure. We show that the apparent causal relation between board structure and firm performance disappears once we include past performance to control for dynamic endogeneity. That is, ignoring past performance appears to bias causality inferences. This is consistent with the theory and evidence that suggests board structure responds directly to past performance, as well as indirectly since past performance proxies for otherwise unobservable factors in the firm's environment that affect both board structure and firm performance (such as managerial ability). Causality appears to run from performance to board structure, rather than the reverse.

In terms of the issues addressed, our paper is similar to that by Coles, Lemmon, and Meschke (2008), who examine the relation between ownership and performance. They show how specifying a structural model of the firm can minimize endogeneity problems that plague empirical corporate finance research. Their conclusions are similar to ours. Both papers find that a measure of governance (ownership in the Coles, Lemmon, and Meschke (2008) paper, board structure in this paper) and performance are determined endogenously, rather than governance driving performance. However, our approach is fundamentally different from theirs. Under our approach, the researcher needs only the firm's historical performance and characteristics. She does not need to know the exact specification of the unobservable process that generates the endogenous variables.

The rest of the paper is organized as follows. In section 2, we discuss related literature and develop our hypotheses. In section 3, we lay out the theoretical basis for the biases that may arise in commonly used techniques for estimating the relation between governance and performance. We also describe the dynamic panel GMM estimator and perform numerical simulations to illustrate the theoretical biases and how to control for them. We describe our data in Section 4 and provide an empirical analysis of the relation between board structure and firm performance in Section 5. We conclude in Section 6.

2.2 Development of the Model

Table 2.1 presents a summary of prior studies that have explicitly examined the relation between board structure and firm performance. The results are mixed. For example, most find either a negative relation between board independence and performance (Agrawal and Knoeber (1996); Klein (1998); Bhagat and Black (2002)) or no relationship at all (Hermalin and Weisbach (1991); Mehran (1995)). Interestingly, most who argue for a particular level of board independence suggest that more independent boards improve performance through better monitoring of management. Yermack (1996) and Coles, Daniel, and Naveen (2008) do find a positive relationship in some specifications.

There appears to be more empirical regularity in studies that examine the effect of board size on performance. Most (e.g., Yermack (1996); Eisenberg, Sundgren, and Wells (1998)) report a negative relation between firm performance and board size. The theory is that larger boards are likely to have higher coordination costs, which reduces their ability to effectively monitor management. However, we have not seen a convergence towards uniformly small boards. For example, as of 2003, U.S. boards contain from between 2 and 19 directors.

2.2.1 A dynamic model of board structure

To consistently estimate the relation between governance and performance we need to develop an empirical specification for governance. If governance is jointly determined with performance, then any empirical model of firm performance must incorporate this endogeneity. For our empirical tests, we examine the relation between performance and board structure and develop our empirical model based on the structural models of Hermalin and Weisbach (1998), Raheja (2005) and Harris and Raviv (2007).

Observable determinants of board structure. Raheja (2005) presents a model in which the optimal board structure is determined by a trade-off between maximizing the incentive for insiders to reveal their private information, minimizing the cost to outsiders to verify projects, and maximizing outsiders' ability to reject inferior projects. Her model suggests that when verification costs are high, optimal boards require more insiders. For example, firms with new technology or firms with unique 'high technology' products often have projects that are difficult for outsiders to verify; thus, her model suggests that such firms may optimally have more insiders on the board. Similarly, Harris and Raviv (2007)'s model suggests that board structure depends on the firm's information and contracting environment.

To the extent that observable firm characteristics (e.g., firm size, growth opportunities, age, leverage, etc.) proxy for the firm's information environment, then these firm characteristics should be systematically related to board structure. Boone, Field, Karpoff, and Raheja (2007), Coles, Daniel, and Naveen (2008), Linck, Netter, and Yang (2008), and Lehn, Patro, and Zhao (2004) provide support for this hypothesis.

Past performance, CEO ability and unobservable determinants of board structure. Hermalin and Weisbach (1998) argue that board independence is the outcome of a bargaining process between the existing CEO and the board. The CEO's bargaining power derives from his perceived ability compared to alternative managers that the firm might be able to hire. Hermalin and Weisbach (1998) propose that the intensity with which the board monitors the CEO: (i) decreases with its prior estimate of the CEO's ability, (ii) decreases with its precision of its prior estimate and (iii) increases with the precision of its privately acquired signal about the CEO's ability. One implication of this model is that within any particular period, there will be a *negative* relation between board independence and the ability of the firm's managers. It also suggests that board composition will be related to the firm's past performance – that is, board structure is *dynamically endogenous* with respect to performance. Specifically, board independence will be *negatively* related to the firm's past performance.

Past performance can affect current board structure through another channel. If board structure is determined by firm characteristics and these characteristics are related to past performance, then board structure is related to past performance through the effect of performance on firm characteristics. For example, following arguments presented by Fama and Jensen (1983), Boone, Field, Karpoff, and Raheja (2007) argue that larger firms are more hierarchical and that the larger firm boards ratify and monitor more decisions of senior managers. It follows that the information requirements of more complex, larger firms will require larger boards. Lehn, Patro, and Zhao (2004), Boone, Field, Karpoff, and Raheja (2007), Coles, Daniel, and Naveen (2008), and Linck, Netter, and Yang (2008), among others, find a positive relation between board size and firm size. Firm size is likely to be *positively* related to firm performance so board size will be *positively* related to past firm performance through the effect of performance on size.

2.2.2 A dynamic model of firm performance

Above we discuss the dynamics involved in estimating a model of board structure. Here we do the same for the determinants of firm performance.

Observable determinants of firm performance. We expect that firm performance will be systematically related to observable characteristics (e.g., firm size, growth opportunities, age, leverage, etc.). These characteristics proxy for such things as the firm's market share, market power and product quality that fundamentally affect performance. Since these firm characteristics also affect board structure, we must include them in the empirical model for firm performance.

Past performance, CEO ability and unobservable determinants of board structure. In section 2.1 we argue that past performance is a determinant of current board structure. However, in estimating the relation between performance and board structure, it is important to consider that current performance is also related to past performance. There is strong intuitive, theoretical and empirical evidence to suggest that this is the case. A number of studies establish the persistence of corporate profitability (e.g., Mueller (1977); Waring (1996)). This persistence is probably due, at least in part, to the fact that managerial ability affects current firm performance (see, for example, Kaplan, Klebanov, and Sorensen (2007); Baird and Rasmussen (2007)). While ability is difficult to measure and partially unobservable, if we assume that past performance proxies for managerial ability, we would expect current firm performance to be related to past performance.

2.2.3 The dynamic joint relation between board structure and firm performance

Our discussions above suggest the following model for board structure, firm characteristics and performance:

$$\mathbf{X}_{it} = \alpha_x + \sum_s \kappa_{xs} y_{it-s} + \sum_m \kappa_{mx} \mathbf{X}_{it-m} + \sum_s \gamma_{xs} \mathbf{Z}_{it-s} + \eta_i + \xi_{it}, \quad m > 0, s \geq 0 \qquad (2.1)$$

$$\mathbf{Z}_{it} = \alpha_z + \sum_s \kappa_{zs} y_{it-s} + \sum_m \kappa_{mz} \mathbf{Z}_{it-m} + \sum_s \gamma_{zs} \mathbf{X}_{it-s} + \eta_i + \varepsilon_{it}, \quad m > 0, s \geq 0 \qquad (2.2)$$

$$y_{it} = \alpha_y + \sum_p \kappa_{yp} y_{it-p} + \beta_y \mathbf{X}_{it} + \gamma_y \mathbf{Z}_{it} + \eta_i + \epsilon_{it}, \quad p > 0 \qquad (2.3)$$

where $\mathbf{X}$, $\mathbf{Z}$ and y represent board structure, firm characteristics and performance, respectively, and η represents an unobserved firm effect. Equations (2.1), (2.2) and (2.3) form a dynamically endogenous system of equations of the joint relation between governance and performance. Equations (2.1) and (2.2) are structural models of the determinants of board structure and firm characteristics. Equation (2.3), which is of primary interest, is a reduced form empirical model that follows from the validity of models (2.1) and (2.2) and our discussion in Sections 2.1 and 2.2. The key economic question is tested by β_y in

(2.3). Under the null *endogenous determinants* hypothesis, $\beta_y = 0$ – i.e., board structure is completely endogenously determined by equation (2.1). Under the null, causality runs from performance to board structure, but not the reverse. The alternative is the *inefficiency* hypothesis (Boone, Field, Karpoff, and Raheja (2007)), which suggests that $\beta_y \neq 0$. That is, even after we control for the endogeneity of governance and firm characteristics, then there is a causal relation that runs from current board structure to firm performance.

2.3 Estimating the relation between governance and firm performance

In sections 3.1, 3.2 and 3.3, we lay out the theoretical basis for the biases that arise when we use OLS or fixed effects regressions to estimate the relation between corporate governance and firm performance. We then discuss the dynamic panel general method of moments (GMM) estimator, which mitigates these biases. In section 3.4, we use the structural models of board structure to predict the biases that may arise from ignoring one or more aspects of the endogeneity inherent in the board structure/performance relationship. Finally, in section 3.5, we use a numerical simulation to illustrate how OLS and fixed effects estimates are biased due to unobserved heterogeneity and dynamic endogeneity, and how these biases can lead to incorrect inferences. We also use the numerical example to show that the dynamic panel GMM estimator yields powerful and unbiased estimates in the presence of unobserved heterogeneity and dynamic endogeneity.

2.3.1 Static models of firm performance and model mis-specification

Many empirical studies essentially ignore the dynamic nature of both performance and governance. That is, they essentially estimate equation (2.3) as a static model, assuming that $\kappa_{xs} = \kappa_{zs} = \kappa_{yp} = 0$ in equations (2.1) and (2.2). However, if governance is dynamically endogenous or performance is persistent, then any estimates of β_y are likely to be biased. In this case, ignoring past performance from our empirical specification results in an omitted variable bias in our estimate of β_y.

2.3.2 Consistent estimation of the dynamic model

As discussed earlier, there are at least three sources of endogeneity we face when estimating the relation between governance and performance:

1. *Unobservable heterogeneity*: This may arise because there are unobservable factors that affect both performance and governance.
2. *Simultaneity*: This may arise if the actors in the firm's nexus of contracts choose a governance structure based on expected performance.
3. *Dynamic endogeneity*: This may arise if past performance is a determinant of both current board structure and current firm performance – i.e., $\kappa_{yp} \neq 0$ in (2.3).

OLS estimation

We can control for dynamic endogeneity in an OLS regression of performance on governance if we include lagged performance as a dependent variable. While OLS estimation of the dynamic model is an improvement over the static model, it does not account for other sources of endogeneity. Thus, an OLS estimate of the model in equation (2.3) assumes there is no observable heterogeneity – that $E(\mathbf{X}_{it}\eta_i) = E(\mathbf{Z}_{it}\eta_i) = 0$ – and that there is no simultaneity – that $E(\mathbf{X}_{it}\epsilon_{it}) = E(\mathbf{Z}_{it}\epsilon_{it}) = 0$.

Instrumental variables (IV) regressions and strict exogeneity

If we could identify a strictly exogenous firm characteristic – a firm characteristic that is part of **Z** in (2.1) but not in (2.3) – then we could carry out IV regressions. In that case, we could estimate a simple 2SLS regression on (2.3) or estimate (2.1), (2.2) and (2.3) jointly using a systems regression procedure like 3SLS. However, we would have to argue that this instrument affects governance but not firm performance. In addition, if $\mathbf{X}$ contains multiple governance variables, then we would be in the even more untenable position of having to argue that more than one instrument is strictly exogeneous. Finally, even if we could identify strictly exogenous instruments, IV regressions may not control for unobserved heterogeneity if these instruments are themselves correlated with the unobserved effects (see Cornwell and Trumbull (1994)). Thus, it is very difficult to apply standard IV regressions in practice.

FIXED EFFECTS (WITHIN) REGRESSIONS

We could eliminate the unobserved heterogeneity with a fixed effect transformation of (2.3). If we rewrite (2.3) as:

$$y_{it} = \kappa y_{it-1} + \mathbf{G}_{it}\Gamma + \eta_i + \epsilon_{it} \tag{2.4}$$

where $\mathbf{G}$ contains all the governance variables and firm characteristics and η is a firm fixed effect then a fixed effect regression is essentially an OLS regression of the transformed system, which can be written as:

$$\widetilde{y}_{it} = \kappa\,\widetilde{y}_{it-1} + \widetilde{\mathbf{G}}_{it}\,\Gamma + \widetilde{\epsilon}_{it} \tag{2.5}$$

In (2.5), $\widetilde{y}_{it} = y_{it} - \bar{y}_i$, $\widetilde{\mathbf{G}}_{it} = \mathbf{G}_{it} - \bar{\mathbf{G}}_i$ and $\widetilde{\epsilon} = \epsilon_{it} - \bar{\epsilon}_i$. For κ and Γ to be consistent both $\tilde{y}_{it-1}$ and $\widetilde{\mathbf{G}}_{it}$ have to be independent of $\widetilde{\epsilon}_{it}$. However, by including lagged performance to control for dynamic endogeneity, then

$$E(\widetilde{y}_{it-1} \cdot \widetilde{\epsilon}_{it}) = E[\widetilde{y}_{it-1} \cdot (\epsilon_{it} - \bar{\epsilon}_i)] = E\left[\widetilde{y}_{it-1} \cdot \left(\epsilon_{it} - \frac{1}{T}\sum_t \epsilon_{it}\right)\right] \neq 0 \tag{2.6}$$

since $\sum_t \epsilon_{it}$ includes ϵ_{it-1} which by definition is correlated with y_{it-1}.[2]

Thus, a fixed effects regression of (2.3) would be inconsistent. Nickel (1981) shows that the bias in the fixed effects regression of a dynamic model would be inversely related to the number of time periods (T), which suggests that the bias would be very small if we had an extremely large time dimension. However, Judson and Owen (1999) show that even when T is as large as 30, the bias of the fixed effects estimator can still be quite large and significant. Most studies that examine the effect of governance on performance have

[2]This idea goes at least as far back as Nerlove (1967).

panels with time dimensions that are much smaller than that. In our numerical simulation exercise, we examine the magnitude of the bias under varying assumptions of T. In our empirical analysis, T=7.

2.3.3 Dynamic panel GMM estimation

To obtain consistent and unbiased estimates, we estimate the relation between board structure and performance using a dynamic GMM panel estimator. This estimator was introduced by Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991), and further developed in a series of papers including Arellano and Bover (1995) and Blundell and Bond (1998). It exploits the dynamic endogeneity inherent in our explanatory variables. The dynamic modeling approach has been used in other areas of economics where the structure of the problem suggests a dynamic relationship between dependent and independent variables. Examples include measuring economic growth convergence (Caselli, Esquivel, and Lefort (1996), estimating a labor demand model (Blundell and Bond (1998)), and estimating the relation between financial intermediary development and economic growth (Beck, Levine, and Loayza (2000)).

The basic estimation procedure consists of two essential steps. First, we write the dynamic model of (2.3) in first-differenced form:

$$\Delta y_{it} = \alpha_y + \kappa_{yp} \sum_p \Delta y_{it-p} + \beta_y \Delta \mathbf{X}_{it} + \gamma_y \Delta \mathbf{Z}_{it} + \Delta \epsilon_{it}, \quad p > 0 \tag{2.7}$$

First differencing eliminates any potential bias that may arise from unobserved heterogeneity. After first-differencing, we estimate (2.7) via GMM using lagged values of the explanatory variables as instruments for the current explanatory variables. That is, we use historical values of performance, board structure and other firm-specific variables as instruments for current changes in these variables.

An important aspect of the dynamic panel estimator is its use of the firm's history as instruments for our explanatory variables. For an instrument to be valid, it must meet two criteria. First, it must be correlated with the variable for which it is serving as an instrument. Second, it must be uncorrelated with the errors. We argue that the firm's history provides valid instruments in our context because:

1. Current board structure, firm performance and firm characteristics are correlated with past performance and past realizations of other firm-specific variables. This is predicted by theory as outlined in our empirical models of (2.1), (2.2) and (2.3).

2. *Expected* performance in the current period is related, in part, to the firm's *entire* history. However, we assume that any information from the firm's past is impounded into current expected performance within p time periods. This means that p lags of past performance are sufficient to capture the influence of the firm's past on the present – i.e., including p lags ensures *dynamic completeness* of (2.3). Thus, the firm's history beyond period $t-p$ should be *exogenous* with respect to any shocks or surprises in the current or future periods. Thus, from (2.3), we can write the following orthogonality conditions:

$$E(\mathbf{X}_{it-s}\epsilon_{it}) = E(\mathbf{Z}_{it-s}\epsilon_{it}) = E(y_{it-s}\epsilon_{it}) = 0, \qquad \forall\ s > p \tag{2.8}$$

Despite the economic appeal of this procedure, it does have at least three econometric shortcomings. First, Beck, Levine, and Loayza (2000)) note that if the original model is conceptually in levels, differencing may attenuate the signal to noise ratio and reduce the power of our tests. Second, Arellano and Bover (1995) suggest that variables in levels may be weak instruments for first-differenced equations. Third, first-differencing may exacerbate the impact of measurement errors on the dependent variables (Griliches and Hausman (1986)).

Arellano and Bover (1995) and Blundell and Bond (1998) argue that we can mitigate these shortcomings and improve the GMM estimator by also including the equations in levels in the estimation procedure. We can then use the first-differenced variables as instruments for the equations in levels in a 'stacked' system of equations that includes the equations in both levels and differences. This produces a “system” GMM estimator. Unfortunately, the equations in levels still include unobserved heterogeneity. To deal with this, we assume that while the governance and control variables may be correlated with the unobserved effects, this correlation is constant over time. This is a reasonable assumption over a relatively short time period if the unobserved effects proxy for factors like unobserved director ability, managerial productivity, etc. The assumption leads to an additional set of orthogonality conditions:

$$E[\Delta \mathbf{X}_{it-s}(\eta_i + \epsilon_{it})] = E[\Delta \mathbf{Z}_{it-s}(\eta_i + \epsilon_{it})] = E[\Delta y_{it-s}(\eta_i + \epsilon_{it})] = 0, \qquad \forall \ s > p \tag{2.9}$$

With the system GMM estimator we obtain efficient estimates while controlling for unobserved heterogeneity, simultaneity and dynamic endogeneity. The orthogonality conditions of (2.8) and (2.9) imply that we can use lagged levels as instruments for our differenced equations and lagged differences as instruments for the levels equations respectively.

We carry out GMM panel estimation, using the orthogonality conditions of (2.8) and (2.9), under the assumption that there is no serial correlation in the error term, ϵ. We thus include post-estimation tests for first- and second-order serial correlation in our analysis. We also carry out an additional test for the validity of our instrument set. Specifically, we include analysis based on the Hansen test of over-identifying restrictions. This test produces a J-statistic that is distributed χ^2 with $J - K$ degrees of freedom under the null hypothesis of valid instruments, where J is the number of instruments and K is the number of regressors.

2.3.4 Biases from ignoring endogeneity of board structure and performance

Our null endogenous determinants hypothesis asserts that board structure does not have a causal relationship with firm performance. We also suggest that under this hypotheses, we can predict the biases that will occur if one ignores endogeneity. Here we more fully describe how these biases arise.

Biases resulting from OLS estimation of a static model

One implication of the model developed by Hermalin and Weisbach (1998) is that the intensity of board monitoring decreases with managerial ability. Since firm performance is positively correlated with CEO ability, OLS estimation that ignores unobservable ability will result in a *negative* bias when estimating the effect of independence on performance. Since board independence and size are positively correlated in a static framework, OLS estimation will also result in a *negative* bias in the estimate of board size on performance.

Biases resulting from fixed effects estimation of a static model

If we have panel data, we can estimate fixed effects regressions to eliminate the unobservable heterogeneity. However, fixed effects will be biased if the explanatory variable is correlated with past realizations of the dependent variable, which is the central argument of this paper. Consider the linear model:

$$y_t = \beta x_t + \eta + \epsilon_t \tag{2.10}$$

where η represents an unobserved fixed effect. A fixed effects transformation, which requires time-demeaning all variables yields:

$$\ddot{y}_t = \beta\, \ddot{x}_t + \epsilon_t \tag{2.11}$$

where $\ddot{x} = x_{it} - \bar{x}_i$ and $\ddot{y} = y_{it} - \bar{y}_i$. The limiting value of the fixed effects estimator (Wooldridge (2002)) is given by:

$$plim(\hat{\beta}_{FE}) = \beta + \left[\frac{1}{T}\sum_{t-1}^{T} E(\ddot{x}'_{it}\ddot{x}_{it})\right]^{-1}\left[\frac{1}{T}\sum_{t-1}^{T} E(\ddot{x}'_{it}\epsilon_{it})\right] \tag{2.12}$$

The direction and bias of the FE estimator will depend on $E(\ddot{x}'_{it}\,\epsilon_{it})$. If we assume that the board structure (x) at time t depends on performance (y) at time $t-1$ (or earlier), then:

$$\frac{1}{T}\sum_{t-1}^{T} E(\ddot{x}'_{it}\epsilon_{it}) = -\frac{1}{T}\sum_{t-1}^{T} E(\bar{x}'_{i}\epsilon_{it}) = -E(\bar{x}'_{i}\bar{\epsilon}_{i}) \neq 0 \tag{2.13}$$

(2.13) suggests that if the explanatory variable, x is positively (negatively) related to past values of the dependent variable, y, then a fixed effects estimate of current values of

y on current values of x will be negatively (positively) biased. It also suggests that even if there is no causal relation from x to y, a fixed effects regression could a yield a spurious estimate of the effect of x on y.

To further illustrate how a spurious correlation could arise if there is dynamic endogeneity, consider a simple model in which past performance (y) causes changes in governance (x) but x does not cause y. The model can be written as follows:

$$\Delta y_{it} = \epsilon_{it} \tag{2.14}$$
$$\Delta x_{it} = A(L)\Delta y_{it} + \varepsilon_{it}$$
$$\epsilon_{it}, \varepsilon_{it} \sim i.i.d.,\ N(0,1)$$

where L is the lag operator and $A(L) = a_1 L + a_2 L^2 + \ldots + a_T L^T$, where all the coefficients have the same sign. Since Δx_{it} is an unambiguously signed linear combination of past changes in y, we can write each x_{it} as:[3]

$$x_{it} = x_{i0} + C^t(L)\Delta y_{it} + u_{it} \tag{2.15}$$

where $C^t(L)$ is a time-varying polynomial whose coefficients are all the same sign, x_{i0} is some initial value of x independent of future performance shocks ($E[x_{i0}\epsilon_{it}] = 0$) and where u_{it} is a random error such that $E[\epsilon_{it}u_{js}] = 0,\ \forall i \neq j$ and $t \neq s$.

Substituting (2.15) into (2.13) and making use of our assumptions above that x is orthogonal to current or future innovations y, $E[x_{i0}\epsilon_{it}] = E[\epsilon_{it}u_{js}]0$ and $\epsilon_{it} \sim i.i.d.,\ N(0,1)$, we get:

$$\begin{aligned} -E(\bar{x}_i'\bar{\epsilon}_i) &= -\frac{1}{T^2}\sum_{t=1}^{T}\left[\sum_{t=1}^{T} x_t \sum_{r=1}^{T}\epsilon_{t-r}\right] = -\frac{1}{T^2}\sum_{t=1}^{T}\left[\sum_{t=1}^{T} C^t(L)\Delta y_t \sum_{r=1}^{T}\epsilon_{t-r}\right] \\ &= -\frac{1}{T^2}\sum_{t=1}^{T}\left[\sum_{t=1}^{T} C_r^t(L)\epsilon_t \sum_{r=1}^{T}\epsilon_{t-r}\right] \end{aligned}$$

Simplifying we obtain

$$-E(\bar{x}_i'\bar{\epsilon}_i) = -\frac{1}{T^2}\sum_{t=1}^{T}\sum_{r=1}^{T} C_r^t \tag{2.16}$$

[3]See Roodman (2008). Roodman (2008) also derives the potential biases from fixed effects regressions of y on leads or lags of x for the model specified in (2.14)

(2.16) suggests that even if there is no causal effect of x on y, a fixed effects regression of y on x could yield a spurious but statistically significant estimate of such an effect. The sign of the estimate will be the opposite of that of the dynamically endogenous effect of past y on current x.

If board independence is negatively related to past performance, then a fixed effects estimate of board independence on firm performance in a static model will be positively biased. If board size is positively related to past performance, a fixed effects regression of board size on firm performance will be negatively biased.

The following table summarizes our key predictions of the relation between the board structure variable and performance based on the endogenous determinants hypothesis (where the true relation is zero):

	Prediction		
	Static Model		Dynamic Model
	OLS	Fixed Effects	System GMM
Board Size	Negative	Negative	Zero
Board Independence	Negative	Positive	Zero

2.3.5 Illustrating the bias from dynamic endogeneity

Above, we note that OLS and fixed effects will be biased if our explanatory variables are not strictly exogenous and the panel's time dimension is small. In this section, we use a numerical simulation to illustrate this bias and to show the power and unbiasedness of the system GMM estimator.

Consider the case where the true model (data generating process) for firm performance (y_{it}) is:

$$y_{it} = \beta x_{it} + \gamma z_{it} + \eta_i + \varepsilon_{it}, \qquad \varepsilon_{it} \sim N(0, \sigma_e^2) \tag{2.17}$$

In this model, performance, y_{it}, is determined by an endogenous governance factor, x, a strictly exogenous factor, z, and an unobservable firm-specific factor, η. z is strictly exogenous in the sense that it does not depend on past performance or the unobservable firm factor.

The endogenous governance factor is determined by the process:

$$x_{it} = \alpha x_{it-1} + \pi z_{it} + \lambda y_{it-1} + \delta \eta_i + \varepsilon_{it} \qquad \varepsilon_{it} \sim N(0, \sigma_e^2) \tag{2.18}$$

In this model, x is endogenous in two dimensions. First, it exhibits dynamic endogeneity because it relates to past performance, y, through λ. Parameter λ captures the key aspect of dynamic endogeneity. Second, x is also correlated with the unobserved firm specific factor, η. Thus, any estimation of equation (2.18) needs to account for both dynamic endogeneity and unobserved heterogeneity. The researcher, unaware of the true model, estimates equation (2.17) to draw inferences based on the magnitude and significance of the estimated coefficient, $\hat{\beta}$.

We simulate the system given by (2.17) and (2.18) and generate panel data sets of time and cross-sectional dimensions that are typical in corporate governance research ($T = 5$, 10 and $N = 500$). We then estimate (2.17) using OLS, fixed effects and Arellano and Bond (1991)'s dynamic GMM estimator.

Table 2.2 reports the results. We generate data using the following parameters: $\gamma = 0.6$, $\kappa = 0.9$, $\alpha = 0.7$, $\pi = 0.2$, $\delta = 0.5$, and a range of values for the dynamic adjustment factor, λ. We report results for different values of λ since this essentially captures the dynamic nature of the panel. The reported coefficients and standard errors are based on 1,000 replications.

In every case where $\lambda \neq 0$, the estimates of $\hat{\beta}$ from OLS and fixed effects are biased. OLS estimates are biased largely because of unobserved heterogeneity. The fixed-effects estimates appear less biased than those of OLS estimates because fixed effects eliminate the unobserved heterogeneity; however, they are still biased due to dynamic endogeneity. Only in the singular case when $\lambda = 0$ (in which case, there is no dynamic 'feedback') are the fixed-effects estimates unbiased. Although the bias of the fixed-effects estimates decreases as T increases, we need a long time series to completely eliminate the bias. For example, Judson and Owen (1999) show that even when T is 30, the bias of the fixed effects estimator can still be quite large and significant. However, most corporate governance studies have limited time-series; typically, $T < 10$.[4]

Panel A of Table 2.2 shows the simulation results when the true $\beta = 0$. That is, the truth is that governance does not impact performance. However, OLS and fixed-effects' estimates are significantly biased, producing a spurious correlation between governance and firm performance. For example, when the true β is zero and there is a modest amount of dynamic endogeneity ($\lambda = -0.1$), fixed-effects estimation produces a statistically significant estimate of 0.3787 with a 0.0740 standard error in a sample where $T = 5$. Overall, Table 2.2 suggests that both OLS and fixed effects, ignoring dynamic endogeneity, lead us to wrongly infer that governance affects performance.

Table 2.2 also shows that Arellano and Bond (1991)'s dynamic GMM estimator produces unbiased results regardless of the magnitude of λ. This estimator uses lagged variables of all the dependent and independent variables as GMM instruments. Not only does it control for dynamic endogeneity, it actually exploits it to obtain unbiased results. In Panel C, we show results for when the true β is 0.3 to demonstrate that the dynamic GMM estimator gives a consistent estimate of the true relation between the endogenous explanatory variable and the dependent variable if such a relation actually exists. Indeed, a further benefit is that the GMM procedure does not require knowledge of the dynamic process that generates the endogenous variable in order to produce consistent and unbiased results.

Overall, the numerical simulation illustrates the pitfalls inherent in ignoring dynamic endogeneity and unobserved heterogeneity in panel data samples. It also illustrates the relative power and unbiasedness of the GMM dynamic estimator when the variable of

[4] For example, studies of governance and ownership that have relied on panels include Yermack (1996) where T=7 and Himmelberg, Hubbard, and Palia (1999) where T=10.

interest adjusts to past realizations of the dependent variable, which is likely to be the case with corporate governance variables.

Next, we examine the relation between performance and board structure using actual data, and compare the results of OLS and fixed effects estimates (used in prior studies) to those obtained with dynamic GMM estimation.

2.4 Data, Sample Selection and Variables

In this section we describe the data we use in our empirical analysis.

2.4.1 Data and Sample Selection

Board structure is highly persistent. This can attenuate the signal-to-noise ratio and reduce the power of any panel data estimator (see, for example, Zhou (2001)). Dynamic estimation also requires that we assume transient errors are uncorrelated. To mitigate these concerns, we sample at two-year intervals instead of every year, using governance data from 1991, 1993, 1995, 1997, 1999, 2001 and 2003.

We use the board data from Linck, Netter, and Yang (2008), which they collected from the DISCLOSURE database. DISCLOSURE is a comprehensive database of over 7,000 firms starting in 1991. Since our empirical tests include a number of control variables, we match the DISCLOUSRE with data from CRSP and COMPUSTAT, leaving a sample of more than 6,000 unique firms and over 16,000 firm-years. To our knowledge, this is the largest panel to date that has been used to study the performance/governance relationship. Table 2.3 reports summary statistics of our board and control variables. To avoid sample selection issues we do not require a balanced panel; thus, the number of firms differs each year – the estimation strategy uses as all available observations. The sample includes both large and small firms, unlike most previous studies that tend to focus on either large or small firms.

2.4.2 Measuring firm performance

The primary performance measure we use is return on assets (ROA), where ROA is defined as operating income before depreciation (COMPUSTAT item #13) divided by fiscal year end total assets (COMPUSTAT item #6). We also estimate industry adjusted ROA, which is the firm's ROA less the industry median ROA, defining industry by the 2-digit SIC code.

Many studies that examine the governance/performance relationship use Tobin's Q as a measure of firm performance. This can be a problem for a number of reasons. Tobin's Q (usually defined as a market-to-book ratio) is a proxy for growth opportunities, and there is strong theoretical reason to expect that growth opportunities are a cause, rather than a consequence, of governance structures. Linck, Netter, and Yang (2008), Boone, Field, Karpoff, and Raheja (2007), and Lehn, Patro, and Zhao (2004) provide empirical evidence to support this notion. Thus, we use market-to-book as a control variable rather than a performance measure. However, for robustness and for comparison with existing research, we examine our results using Tobin's Q as a performance measure. Further, we also replicate our results using return on sales (ROS) as a performance measure to assess whether our results are sensitive to the specific performance measures we select.

2.4.3 Governance variables

We consider the effect of past performance on three board structure variables - board size, board composition and board leadership. More precisely, these variables are defined as follows:

- $LogBSIZE$, the logarithm of the number of directors on the board.
- $INDEP$, the proportion of outside (non-executive) directors on the board.
- CEO_CHAIR, a dummy variable equal to 1 if the CEO is also the chairman of the board.

2.4.4 Control variables

Recent studies (Raheja (2005), Coles, Daniel, and Naveen (2008), Boone, Field, Karpoff, and Raheja (2007) and Linck, Netter, and Yang (2008)) suggest that firms will choose their board structures based on the relative costs and benefits of each governance mechanism. The firm's chosen board structure will reflect the monitoring costs and private benefits of control the firm faces, as well as the scope and complexity of its operations. Thus, as suggested by the prior literature, we use size, age, the number of business segments, growth opportunities, and leverage as determinants of board structure. Specifically, we define our control variables as follows:

- $LogMVE$, logarithm of the market value of equity.
- MTB, ratio of market-to-book value. This is obtained as market value of equity *plus* book value of assets (COMPUSTAT item #6) *minus* book value of equity (COMPUSTAT item #60) *minus* deferred taxes (COMPUSTAT item #74), all *divided* by book value of assets.
- $RETSTD$, standard deviation of (the past twelve months) of the firm's stock returns.
- $LogAGE$, the logarithm of the firm's age, where age is computed from the time the firm first appears on CRSP.
- $LogSEGMENTS$, the logarithm of the number of business segments.
- $DEBT$, the ratio of the firm's long-term debt (COMPUSTAT item #9) to total assets (COMPUSTAT item #6).

Since these variables might also be related to firm performance, they serve as control variables in our empirical specification of firm performance.

2.5 The relation between board structure and firm performance

Previously we argued that the past is an excellent instrument for current governance and current firm characteristics because the present is correlated with the past, but is exogenous with respect to expected future realizations if go back far enough (greater than p lags into the past). Next, we examine the empirical validity of these predictions.

2.5.1 How many lags of performance are needed to ensure dynamic completeness?

Empirically it is important to understand how many lags of performance we need to capture all information from the past. This is important for at least two reasons. First, failure to capture all influences of the past on the present could still mean that equation (2.3) is mis-specified. Second, and perhaps more importantly, we argue that all older lags are exogenous with respect to residuals of the present; thus, they can be used as instruments. This is important for consistent estimation using the dynamic panel GMM estimator.

While we would like to include as many lags as possible, our short panel means that every lag we include substantially reduces our sample size. In addition, including too many lags of performance might drive sample selection biases since this automatically excludes younger firms with shorter histories. Thus, we face a trade-off between including as many lags as possible to capture all dynamic endogeneity, and retaining a reasonable sample size.

Glen, Lee, and Singh (2001) and Gschwandtner (2005) suggest that two lags is sufficient to capture the persistence of profitability. Thus, we propose including two lags in our estimates of the performance/governance relation (i.e., we set $p = 4$ in equation (2.3) since our data is sampled every two years). To see if two lags are sufficient to ensure dynamic completeness, we estimate a regression of current performance on *four* lags of past performance, controlling for other firm-specific characteristics. Table 2.4 shows the results. We use two profitability measures: return on assets (*ROA*) and return on sales

(*ROS*). Results suggest that including two lags is sufficient to capture the dynamic endogeneity of the governance/performance relation. In columns (1) and (3) the first two lags are statistically significant while older lags are insignificant. In columns (2) and (4) we drop the recent lags and include only the older lags. In these specifications, the older lags are statistically significant. Thus, while the older lags include relevant information, that information is subsumed by the more recent lags.

As an additional test of dynamic completeness, we perform post-estimation tests for first- and second-order serial correlation after our estimates of the effect of governance on firm performance (see Section 5.3).

2.5.2 How strongly is the present correlated with the past?

A central argument in our paper is that board structure (size and independence) and other firm-specific variables are related to past performance. We test this assertion directly with a series of tests. Our first set of tests involve OLS regressions of (1) current *levels* of board size, independence and other firm specific variables and (2) *changes* in these levels on past performance and historical values of the firm-specific variables.

The results are shown in Table 2.5. In panel A, we present results from OLS regressions of the *levels* of board structure and other firm characteristics on performance and characteristics from two years before. We find that board independence is significantly negatively related to past performance as suggested by Hermalin and Weisbach (1998), and previously documented by Hermalin and Weisbach (1988). We also find that board size is significantly positively related to past performance, although the significance level drops when we control for past firm size. Further, current board size is significantly positively related to past firm size, and firm size is significantly related to past performance. The results suggest that firms that have done well in the past will be larger today and as a result will have bigger boards, as suggested by Fama and Jensen (1983) and documented by Boone, Field, Karpoff, and Raheja (2007), Coles, Daniel, and Naveen (2008) and Linck, Netter, and Yang (2008).

Panel B of Table 2.5 shows the results from OLS regressions of *changes* in board structure and firm characteristics on the levels performance and characteristics from two years before. The results are similar to those obtained from using the levels as dependent variables. Changes in board independence are negatively related to past performance, while changes in board size are positively related to past performance. Again we find that changes in board size in response to past performance is through the effect of performance on firm size.

Table 2.5 also shows that even the potential control variables are dynamically endogenous. Current levels and changes in market-to-book (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$) and leverage ($DEBT$) are all significantly related to past performance. This highlights the fact that it is not only corporate governance that can be considered endogeneous, but *all* the control variables that we may want to use as proxies for the firm's operating and contracting environment are likely to be endogenous as well.

We carry out a second test of strict exogeneity suggested by Wooldridge (2002). If $\mathbf{X}_{i,t}$ contains the explanatory governance and control variables, we can test for strict exogeneity by estimating the following fixed effects model:

$$\mathbf{y}_{i,t} = \alpha + \beta\mathbf{X}_{i,t} + \Omega\mathbf{W}_{i,t+2} + \eta_i + \varepsilon_{it}, \qquad t = 1991, 1993, 1995, \ldots, 2001 \tag{2.19}$$

where $\mathbf{W}_{i,t+2}$ is a subset of future values of the corporate governance and control variables. Under the null hypothesis of strict exogeneity, $\Omega = 0$.

Table 2.6 shows the results of estimating (2.19), with different subsets of the governance and control variables, $\mathbf{W}_{i,t+2}$. In every specification in which they are included, the coefficient estimates for the future vales of both board size ($LogBSIZE_{t+2}$) and CEO as board chair (CEO_CHAIR_{t+2}) are significantly different from zero. This suggests that neither of these board variables are strictly exogenous and instead adjust in response to firm performance. In addition, the coefficient estimates on the future values of some control variables ($LogMVE_{t+2}$, $RETSTD_{t+2}$ and $DEBT_{t+2}$) are also significantly different from zero, suggesting that these variables also adjust to firm performance. An F-test of the joint significance of the coefficient estimates of all the futures values is also significant.

Overall, the results from Table 2.6 suggest that neither the board structure nor the firm control variables are strictly exogenous, and confirms both our theoretical predictions and the results from the OLS regressions in Table 2.5.

In the system GMM estimate of the dynamic model, we explicitly assume that we can use the firm's history as instruments for the present. In fact, once we determine that two lags of performance are sufficient to ensure dynamic completeness, we assume that we can use older values of performance and firm characteristics as instruments for current values. To empirically examine the validity of this assumption we regress current values of all our board structure variables and firm characteristics on historical values, lagged three periods, i.e., values at time $t - 6$.

Table 2.7 reports the results. Even at a horizon of three periods (six years) we see a strong relation between current and historical values of our explanatory variables. Column (1) shows a negative relation between board independence and past firm performance, as predicted in the model by Hermalin and Weisbach (1998). Columns (2) shows a positive relation between board size and firm performance although columns (3) and (4) suggest that this relation is largely through the effect of past firm performance on firm size.

In summary, the results in Tables 2.5, 2.6 and 2.7 support the hypothesis that any estimate of the governance/performance relationship must be based on a dynamic model, and supports our contention that a firm's past provides valid instruments for current governance.

2.5.3 The relation between board structure and current firm performance

In this section, we examine the results from estimating the relation between board structure and current firm performance. In order to compare to past research and highlight the potential problems from ignoring dynamic endogeneity, we estimate the following models:

1. A static OLS model
2. A static fixed effects model
3. A dynamic OLS model
4. A dynamic fixed effects model (System GMM)[5]

Table 2.8 reports the results when we use return on assets (ROA) as our performance measure. Static OLS and fixed effects estimates suggest a *negative* relation between board size and firm performance. This finding is similar to those obtained by a number of prior studies including Yermack (1996), Eisenberg, Sundgren, and Wells (1998) and Bhagat and Black (2002). These results disappear when we control for dynamic endogenity: board size is no longer significantly related to firm performance. For example, the coefficient on board size is a significantly negative -0.0262 ($t = 5.76$) using OLS, but is insignificant in the dynamic OLS model that includes lagged performance (-0.0033, $t = -0.73$). The

[5] An intuitive way of thinking about the dynamic model is that it is essentially an empirical estimate of the following dynamic simultaneous equation model:

$$\begin{bmatrix} y_t \\ \mathbf{X}_t \\ \mathbf{Z}_t \end{bmatrix} = \begin{bmatrix} \alpha_y \\ \alpha_x \\ \alpha_z \end{bmatrix} + \begin{bmatrix} 0 & \kappa_{y2} & \kappa_{y2} & 0 \\ \kappa_{x0} & \kappa_{x2} & \kappa_{x4} & \kappa_{x6} \\ \kappa_{z0} & \kappa_{z2} & \kappa_{z4} & \kappa_{z6} \end{bmatrix} \begin{bmatrix} y_t \\ y_{t-2} \\ y_{t-4} \\ y_{t-6} \end{bmatrix} + \begin{bmatrix} \beta_{y0} & 0 & 0 & 0 \\ 0 & \beta_{x2} & \beta_{x4} & \beta_{x6} \\ 0 & \beta_{z2} & \beta_{z4} & \beta_{z6} \end{bmatrix} \begin{bmatrix} \mathbf{X}_t \\ \mathbf{X}_{t-2} \\ \mathbf{X}_{t-4} \\ \mathbf{X}_{t-6} \end{bmatrix}$$
$$+ \begin{bmatrix} \gamma_{y0} & 0 & 0 & 0 \\ 0 & \gamma_{x2} & \gamma_{x4} & \gamma_{x6} \\ 0 & \gamma_{z2} & \gamma_{z4} & \gamma_{z6} \end{bmatrix} \begin{bmatrix} \mathbf{X}_t \\ \mathbf{X}_{t-2} \\ \mathbf{X}_{t-4} \\ \mathbf{X}_{t-6} \end{bmatrix} + \begin{bmatrix} \eta \\ \eta \\ \eta \end{bmatrix} + \begin{bmatrix} \epsilon_{yt} \\ \epsilon_{xt} \\ \epsilon_{zt} \end{bmatrix}$$

where y_t is firm performance, $\mathbf{X}_t$ contains the governance variables and $\mathbf{Z}_t$ contains the firm characteristics. The essential difference between the OLS and the System GMM estimates is that OLS requires the restrictive assumption that $\kappa_{x0} = \kappa_{z0} = 0$, i.e., no simultaneity and that $\eta = 0$, i.e., no unobservable heterogeneity. See Engle, Hendry, and Richard (1983) and Holtz-Eakin, Newey, and Rosen (1988) for a discussion of this concept.

coefficient on board size is also significantly negative (-0.0261, $t = -4.52$) in the static fixed-effects model. However, this disappears when we include dynamics via the dynamic GMM estimator (0.0293, $t = 0.79$). A t-test of the difference between the static fixed-effects and dynamic GMM coefficients is significantly positive ($t = 2.07$).[6] The fixed-effects point estimate lies outside a 90% confidence around the GMM estimate. The negative bias in the fixed effects' coefficient estimate is consistent with the bias we expect to have from ignoring dynamic endogeneity. That is, if board size is positively related to past performance, then fixed effects estimates of the relation between board size and firm performance will be negatively biased.

The static OLS estimation also suggests a negative relation between board independence and firm performance, similar to that reported in a number of prior studies including Yermack (1996), Klein (1998) and Bhagat and Black (2002). Interestingly, when we estimate this in a static fixed effects' model, the sign flips to positive and significant. However, in both the dynamic OLS model and the dynamic GMM model, the relation between board independence and firm performance becomes insignificant. The positive bias in the static fixed effects estimates is the bias we would expect to be introduced by ignoring dynamic endogeneity. If board independence is negatively related to past performance, then fixed effects estimates of the relation between board independence and firm performance will be positively biased.

Table 2.8 also includes a number of specification tests for the validity of the dynamic models. The biggest concern is whether or not we have included enough lags to control for dynamic endogeneity. Wooldridge (2002, page 176) suggests that if the model is dynamically complete then there should be no serial correlation in the residuals. In Table 2.8, $AR(1)$ and $AR(2)$ are tests of the null hypothesis of no first or second order serial correlation. For the dynamic OLS results, there does not appear to be any serial correlation: $AR(1)$ and $AR(2)$ have p-values of 0.22 and 0.77 respectively. For our GMM estimates, if

[6] This t-statistic is calculated as the difference between the two point estimates divided by the square root of the sum of square of the standard errors of the point estimates

the assumptions of our specification are valid, then by construction the residuals in first differences ($AR(1)$) should be correlated, but there should be no serial correlation in second differences ($AR(2)$). Results of these tests confirm that this is the case: the $AR(2.1)$ test yields a p-value of 0.00 and the $AR(2)$ test yields a p-value of 0.83. Taken together, these tests suggest that two lags of past performance are sufficient to capture the dynamic endogeneity of board structure with respect to past performance. We also include a Hansen test for over-identifying restrictions (J-statistic) in the System GMM estimates. Under the hypothesis of instrument validity, this statistic should be distributed χ^2. Results reveal a J-statistic with a p-value of 0.11, so we cannot reject the hypothesis that our GMM instruments are valid.

2.5.4 Robustness tests

Alternative measures of firm performance

We re-estimate the relation between firm performance and board structure using two alternative performance measures - return on sales and Tobin's Q. Return on sales is measured as operating income divided by total sales. We also compute an industry adjusted ROS for each firm, which is the individual firm *ROS* less the median industry ROS, where industry is defined by the 2-digit SIC code. Tobin's Q is the market value of equity *plus* book value of assets *minus* book value of equity *minus* deferred taxes, all *divided* by book value of assets.

The first two columns of Table 2.9 show the results of static and dynamic (System GMM) fixed effects estimates using return on sales (ROS) as the measure of a firm performance. The results are similar to those obtained when we use return on assets (ROA). The fixed effects regression shows a negative relation between board size and firm performance; however, the coefficient is insignificant with GMM estimation. The fixed effects regression also shows a positive relation between independence and firm performance. Again, using GMM estimation we find no relationship between independence and performance. As with *ROA*, the biases we observe are consistent with the biases we expect to be induced from ignoring dynamic endogeneity.

Table 2.9 also shows the results from using Tobin's Q as the performance measure. Earlier we argue that Tobin's Q is likely to be a problematic measure of firm performance when examining the effect of board structure variable on performance. This is because market-to-book (which is the most commonly used proxy for Q) likely reflects a firm's growth opportunities, and prior research suggests that growth opportunities affect board structure. However, if we assume that growth opportunities are likely to be common across industries, using an industry-adjusted market-to-book value as a proxy for Tobin's Q may help to separate the "performance" component of Tobin's Q from the "growth opportunities" component.

The last two columns of Table 2.9 show the results of static and dynamic (System GMM) fixed effects estimates using Tobin's Q as the performance measure. The results are similar to those obtained from using *ROA* and *ROS*. The fixed effects regression that ignores dynamic endogeneity suggests a negative relation between board size and firm performance and a positive relation between independence and firm performance. Again we see that once we control for dynamic endogeneity and estimate the relationship using System GMM, we find no relationship between any board variables and firm performance. Past performance is the only significant determinant of current performance.

Ownership, board structure and performance

As an additional robustness test, we consider the impact of ownership on estimates of the relation between board structure and firm performance. While ownership could be directly related to firm performance, a number of studies (e.g., Demsetz and Lehn (1985); Himmelberg, Hubbard, and Palia (1999); Demsetz and Villalonga (2001); Coles, Lemmon, and Meschke (2008)) suggest that ownership is endogenously determined. Ownership could also affect board structure in a number of ways. For example, ownership concentration could be a substitute governance mechanism that reduces the need for board monitoring. In addition, ownership may affect the CEO's power over the board. There is also evidence that ownership itself is dynamically endogenous: Kole (1996) finds that management ownership is related to past performance.

Table 2.10 shows the results from including ownership variables in our estimates of the relationship between board structure and firm performance. We consider the effects of two ownership variables – CEO ownership and director ownership. All the results are based on dynamic GMM estimation. Again, we find no significant relation between any aspect of board structure and firm performance. Further, we find no relation between ownership and firm performance, a result consistent with Demsetz and Lehn (1985), Himmelberg, Hubbard, and Palia (1999), Demsetz and Villalonga (2001) and Coles, Lemmon, and Meschke (2008).

2.6 Conclusion

While a large body of research suggests that certain governance structures drive improved performance, this research is plagued with endogeneity concerns. In this paper, we examine how dynamic endogeneity – the idea that a firm's current performance affects both future governance and future performance – impacts research efforts to measure the causal relation between governance and firm performance. The key notion is that a major determinant of a firm's governance and contracting environment is the firm's history and past performance, and that failure to account for this may lead to biased inferences. The reason is that the firm's historical performance may proxy for important attributes, such as managerial ability, that are otherwise unobservable and that affect future decisions and performance.

The contribution of this paper, by developing and applying the techniques of dynamic endogenity is two-fold. First, we show how controlling for dynamic endogeneity results in well specified and powerful empirical tests of the relation between corporate governance and firm performance. It enables the corporate finance researcher to improve their estimations, both theoretically and practically, by using instruments that are grounded in theory, as opposed to the more ad hoc instruments often used. Second, we apply this technique to an important question - the relation between board structure and performance. In a panel of 6,000 firms from 1991-2003, we find evidence of dynamic endogeneity. After controlling for it, we find no relation between board size or independence and firm performance. We show the results of earlier studies that do not account for dynamic endogeneity may be biased in a predictable way.

Table 2.1: **Prior empirical analysis of the relationship between board structure and firm performance**

Paper	**Sample**	**Period**	**Performance Measure**	**Methodology**	**Relationship**
Panel A: Papers examining relationship between board independence and firm performance					
Hermalin and Wesibach (1991)	134	1971-1983	Q, ROA	OLS, 2SLS (Instruments: lagged value of management ownership)	None
Mehran (1995)	153	1979-1980	Q, ROA	OLS	None
Agrawal and Knoeber (1996)	800	1988	Q	2SLS (Instruments: Assets, regulatory dummy, founder dummy)	Negative
Yermack (1996)	452	1984-1991	Q, ROA	OLS, FE	OLS: Negative FE: Positive
Klein (1998)	486	1992-1993	ROA, Jensen productivity measure, Market Returns	OLS	Negative
Bhagat and Black (2002)	934	1988-1991	Q, ROA, ROS, Market Returns	OLS, 2SLS	Negative
Coles, Daniel and Naveen (2007)	8,165	1992-2001	Q	OLS, 3SLS	Negative for high R&D firms
Panel B: Papers examining relationship between board size and firm performance					
Yermack (1996)	452	1984-1991	Q, ROA	OLS, FE	OLS: Negative FE: Negative
Eisenberg, Sundgren and Wells (1998)	879	1992-1994	ROA	2SLS (Instruments: firm age, membership in group)	Negative
Bhagat and Black (2002)	934	1988-1991	Q, ROA, ROS, Market Returns	OLS, 2SLS	Negative (None in some specifications)
Coles, Daniel and Naveen (2007)	8,165	1992-2001	Q	OLS, 3SLS	Positive for large diversified firms

Table 2.2: **Measuring the bias when explanatory variables is endogenous: Simulation results**

In this table, we report the simulation results from estimating a model with OLS, fixed effects (FE) and GMM when the explanatory variable is dynamically endogenous and correlated with unobservable effects. The model estimated is: $y_{it} = \mathbf{x}_{it}\beta + \mathbf{z}_{it}\gamma + \eta_i + \nu_{it}$. The true data generating process (DGP) for z_{it} is $z_{it} = \kappa z_{it-1} + \xi_{it}$; and that for x_{it} is $x_{it} = \alpha x_{it-1} + \pi z_{it} + \lambda y_{it-1} + \delta\eta_i + \varepsilon_{it}$. Thus, x_{it} is endogenously related to y_{it-1} through the parameter λ and is endogenously related to the unobserved heterogeneity, η. The parameters used for generating the data in Panels A and B are : $\beta = 0$; $\gamma = 0.6$, $\kappa = 0.9$, $\alpha = 0.7$, $\pi = 0.2$, $\delta = 0.5$. In Panel C, we set $\beta = 0.3$

Panel A: $\beta = 0$, $N = 500$, $T = 5$

	OLS	FE	GMM	OLS	FE	GMM	OLS	FE	GMM
	$\lambda = -0.8$			$\lambda = 0.8$			$\lambda = 0.5$		
$\hat{\beta} - \beta$	-0.0993	0.1467	0.0054	0.1018	−0.0559	−0.0001	0.1461	−0.0706	0.0001
	(0.0132)	(0.0160)	(0.0395)	(0.0052)	(0.0102)	(0.0220)	(0.0077)	(0.0139)	(0.0305)
$\hat{\gamma} - \gamma$	−0.0581	−0.0128	−0.0045	−0.1670	0.0230	−0.0010	−0.1776	0.0243	0.0008
	(0.0108)	(0.0108)	(0.0525)	(0.0110)	(0.0115)	(0.0484)	(0.0114)	(0.0111)	(0.0457)
	$\lambda = -0.1$			$\lambda = 0.1$			$\lambda = 0.0$		
$\hat{\beta} - \beta$	0.6335	0.3787	0.0228	0.3222	−0.0739	0.0007	0.4370	−0.0008	0.0066
	(0.0189)	(0.0740)	(0.1433)	(0.0125)	(0.0319)	(0.0691)	(0.0153)	(0.0464)	(0.0990)
$\hat{\gamma} - \gamma$	−0.2440	−0.0857	−0.0010	−0.2134	0.0197	−0.0010	−0.2287	0.0003	0.0020
	(0.0089)	(0.0194)	(0.0419)	(0.0100)	(0.0133)	(0.0446)	(0.0096)	(0.0153)	(0.0431)

Panel B: $\beta = 0$, $N = 500$, $T = 10$

	OLS	FE	GMM	OLS	FE	GMM	OLS	FE	GMM
	$\lambda = -0.8$			$\lambda = 0.8$			$\lambda = 0.5$		
$\hat{\beta} - \beta$	−0.0989	0.0525	0.0034	0.0977	−0.0185	−0.0007	0.1405	−0.0234	0.0000
	(0.0105)	(0.0079)	(0.0158)	(0.0045)	(0.0046)	(0.0087)	(0.0061)	(0.0063)	(0.0121)
$\hat{\gamma} - \gamma$	−0.0590	−0.0060	−0.0014	−0.1670	0.0230	0.0010	−0.1743	0.014	0.0009
	(0.0085)	(0.0055)	(0.0174)	(0.0110)	(0.0115)	(0.0484)	(0.0091)	(0.0067)	(0.0150)
	$\lambda = -0.1$			$\lambda = 0.1$			$\lambda = 0.0$		
$\hat{\beta} - \beta$	0.6139	0.1312	0.0153	0.3093	−0.0226	0.0020	0.4205	−0.0005	0.0057
	(0.0156)	(0.0348)	(0.0552)	(0.0101)	(0.0143)	(0.0257)	(0.0126)	(0.0209)	(0.0377)
$\hat{\gamma} - \gamma$	−0.2389	−0.0357	−0.0016	−0.2080	0.0086	0.0004	−0.2231	0.0002	0.0006
	(0.0072)	(0.0108)	(0.0161)	(0.0083)	(0.0076)	(0.0145)	(0.0080)	(0.0086)	(0.0144)

Panel C: $\beta = 0.3$, $N = 500$, $T = 5$

	OLS	FE	GMM	OLS	FE	GMM	OLS	FE	GMM
	$\lambda = -0.8$			$\lambda = 0.8$			$\lambda = 0.5$		
$\hat{\beta} - \beta$	-0.1001	0.1483	0.0066	0.1018	−0.0563	0.0009	0.1464	−0.0714	0.0004
	(0.0130)	(0.0159)	(0.0330)	(0.0053)	(0.0092)	(0.0361)	(0.0073)	(0.0135)	(0.0427)
$\hat{\gamma} - \gamma$	−0.0589	−0.0127	−0.0050	−0.1662	0.0227	0.0006	−0.1786	0.0243	0.0028
	(0.0105)	(0.0106)	(0.0530)	(0.0109)	(0.0109)	(0.0459)	(0.0109)	(0.0116)	(0.0462)
	$\lambda = -0.1$			$\lambda = 0.1$			$\lambda = 0.0$		
$\hat{\beta} - \beta$	0.6331	0.3781	0.0267	0.3222	−0.0735	0.0028	0.4369	0.0008	0.0128
	(0.0189)	(0.0716)	(0.1560)	(0.0126)	(0.0322)	(0.0776)	(0.0153)	(0.0463)	(0.0955)
$\hat{\gamma} - \gamma$	−0.2439	−0.0859	−0.0024	−0.2134	0.0197	−0.0009	−0.2287	0.0000	0.0008
	(0.0088)	(0.0190)	(0.0422)	(0.0100)	(0.0132)	(0.0439)	(0.0153)	(0.0463)	(0.0955)

Notes

1. All estimated biases and standard errors are based on 1,000 replications. Standard errors of biases are in parentheses.
2. GMM estimation is carried out using the Arellano and Bond (1991) estimation procedure. Instruments used are: $y_{t-2}, y_{t-3}, \ldots, y_1, x_{t-1}, x_{t-2}, \ldots, x_1, z_{t-1}, z_{t-2}, \ldots, z_1$

Table 2.3: **Summary statistics of board and control variables**

The table contains the sample characteristics of the board and firm characteristics of the firms used in the study. The board variables data comes from the DISCLOSURE database. The control variables data comes from CRSP and COMPUSTAT. **Board size** is the total number of directors on the board. **CEO_Chair** is 1 if the CEO is also the chairman of the board, 0 otherwise. **Board Independence** is the percentage of directors who are not employees of the firm. **Firm Size** is the market value of equity. **Segments** is the number of business segments the firm operates in, as reported by COMPUSTAT. **Firm Age** is computed based on the year the firm first appears on CRSP. **Debt** is the ratio of long-term debt to total assets. **RETSTD** is the standard deviation of the firm's stock returns in the previous twelve months. **Market-to-book** is obtained as the value of equity *plus* book value of assets *minus* book value of equity *minus* deferred taxes, all *divided* by book value of assets. Median values are shown in parentheses; standard deviations are shown in brackets

Panel A: Mean (Median) [Standard Deviation] of Board Variables							
	1991	1993	1995	1997	1999	2001	2003
Board Size	7.79	7.59	7.39	7.49	7.37	7.59	7.93
	(7.00)	(7.00)	(7.00)	(7.00)	(7.00)	(7.00)	(8.00)
	[2.94]	[2.77]	[2.66]	[2.63]	[2.43]	[2.34]	[2.30]
CEO_Chair	0.59	0.60	0.59	0.59	0.59	0.59	0.56
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
	[0.49]	[0.49]	[0.49]	[0.49]	[0.49]	[0.49]	[0.49]
Board Independence	0.63	0.64	0.64	0.67	0.67	0.67	0.71
	(0.66)	(0.67)	(0.66)	(0.70)	(0.69)	(0.70)	(0.71)
	[0.18]	[0.18]	[0.19]	[0.18]	[0.17]	[0.15]	[0.14]

Panel B: Mean (Median) [Standard Deviation] of Firm Characteristics							
	1991	1993	1995	1997	1999	2001	2003
Firm Size (millions)	$1,250	$1,240	$1,430	$2,060	$3,130	$2,610	$3,000
	(100)	(114)	(131)	(186)	(186)	(264)	(358)
	[5,380]	[5,150]	[6,770]	[10,040]	[21,200]	[16,000]	[15,700]
Segments	1.60	1.53	1.46	1.49	2.36	2.50	2.35
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
	[1.09]	[1.03]	[0.95]	[1.13]	[1.84]	[1.99]	[1.79]
Firm Age	15.04	14.42	13.53	13.42	13.38	14.18	15.95
	(10.00)	(10.00)	(9.00)	(8.00)	(8.00)	(9.00)	(10.00)
	[14.46]	[14.36]	[14.52]	[14.66]	[14.18]	[14.47]	[14.61]
Debt	0.17	0.15	0.16	0.16	0.17	0.16	0.15
	(0.12)	(0.10)	(0.11)	(0.11)	(0.11)	(0.09)	(0.09)
	[0.16]	[0.15]	[0.16]	[0.16]	[0.17]	[0.21]	[0.15]
RETSTD	14.29%	14.62%	12.13%	14.30%	17.87%	21.62%	17.64%
	(12.68)	(12.36)	(10.77)	(12.48)	(15.48)	(18.41)	(15.13)
	[7.96]	[9.99]	[6.84]	[8.74]	[11.79]	[13.37]	[10.93]
Market-to-Book	1.92	2.07	1.93	2.11	2.49	1.94	2.15
	(1.24)	(1.49)	(1.50)	(1.58)	(1.32)	(1.38)	(1.63)
	[2.88]	[1.93]	[2.14]	[1.77]	[4.19]	[1.88]	[1.73]
Number of observations	2,492	2,913	3,025	3,261	3,160	2,754	2,398

Table 2.4: **How many lags of firm performance are significant?**
In this table, we report results from the OLS estimation of the model:

$$y_{it} = \alpha_1 + \sum_{p=2}^{p=8} \kappa_p y_{it-p} + \kappa \mathbf{Z}_{it} + \eta_i + \epsilon_{it}, \qquad t = 1999, 2001, 2003$$

y_{it} is ROA or ROS. $\mathbf{Z}_{it}$ includes firm size ($LogMVE$), market-to-book ratio (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$) and leverage ($DEBT$). t-statistics are reported in parentheses. All t-statistics are based on robust, firm-clustered standard errors. a, b, c represent significance at the one percent, five percent and ten percent level respectively. Year dummies are included in all specifications.

Dependent Variable	Performance ROA	Performance ROA	Performance ROS	Performance ROS
Performance$(t-2)$	**0.4823**^{a}		**0.5905**^{a}	
	(16.34)		(10.68)	
Performance$(t-4)$	**0.0766**^{b}		0.0183	
	(2.27)		(0.36)	
Performance$(t-6)$	0.0255	**0.2450**^{a}	0.0701	**0.2681**^{a}
	(0.72)	(5.97)	(5.58)	(5.58)
Performance$(t-8)$	0.0400	**0.1080**^{a}	0.0566	**0.1470**^{a}
	(1.61)	(3.38)	(1.40)	(3.24)
$LogMVE$	**0.0036**^{a}	**0.0079**^{a}	**0.0045**^{a}	**0.0137**^{a}
	(3.37)	(5.79)	(3.22)	(7.45)
MTB	**0.0120**^{a}	**0.0141**^{a}	**0.0124**^{a}	**0.0126**^{a}
	(5.71)	(5.39)	(6.11)	(4.99)
$RETSTD$	−**0.0991**^{a}	−**0.1711**^{a}	−**0.1109**^{a}	−**0.1943**^{a}
	(−3.42)	(−5.07)	(−3.28)	(−4.63)
$LogSEGMENTS$	0.0024	0.0018	0.0018	−0.0021
	(1.10)	(0.62)	(0.67)	(−0.56)
$LogAGE$	−0.0043	−**0.0081**^{b}	−0.0016	−**0.0108**^{b}
	(−1.35)	(−2.10)	(−0.41)	(−2.20)
$DEBT$	0.0166	0.0019	**0.0311**^{b}	**0.0356**^{b}
	(1.23)	(0.12)	(2.28)	(2.17)
R^2	0.47	0.27	0.51	0.30

Table 2.5: **Relationship between board structure, firm-specific variables and past performance**
In this table we report the results of OLS regressions of current board size ($LogBSIZE$), independence ($INDEP$) and current firm specific variables, on past performance and historic values of the firm specific variables. Performance is measured by return on assets (ROA). The firm-specific include firm size ($LogMVE$), market-to-book ratio (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$) and leverage ($DEBT$). Panel A reports the results of the regressions in which the dependent variables are current levels. Panel B reports the results of the regression in which the dependent variable is the change from $t-1$ to t. All t-statistics (in parentheses) are based on robust standard errors. Year dummies are included in all specifications. Items in **boldface** are significant at the 10% level or higher.

Panel A: Dependent variable is level at time t

	Indep	LogBsize	LogBsize	LogMVE	MTB	Retstd	LogSeg	Debt
ROA($t-2$)	**−0.0185**	**0.0956**	0.0048	**4.2779**	**−0.7200**	**−0.1637**	**−0.1868**	**−0.1027**
	(−1.76)	(6.02)	(0.30)	(21.73)	(−2.47)	(−18.32)	(−4.35)	(−6.31)
LogMVE ($t-2$)	**0.0085**		**0.0241**		**0.2288**	**−0.0105**	**0.0634**	**0.0208**
	(10.31)		(18.96)		(21.63)	(−16.63)	(17.98)	(16.02)
MTB ($t-2$)	**−0.0017**	**−0.0037**	**−0.0024**	**0.1731**		**0.0051**	**−0.0188**	**−0.0113**
	(−2.26)	(1.14)	(−5.46)	(4.17)		(5.21)	(−3.75)	(−3.73)
Retstd ($t-2$)	0.0230	**−0.0533**	**−0.0827**	**−3.1313**	**2.2846**		**−0.2483**	**−0.0876**
	(1.83)	(−4.23)	(−2.73)	(−10.07)	(6.89)		(−3.56)	(−4.29)
LogSeg ($t-2$)	**0.0060**	**0.0010**	0.0067	**0.5535**	**−0.2642**	**−0.0029**		**0.0228**
	(2.97)	(3.03)	(0.32)	(16.83)	(−10.61)	(−1.89)		(6.58)
LogAge ($t-2$)	0.0006	**0.0101**	**0.0082**	**0.3079**	**−0.1773**	**−0.0151**	**0.1225**	**−0.0109**
	(0.55)	(5.53)	(4.61)	(16.00)	(−10.12)	(−17.44)	(22.63)	(−5.66)
Debt ($t-2$)	**−0.0190**	**0.0482**	0.0083	**2.1498**	**−2.0266**	**−0.0118**	**0.1592**	
	(−2.61)	(4.54)	(0.81)	(15.11)	(−16.46)	(−2.03)	(4.46)	
Indep ($t-2$)	**0.6010**	0.0036	− **0.0301**					
	(65.13)	(0.29)	(−2.45)					
LogBsize ($t-2$)	**0.0193**	**0.7836**	**0.7242**					
	(3.94)	(115.34)	(93.38)					
R^2	0.4753	0.7036	0.7147	0.2645	0.0946	0.2657	0.2023	0.0684

Panel B: Dependent variable is change from $t-1$ to t

	ΔIndep	ΔLogBsize	ΔLogBsize	ΔLogMVE	ΔMTB	ΔRetstd	ΔLogSeg	ΔDebt
ROA($t-2$)	**−0.0254**	**0.0158**	0.0067	**0.1667**	**−0.5963**	**−0.1540**	**0.0563**	**−0.0220**
	(−2.40)	(6.13)	(0.42)	(1.88)	(−2.35)	(−17.43)	(1.96)	(−2.20)
LogMVE ($t-2$)	**0.0108**		**0.0244**	**−0.0231**	**0.1082**	**−0.0083**	**0.0167**	**0.0040**
	(14.38)		(20.78)	(−5.65)	(4.03)	(−13.93)	(8.06)	(6.45)
MTB ($t-2$)	**−0.0022**	0.0034	**−0.0024**	**−0.0323**	**−0.7290**	**0.0036**	**−0.0044**	−0.0005
	(−2.65)	(1.36)	(−5.17)	(−5.84)	(10.60)	(5.25)	(−2.81)	(−0.77)
Retstd ($t-2$)	0.0165	**−0.0379**	**−0.1695**	**−0.1358**	**0.9684**	**−0.8251**	−0.0361	−0.0162
	(1.27)	(−3.61)	(−1.96)	(−1.76)	(2.69)	(−46.10)	(−0.68)	(−1.39)
LogSeg ($t-2$)	**0.0057**	**0.0010**	0.0067	**−0.0420**	**−0.1568**	−0.0007	**−1889**	**0.0051**
	(2.71)	(3.17)	(0.32)	(−3.52)	(−4.54)	(−0.49)	(−28.28)	(2.49)
LogAge ($t-2$)	0.0011	**0.0099**	**0.0076**	**0.0149**	**−0.0667**	**−0.0111**	**0.0141**	**−0.0057**
	(0.30)	(4.34)	(4.19)	(2.10)	(−2.77)	(−12.63)	(3.87)	(−4.77)
Debt ($t-2$)	**−0.0129**	**0.0358**	**0.0008**	**−0.1647**	**0.0132**	**−0.0235**	−0.0174	**−0.2644**
	(−1.67)	(3.24)	(0.07)	(−3.83)	(2.54)	(−3.79)	(−0.83)	−(20.60)
Indep ($t-2$)	**−0.4008**							
	(−44.27)							
LogBsize ($t-2$)		**−0.2265**	**−0.2905**					
		(−31.45)	(−35.40)					
R^2	0.2251	0.1823	0.1623	0.0586	0.5375	0.4791	0.2004	0.0684

Table 2.6: **Does board structure adjust to past performance? Tests of strict exogeneity**
In this table, we report results from the fixed-effects estimation of the model:

$$\mathbf{y}_{i,t} = \alpha + \beta\mathbf{X}_{i,t} + \Omega\mathbf{W}_{i,t+2} + \eta_i + \epsilon_{it}, \qquad t = 1991, 1993, 1995 \ldots 2001$$

where $\mathbf{W}_{it+1}$ is a subset of forward values of the corporate governance and control variables, $\mathbf{X}$. $\mathbf{y}$ is firm performance (ROA). $\mathbf{X}$ includes board size ($LogBSIZE$), board independence ($INDEP$), a dummy variable which is 1 if the CEO is the board chair (CEO_CHAIR), firm size ($LogMVE$), market-to-book ratio (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$) and leverage ($DEBT$). $\Omega = 0$ is the null hypothesis of strict exogeneity. All t-statistics (in parentheses) are based on robust standard errors. Year dummies are included in all specifications.

Dependent Variable: $ROA(t)$	1	2	3	4	5
$LogBSIZE(t)$	**−0.0267***	**−0.0282***	**−0.0247***	**−0.0234***	**−0.0251***
	(−3.59)	(−3.80)	(−3.29)	(−3.13)	(−3.32)
$INDEP(t)$	0.0082	0.0088	0.0059	0.0055	0.0050
	(0.81)	(0.86)	(0.57)	(0.54)	(0.49)
$CEO\_CHAIR(t)$	0.0005	0.0005	−0.0005	−0.0005	−0.0009
	(0.21)	(0.20)	(−0.17)	(−0.16)	(−0.33)
$LogMVE(t)$	**0.0442***	**0.0438***	**0.0441***	**0.0443***	**0.0416***
	(18.13)	(17.98)	(17.87)	(17.99)	(14.74)
$MTB(t)$	0.0008	0.0008	0.0008	0.0009	0.0011
	(0.75)	(0.79)	(0.80)	(0.76)	(0.97)
$RETSTD(t)$	−0.0085	−0.0082	−0.0091	−0.0091	**−0.0371***
	(−0.56)	(−0.55)	(−0.59)	(−0.59)	(−2.24)
$LogSEGMENTS(t)$	**−0.0070***	**−0.0068***	**−0.0066***	**−0.0067***	−0.0042
	(−2.39)	(−2.34)	(−2.27)	(−2.29)	(−1.34)
$LogAGE(t)$	**−0.0083***	**−0.0087***	**−0.0093***	**−0.0089***	−0.0059
	(−2.20)	(−2.21)	(−2.49)	(−2.35)	(−0.33)
$DEBT(t)$	**−0.0869***	**−0.0864***	**−0.0866***	**−0.0869***	**−0.0758***
	(−5.51)	(−5.46)	(−5.44)	(−5.43)	(−4.51)
$LogBSIZE(t+2)$	**−0.0136***			**−0.0116***	**−0.0150***
	(−2.08)			(−1.72)	(−2.18)
$INDEP(t+2)$		−0.0030		−0.0023	−0.0027
		(−0.31)		(−0.23)	(−0.26)
$CEO\_CHAIR(t+2)$			**0.0064***	**0.0062***	**0.0055***
			(2.26)	(2.20)	(1.95)
$LogMVE(t+2)$					**0.0076***
					(2.64)
$MTB(t+2)$					0.0003
					(0.17)
$RETSTD(t+2)$					**0.0997***
					(−5.05)
$LogSEGMENTS(t+2)$					−0.0041
					(−1.43)
$LogAGE(t+2)$					−0.0060
					(−0.19)
$DEBT(t+2)$					**−0.0257***
					(−2.19)

* significant at the ten percent level or smaller

Table 2.7: **Historical performance, current board structure and firm characteristics**
In this table, we report results from the estimation of the model:

$$\mathbf{X}_{it} = \alpha_2 + \kappa_p y_{it-6} + \kappa \mathbf{Z}_{it} + \eta_i + \epsilon_{it}, \qquad t = 1997, 1999, 2001, 2003$$

$\mathbf{X}_{it}$ is one of board size($LogBSIZE$), independence($INDEP$) or firm size($LogMVE$) . $\mathbf{Z}_{it}$ includes firm size ($LogMVE$), market-to-book ratio (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$) and leverage ($DEBT$). t-statistics are reported in parentheses. All t-statistics are based on robust, firm-clustered standard errors. a, b, c represent significance at the one percent, five percent and ten percent level respectively. Year dummies are included in all specifications.

Dependent variable is level at time t

	Indep	LogBsize	LogBsize	LogMVE	MTB	Retstd	LogSeg	Debt
ROA($t-6$)	**−0.0519**	**0.2474**	**− 0.0048**	**4.1140**	**−0.7480**	**−0.1217**	**−0.2121**	**−0.0728**
	(−2.29)	(5.20)	(−2.77)	(10.72)	(−1.90)	(−9.10)	(−2.13)	(−2.54)
LogMVE ($t-6$)	**0.0856**		**0.0241**		**0.2073**	**−0.0090**	**0.0764**	**0.0210**
	(16.38)		(30.43)		(10.63)	(−9.91)	(9.94)	(11.39)
MTB ($t-6$)	**−0.0048**	**0.0087**	**−0.0134**	**0.2065**		**0.0050**	**−0.0194**	**−0.0150**
	(−3.36)	(2.64)	(−4.60)	(4.58)		(4.15)	(−2.42)	(−4.81)
Retstd ($t-6$)	0.0036	**−0.8442**	**−0.2909**	**−6.2875**	**2.1367**		−0.2175	−0.0232
	(0.12)	(−10.04)	(−5.43)	(−10.00)	(4.51)		(−1.59)	(0.57)
LogSeg ($t-6$)	**0.0163**	**0.0911**	**0.0317**	**0.6002**	**−0.0066**	**−0.0029**		**0.0136**
	(2.87)	(7.48)	(3.10)	(6.53)	(−2.51)	(−1.89)		(2.10)
LogAge ($t-6$)	**0.0065**	**0.0650**	**0.0338**	**0.3125**	**−0.1392**	**−0.0121**	**0.1206**	**−0.0081**
	(2.44)	(12.09)	(7.19)	(7.94)	(−5.11)	(−6.97)	(10.23)	(−2.56)
Debt ($t-6$)	**−0.0460**	**0.2908**	**0.0625**	**2.5252**	**−1.0187**	**−0.0118**	**0.1469**	
	(−2.12)	(7.72)	(1.93)	(10.85)	(−-1.98)	(−2.03)	(1.89)	
R^2	0.1315	0.2171	0.4018	0.2645	0.0829	0.1758	0.1758	0.0751

Table 2.8: **The effect of board structure on current firm performance**

In this table, we report results from the estimation of the model:

$$y_{it} = \alpha_1 + \kappa_1 y_{it-2} + \kappa_2 y_{it-4} + \beta \mathbf{X}_{it} + \kappa \mathbf{Z}_{it} + \eta_i + \epsilon_{it}, \qquad t = 1997, 1999, 2001, 2003$$

y_{it} is return on assets (ROA) which is defined as operating income divided by assets. $\mathbf{X}_{it}$ includes board size($LogBSIZE$), board independence ($INDEP$) and a dummy variable which is 1 if the CEO is the board chair (CEO_CHAIR). $\mathbf{Z}_{it}$ includes firm size ($LogMVE$), market-to-book ratio (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$) and leverage ($DEBT$). t-statistics are reported in parentheses. For the Static models it is assumed that $\kappa_1 = \kappa_2 = 0$. All t-statistics are based on robust, firm-clustered standard errors. a, b, c represent significance at the one percent, five percent and ten percent level respectively. Year dummies are included in all specifications.

	Static Model		Dynamic Model	
Dependent Variable (ROA)	Pooled OLS	Fixed Effects	Pooled OLS	System GMM
$LogBSIZE$	**−0.0262**^{a}	**−0.0261**^{a}	−0.0033	0.0293
	(−5.67)	(−4.32)	(−0.73)	(0.79)
$INDEP$	**−0.0266**^{a}	**0.0202**^{b}	0.0061	−0.0077
	(−3.56)	(2.48)	(0.82)	(−0.18)
CEO_CHAIR	0.0025	0.0003	0.0018	−0.0097
	(1.09)	(0.13)	(0.83)	(−0.48)
$LogMVE$	**0.0234**^{a}	**0.0429**^{a}	**0.0070**^{a}	**0.0147**^{a}
	(27.97)	(21.29)	(6.89)	(2.97)
MTB	**−0.0025**^{a}	0.0014	**0.0070**^{a}	−0.0061
	(−2.91)	(1.34)	(3.36)	(−0.93)
$RETSTD$	**−0.2047**^{a}	−0.0117	**−0.0832**^{a}	**−0.4349**^{b}
	(−11.69)	(−0.94)	(−4.44)	(−2.43)
$LogSEGMENTS$	**−0.0087**^{a}	**−0.0074**^{a}	−0.0012	−0.0007
	(−4.47)	(−3.06)	(−0.76)	(−0.09)
$LogAGE$	**0.0056**^{a}	0.0008	−0.0003	**−0.0253**^{a}
	(4.26)	(0.27)	(−0.20)	(−2.90)
$DEBT$	**−0.0307**^{a}	**−0.0625**^{a}	−0.0040	−0.0048
	(−3.37)	(−3.99)	(−0.45)	(−0.08)
$ROA(t-2)$			**0.4833**^{a}	**0.4322**^{a}
			(24.40)	(2.67)
$ROA(t-4)$			**0.1054**^{b}	0.0175
			(6.00)	(0.22)
R^2	0.27	0.11	0.41	
$AR(1)$ test (p-value)			(0.22)	(0.00)
$AR(2)$ test (p-value)			(0.77)	(0.83)
Hansen's J-statistic (p-value)				(0.11)

Notes

1. $AR(1)$ and $AR(2)$ are tests for first-order and second-order serial correlation in the first-differenced residuals asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
2. J-statistic is from the Hansen test of over-identifying restrictions,asymptotically distributed χ^2, under the null of instrument validity.
3. The instruments used in the GMM estimation are: differenced equations: y_{it-6}, y_{it-8}, $\ldots$,$y_{i,1991}$, $\mathbf{x}_{it-6}$, $\mathbf{x}_{it-8}$, $\ldots$, $\mathbf{x}_{i,1991}$, $\mathbf{z}_{it-6}$, $\mathbf{z}_{it-8}$, $\ldots$, $\mathbf{z}_{i,1991}$; level equations: Δy_{it-6}, Δx_{it-6}, $\Delta \mathbf{z}_{it-6}$

Table 2.9: **The effect of board structure on current firm performance: Alternative performance measures**
In this table, we report results from the estimation of the model:

$$y_{it} = \alpha_1 + \kappa_1 y_{it-2} + \kappa_2 y_{it-4} + \beta\mathbf{X}_{it} + \kappa\mathbf{Z}_{it} + \eta_i + \epsilon_{it}, \qquad t = 1997, 1999, 2001, 2003$$

y_{it} is either return on sales (ROS) or Tobins Q. $\mathbf{X}_{it}$ includes board size($LogBSIZE$), board independence ($INDEP$) and a dummy variable which is 1 if the CEO is the board chair (CEO_CHAIR). $\mathbf{Z}_{it}$ includes firm size ($LogMVE$), market-to-book ratio (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$) and leverage ($DEBT$). t-statistics are reported in parentheses. For the Static models it is assumed that $\kappa_1 = \kappa_2 = 0$. All t-statistics are based on robust, firm-clustered standard errors. a, b, c represent significance at the one percent, five percent and ten percent level respectively. Year dummies are included in all specifications.

Dependent Variable	Return on Sales (ROS)		Tobin's Q (Industry-adjusted)	
	Static Fixed Effects	Dynamic System GMM	Static Fixed Effects	Dynamic System GMM
$LogBSIZE$	**−0.0319**^{a}	0.0142	**−0.6750**^{a}	−0.1618
	(−4.22)	(0.36)	(−6.72)	(−0.31)
$INDEP$	**0.0189**^{c}	0.0668	**0.2910**^{c}	0.1703
	(1.80)	(1.13)	(1.83)	(1.34)
CEO_CHAIR	0.0044	−0.0031	−0.1135	−0.2678
	(1.40)	(−0.16)	(−1.59)	(−0.91)
$LogMVE$	**0.0459**^{a}	**0.0260**^{a}	**1.0540**^{a}	0.0223
	(17.20)	(3.83)	(14.81)	(0.21)
MTB	**0.0023**^{b}	−0.0037		
	(1.99)	(−0.38)		
$RETSTD$	**−0.0520**^{a}	−0.2862	−0.5213	−-3.6937
	(−3.21)	(−1.47)	(1.46)	(−1.28)
$LogSEGMENTS$	**−0.0104**^{a}	−0.0025	**−0.2133**^{a}	−0.1625
	(−3.19)	(−0.27)	(−4.52)	(−1.57)
$LogAGE$	**0.0073**^{c}	**−0.0326**^{a}	**−0.4581**^{a}	−0.1436
	(1.91)	(−3.29)	(−7.68)	(−1.18)
$DEBT$	−0.0118	0.0878	**−1.513**^{a}	−0.9635
	(−0.89)	(1.45)	(−7.46)	(−1.32)
$ROA(t)$			**0.6775**^{c}	2.3188
			(1.89)	(1.26)
$ROS(t-2)$		**0.3095**^{c}		
		(1.71)		
$ROS(t-4)$		0.0024		
		(0.03)		
$Q(t-2)$				**0.4291**^{a}
				(3.14)
$Q(t-4)$				0.0541
				(1.19)
R^2	0.08		0.15	
$AR(1)$ test (p-value)		(0.00)		(0.00)
$AR(2)$ test (p-value)		(0.25)		(0.28)
Hansen's J-statistic (p-value)		(0.32)		(0.68)

Notes

1. $AR(1)$ and $AR(2)$ are tests for first-order and second-order serial correlation in the first-differenced residuals asymptotically distributed as $N(0,1)$ under the null of no serial correlation.

2. J-statistic is from the Hansen test of over-identifying restrictions,asymptotically distributed χ^2, under the null of instrument validity.

3. The instruments used in the GMM estimation are: differenced equations: y_{it-6}, y_{it-8}, $\ldots$,$y_{i,1991}$, $\mathbf{x}_{it-6}$, $\mathbf{x}_{it-8}$, $\ldots$, $\mathbf{x}_{i,1991}$, $\mathbf{z}_{it-6}$, $\mathbf{z}_{it-8}$, $\ldots$, $\mathbf{z}_{i,1991}$; level equations: Δy_{it-6}, Δx_{it-6}, $\Delta\mathbf{z}_{it-6}$

Table 2.10: **The effect of board structure on firm performance: Inclusion of ownership**
In this table, we report results from the System GMM estimation of the model:

$$y_{it} = \alpha_1 + \kappa_1 y_{it-2} + \kappa_2 y_{it-4} + \beta \mathbf{X}_{it} + \kappa \mathbf{Z}_{it} + \eta_i + \epsilon_{it}, \qquad t = 1997, 1999, 2001, 2003$$

y_{it} is return on assets (ROA) which is defined as operating income divided by assets. $\mathbf{X}_{it}$ includes board size($LogBSIZE$), board independence ($INDEP$) and a dummy variable which is 1 if the CEO is the board chair (CEO_CHAIR). $\mathbf{Z}_{it}$ includes firm size ($LogMVE$), market-to-book ratio (MTB), standard deviation of stock returns ($RETSTD$), number of business segments ($LogSEGMENTS$), firm age ($LogAGE$), leverage ($DEBT$), insider ownership (OFF_OWN) and director ownership (DIR_OWN). t-statistics are reported in parentheses. a, b, c represent significance at the one percent, five percent and ten percent level respectively. Year dummies are included in all specifications.

Dependent Variable (ROA)	1	2	3
$LogBSIZE$	0.0316	0.0320	0.0341
	(0.86)	(0.87)	(0.93)
$INDEP$	0.0109	0.0142	0.0109
	(0.16)	(0.23)	(0.17)
CEO_CHAIR	−0.0160	−0.0216	−0.0209
	(−0.78)	(−1.09)	(−1.03)
$LogMVE$	**0.0167**^{a}	**0.0150**^{a}	**0.0173**^{a}
	(3.49)	(2.93)	(3.48)
MTB	−0.0057	−0.0064	−0.0066
	(−0.20)	(−0.99)	(−1.08)
$RETSTD$	−**0.4530**^{a}	−**0.4146**^{a}	−**0.4755**^{b}
	(−2.64)	(−2.37)	(−2.76)
$LogSEGMENTS$	−0.0023	−0.0020	−0.0040
	(−0.30)	(−0.25)	(−0.51)
$LogAGE$	−**0.0269**^{a}	−**0.0246**^{a}	−**0.0278**^{a}
	(−3.20)	(−2.89)	(−3.33)
$DEBT$	−0.0113	−0.0194	−0.0123
	(−0.20)	(−0.34)	(−0.22)
OFF_OWN	0.0186		0.0087
	(0.31)		(0.15)
DIR_OWN		0.1759	0.1707
		(0.86)	(0.85)
$ROA(t-2)$	**0.4075**^{a}	**0.4422**^{a}	**0.4076**^{a}
	(2.59)	(2.83)	(2.59)
$ROA(t-4)$	0.0194	0.0176	0.0194
	(0.26)	(0.23)	(0.26)
$AR(1)$ test (p-value)	(0.00)	(0.00)	(0.00)
$AR(2)$ test (p-value)	(0.77)	(0.80)	(0.72)
Hansen's J-statistic (p-value)	(0.13)	(0.15)	(0.22)

Notes

1. $AR(1)$ and $AR(2)$ are tests for first-order and second-order serial correlation in the first-differenced residuals asymptotically distributed as $N(0,1)$ under the null of no serial correlation.

2. J-statistic is from the Hansen test of over-identifying restrictions,asymptotically distributed χ^2, under the null of instrument validity.

3. The instruments used in the GMM estimation are: differenced equations: y_{it-6}, y_{it-8}, $\ldots$,$y_{i,1991}$, $\mathbf{x}_{it-6}$, $\mathbf{x}_{it-8}$, $\ldots$, $\mathbf{x}_{i,1991}$, $\mathbf{z}_{it-6}$, $\mathbf{z}_{it-8}$, $\ldots$, $\mathbf{z}_{i,1991}$; level equations: Δy_{it-6}, Δx_{it-6}, $\Delta \mathbf{z}_{it-6}$

Chapter 3

Corporate Boards and Regulation: The Effect of the Sarbanes-Oxley Act and the Exchange Listing Requirements on Firm Value

3.1 Introduction

Following a string of high profile corporate scandals at the turn of the century, congress passed the Sarbanes-Oxley Act of 2002 (SOX), which represents one of the most significant pieces of corporate regulation in over half a century. In addition, the Securities Exchange Commission (SEC) collaborated with the major stock exchanges to develop a stricter set of exchange listing requirements for publicly traded firms.[1]

A key feature of SOX and the new exchange listing standards is that they mandate a vastly increased role for monitoring by outside or "independent" directors. For example, the essential provisions of the new exchange listing include: (1) a majority of independent directors on boards; (2) stricter definition of independence; (3) existence of audit, nomination and compensation committees and their independence; (4) board sessions without insiders.

While SOX does not specifically require firms to have a majority of independent directors, one of its key provisions is that firms must have audit committees consisting entirely of independent directors. This mandate is also likely to increase the involvement of outsiders on boards of directors. Taken together the provisions in SOX and the new exchange regulations go beyond just specifying the number of outside and inside directors; they impose a much higher level of outside director monitoring on all firms.

[1]See, for example, SEC Press Release, "Pitt Seeks Review of Corporate Governance" at http://www.sec.gov/news/press/2002-23.txt

The motivation for much of these new regulations appears to be the belief that a board of directors dominated by outside directors is uniformly good for all firms. This belief is predicated on the widely held view that prior to the regulations, many firms had inefficient boards. However, defining an inefficient board is not a straightforward exercise. Recent research (e.g. Mulherin (2005), Raheja (2005), Boone, Field, Karpoff, and Raheja (2007), Coles, Daniel, and Naveen (2008), Linck, Netter, and Yang (2008)) suggests that boards are endogenously determined based on a firm's individual characteristics and operating environment. The evidence emerging from these studies is that boards are structured in ways consistent with economic efficiency. The *"endogenous determinants"* hypothesis contends that there are systematic variations in board composition and firms tend towards a board structure that optimally balances the costs and benefits of outside monitoring. Firms face different costs and benefits from outside director monitoring, related to the nature of their businesses or their ownership structures. Thus, there will be cross-sectional variation in board structure across firms in the economy that will reflect the trade-off between the costs and benefits of outside monitoring. The recent studies build on similar ideas (applied to corporate ownership) proposed by Demsetz and Lehn (1985) and provide very compelling evidence that even before the recent governance regulations, boards were generally structured in ways consistent with value maximization.

If boards were, in general, efficiently structured prior to the passage of the recent regulations, then a regulation that mandates uniformly high levels of outside director monitoring on *all* firms may in fact be detrimental to certain firms. While the regulation may be benign when applied to firms whose operating environments are conducive to high levels of outside director monitoring, firms that are costly to monitor and derive little benefits from outside director monitoring may be adversely affected by the regulations. The endogenous determinants hypothesis therefore suggests that there will be significant cross-sectional variation in the impact of the new rules on firms. A firm whose optimal board is one that calls for less outside director involvement (or more insiders) would certainly benefit much less from the new regulations than a firm whose economically optimum board structure calls for more outside directors. It is even possible that for those firms with prohibitively high costs of outside director monitoring relative to the benefits, the new regulations might actually have an negative effect on firm value, by forcing these firms to adopt inefficient board structures in order to meet the different provisions of the new regulations.

In this paper, I propose that the economic determinants of board structure provides a useful framework for understanding the value effects of SOX and the recent exchange listing requirements. The wealth effects of the recent regulations will be related to the costs and benefits of outside director monitoring. I hypothesize that firms that face higher costs of outside directors relative to the benefits, will have benefitted much less from these regulations than those firms with lower costs and higher benefits of having outside directors.

Using a sample of 1,526 publicly traded firms, and empirical proxies for costs and benefits of monitoring from prior literature, I find that firms that have higher costs (and/or lower benefits) of outside director monitoring appear to have benefited less from SOX and the recently adopted exchange governance regulations. In particular, I find that firm size and age are positively related to returns around the announcement of the regulations, while market-to-book values and R&D expenditures are negatively related to announcement returns.

Based on the empirical proxies for costs and benefits of outside monitoring, I predict how firms are likely to be affected by regulations mandating higher outside monitoring, and sort my sample firms into portfolios accordingly. A portfolio that buys the firms that are predicted to be least adversely affected and shorts the firms that are predicted to be most adversely affected by the regulations, earns an abnormal return of 17%, over the period in which these regulations were announced and enacted. Under the hypothesis that small, young, R&D-intensive, growth firms that operate in uncertain environments face high monitoring costs and have fewer benefits of outside monitoring, these results provide evidence that boards are determined as a trade-off between the relative costs and benefits of outside monitoring and that recent regulations may have imposed undue constraints on certain firms. The results provide evidence against the alternative viewpoint that imposing greater outside director monitoring is uniformly good for all firms. These results are robust to different specifications and combinations of empirical proxies for the costs and benefits of outside director monitoring.

This paper contributes to the debate on the effect of recently imposed governance regulations on firms in a number of ways. A handful of other studies have attempted to discern the overall benefit (or cost) of SOX on the market as a whole. A major problem with this approach is that of identifying a model of what the expected performance for the market would have been without the regulations. Generally, asset pricing models of expected returns capture the cross-sectional variation in expected returns, rather than the overall expected return on the market. This may explain why the results from these studies have been mixed. For example, while Jain and Rezaee (2005) and Li, Pincus, and Rego (2005) find a positive value effect for the regulations, Zhang (2005) concludes that SOX has had a negative effect on the market as whole. In contrast, by applying an ex-ante measure of anticipated effects, I can measure the impact of the regulations without having to make potentially biased inference on the overall effects of the regulation.

The findings in this paper also contribute to the debate on what, if any, may be driving any cross-sectional variations in the costs or benefits of SOX and the modified exchange listing requirements. There has been extensive focus on the 'fixed' compliance costs that firms face, especially the costs of complying with the internal audit reporting requirements of SOX's section 404. Indeed, one explanation that may be consistent with my findings is that while SOX may be beneficial to all firms, the only cross-sectional variation is in the fixed compliance costs that have a disproportionate impact on small firms. However, careful analysis and robustness tests suggest that my results are not being driven merely by a ‘fixed compliance costs’ or ‘size’ effect. In fact, when I sort my firms into portfolios just based on size, I find that size does not explain the entire cross-sectional variation in wealth effects surrounding the passage of SOX and the modified exchange listing requirements. The results strongly suggest that the composite effects of monitoring costs are definitely an important determinant of the relative value effects of these recent governance regulations.

The results from this paper may also be pertinent in the discussion of whether or not the cost of recent regulations (especially for small growth firms) might affect the competitiveness of U.S. capital markets. Zingales (2006) finds a dramatic drop in the U.S. market share of both domestic and foreign IPOs between 2000 and 2005. While he considers many alternative explanations, he suggests that a major reason might be an increase in regulatory costs for publicly traded firms. This has not gone unnoticed by the regulatory authorities. The SEC has twice extended (in September 2005 and December 2006) the deadline for small firms (with market capitalization $<$ \$75 million) to comply with the requirements of SOX. Similarly NASDAQ is considering exempting small/newly listed firms from its newly adopted exchange regulations.

As with any study of the value effects of regulation, any inference that is taken from my findings is subject to a number of caveats. My measurement of wealth effects is carried out with the underlying assumption that I have correctly identified the window within which the markets were ‘surprised’ by the passage of the regulations. In addition, any empirical analysis of regulation is faced with having to deal with the possibility that confounding events could taint the findings. Mulherin (2007) suggests two ways of mitigating this problem. One way is to find a control sample of firms which are not subject to the regulations, which is the approach Litvak (2007) takes by comparing the returns of foreign firms cross-listed in the U.S. (and subject to SOX) to those that are not. Another approach is to model the anticipated cross-sectional effects of the regulation. This is the approach that I take in this paper.

In this paper, I have chosen to focus largely on the board-related provisions of the regulations and have used the costs and benefits of outside director monitoring as a benchmark. It is possible that there are other costs and benefits of the rules and regulation that vary across firms. Indeed Chhaochharia and Grinstein (2006), who also examines the cross-sectional wealth effects of the recent regulations, focus largely on some of the non-board related aspects of the recent rules and regulations. However, to the extent that any other costs or benefits of the regulations are largely orthogonal to my predicted costs and benefits of outside director monitoring, my study provides a useful framework for understanding the cross-sectional variation in the value effects of SOX and the new exchange listing requirement.

The rest of the paper proceeds as follows: in Section 2, I review the literature on the determinants of board structure and develop the hypotheses that I test. In Section 3, I discuss the data and variables that I use in my study. In Section 4, I present the results of my empirical tests, and in Section 5, I conclude and suggest possible extensions of this study.

3.2 Hypotheses Development

As Becht, Bolton, and Roell (2003) note in their survey of corporate governance, a governance problem arises whenever an outside investor or shareholder wishes to exercise control in a way different from the manager who runs the firm. Dispersed ownership magnifies the problem by giving rise to conflicts of interest between the various corporate claimholders and by creating a collective action problem among investors. Boards of directors represent one of the potential mechanisms for mitigating agency costs and resolving the corporate governance problem.

Fama (1980) and Fama and Jensen (1983) argued that outside directors have strong reputational incentives to effectively monitor CEOs and management. Consistent with this argument, Weisbach (1988) found that outside directors were more likely to replace CEOs at poorly performing firms and Rosenstein and Wyatt (1990) found that the addition of an outsider to a corporate board had a positive announcement effect. However, subsequent studies (including those by Hermalin and Weisbach (1991), Agrawal and Knoeber (1996), Bhagat and Black (2002)) that looked more generally at the effect of board composition on corporate performance failed to find any consistent cross-sectional relation.

Despite the lack of broad empirical evidence to support the idea that independent boards were uniformly good for all firms, the idea came to be widely accepted by a large section of the public and the business press. Although, it is unclear how the viewpoint became so pervasive, Bainbridge (2003) suggests that by the late 1980s, many influential institutions (e.g. the American Law Institute and the Council of Institutional Investors) were calling for regulatory agencies to impose more outside directors on all firms. These institutions believed that, at best, boards of directors were an ineffective mechanism for monitoring management and that, at worst, they were "co-conspirators" with management in expropriating shareholders. However, while it was indeed possible that there were some really incompetent or ineffective boards, there was no empirical evidence that this was pervasive. Nevertheless, as Stigler (1964) points out in his analysis of the regulation of securities, public sentiment could lead to political or regulatory overreaction to even the most minor reports of violations of investor protection, especially in the aftermath of market downturns. As Stigler (1964, p.119) observes: *"... no matter how infrequent or trivial the damage to investors, the regulatory process must seek to eliminate it... Surely rhetoric has replaced reason at this point".*

The outcome of this particular viewpoint (dubbed the *"inefficiency"* hypothesis by Boone, Field, Karpoff, and Raheja (2007)), is the ever increasing amount of regulation that include provisions to prevent boards from becoming "captured" by management. These provisions mandate companies to appoint more non-executive directors, with the idea that that outsiders are less likely to be under the thumb of the CEO. In the U.S., this prevailing belief has culminated most recently in the passage of the Sarbanes-Oxley Act and the adoption of even more restrictive listing rules by the major stock exchanges. As previously noted in the introduction, SOX and the recent exchange regulations directly affect boards of directors of firms. The key mandates of these regulations impose higher outside director involvement in all public firms, in one or more of the following ways:

1. Mandating a majority of outsiders on boards (as do the exchange requirements)
2. Mandating that firms have audit, nominating and compensation committees consisting entirely of independent directors (as do both SOX and the exchange requirements)
3. Mandating that outside directors must meet regularly without the presence of insiders (as do the exchange requirements)
4. Tightening the definition of independence (as do both SOX and the exchanges)

These rules include specific mandates which expand the role of outside directors in corporate governance, among other things. The widespread belief in the "inefficiency" hypothesis is not limited to the U.S.; many countries have adopted or are developing guidelines which call for majority independent or outside directors on corporate boards (see Organisation for Economic Co-Operation and Development (2004) for an international survey).

However, in the last few years, a number of researchers have proposed that even before the recent regulations, boards were structured efficiently. This would imply that that board composition is chosen by firms to balance the trade-off between the cost and benefit of having outside directors, based on the firm's unique characteristics and operating environments. Recent studies including those by Mulherin (2005), Raheja (2005) Boone, Field, Karpoff, and Raheja (2007), Coles, Daniel, and Naveen (2008) and Linck, Netter, and Yang (2008) find that board structure is systematically related to firm and industry level characteristics. These studies provide compelling evidence that, in general, firms endogenously choose a level of outside director monitoring that is value-maximizing given their unique set of operating and contracting constraints.

The growing evidence that firms, even prior to the recent regulations, had efficiently structured boards, has important empirical implications for the value effects of the regulations. By imposing a greater role for outside directors on *all* firms, SOX and the exchange regulations may have an adverse impact on those firms that face higher costs of outside director monitoring, or firms that benefit less from outside director monitoring. Even if the regulations benefit some firms with contracting environments conducive to extensive outside director monitoring, these benefits may be non-existent for those firms that are forced away from their optimal board structures by the need to add outsiders simply to comply with the regulations. In addition, mandatory board regulations may reduce the flexibility that some firms (especially young, fast growing firms) require to adjust their governance structures to the rapidly changing nature of agency costs that these firms face. Regardless of the overall benefits of SOX and the new exchange listing requirements to the economy as whole, I predict that there will be cross-sectional differences in the impact of these regulation on firms that will be related to the relative costs and benefits of having outsiders on a particular firm's board of directors. The determinants of board structure thus provides a framework for assessing the cross-sectional differences in the effects of the recent governance regulations.

One of the theoretically proposed determinants of board structure revolves round the potential trade-offs between the costs and benefits of outside monitoring. The arguments presented by Demsetz and Lehn (1985) suggest that in uncertain environments, it might be extremely costly for outsiders to effectively monitor management's actions. In such an environment, board monitoring by independent directors is relatively inefficient. Supporting this view, Hermalin and Weisbach (1988) show that with poorer information, the option to fire management is less valuable. Consequently, the cost of outside monitoring is likely to be higher for firms in uncertain environments. Recent empirical studies, including those by Gillan, Hartzell, and Starks (2003), Coles, Daniel, and Naveen (2008), Boone, Field, Karpoff, and Raheja (2007) and Linck, Netter, and Yang (2008), find some evidence that firms with high standard deviation of returns, high market-to-book values and high R&D expenditure generally have a smaller proportion of outsiders on their boards. If these firm characteristics are proxies for monitoring costs, these results suggest that monitoring costs may be a significant determinant of board composition. Imposing a high level of outside director monitoring on *all* firms may have an adverse value effect on firms with high monitoring costs relative to firms with low monitoring costs. This suggests the following hypothesis:

H1: The wealth effect of SOX and the exchange listing requirements is negatively related to the firm's monitoring costs.

Proxies for monitoring cost include standard deviation of returns, (Gillan, Hartzell, and Starks (2003), market-to-book ratio (Boone, Field, Karpoff, and Raheja (2007)) and R&D expenditure (Coles, Daniel, and Naveen (2008)).

A related concept is that of private benefits. In a theoretical model, Raheja (2005) proposes that firms where managers can extract high private benefits of control might have higher benefits from outside monitoring. Linck, Netter, and Yang (2008) find some empirical evidence supporting this proposition. This means that regulation that imposes a high level of outside director monitoring may only be beneficial to firms with high levels of private benefits while simply imposing costs on firms with low levels of private benefits. This suggests the following hypothesis:

H2: The wealth effect of SOX and the exchange listing requirements is positively related to the firm's level of private benefits.

While private benefits are difficult to measure, older firms are more likely to provide benefits of control to managers, so firm age is a possible proxy for private benefits of control. Linck, Netter, and Yang (2008) also suggest using the proportion of debt in the capital structure as a proxy for the private benefits of control. In additional analysis, I use free cash as a proxy for private benefits, based on arguments from Jensen (1986).

Board composition is also hypothesized to be related to firm complexity and the scope of the firm's operations. This is based on the idea that as firm operations become more complex, or as firms move into new business areas, firms may benefit from the expertise of outside directors. This suggests that as firms grow older (and develop more business segments), the benefit from having outsiders on the board increases. Empirical evidence from Lehn, Patro, and Zhao (2004) and Boone, Field, Karpoff, and Raheja (2007) suggests that the number of outsiders on boards increases with firm age. Again, any mandatory imposition of uniformly high levels of outside director monitoring may simply impose costs on focused firms with little to benefit from outside directors. This suggests the following hypothesis:

H3: The wealth effect of SOX and the exchange listing requirements is positively related to the level of firm complexity.

As suggested by prior literature we use the size and the age of the firm as proxies for firm complexity. In additional analysis, I use the number of a firm's business segments as a proxy for complexity.

In my empirical analysis, I include director ownership as a control variable. The ownership structure of a firm will have a direct impact on the relative costs and benefits of having outside directors on the board. Higher CEO ownership serves to more closely align the CEO interests with those of other shareholders, thus reducing the benefits of outside monitoring. Higher outside director ownership and institutional ownership serve as constraints on the CEO's tendency to want to consume private benefits and may also serve to reduce the payoff from having more outsiders on the board. These ownership variables may reduce the need for outside board monitoring and can serve as control variables in the empirical specifications.

3.3 Data and Variables

The stock return data is taken from *CRSP*. Accounting data and business segment data is taken from *COMPUSTAT*. Data on board composition (proportion of insiders) and board leadership is drawn from the *DISCLOSURE* database. This data is supplemented by board committee, CEO tenure and CEO age data from the *IRRC* database. From *DISCLOSURE* , I start out with 3,571 firm that have board composition, leadership and ownership data for the year 2001. This data is merged with COMPUSTAT and CRSP. This leaves a sample of 1,526 firms that have board data, stock returns data and sufficient accounting data to test the hypotheses outlined in the previous section.

The variables are as defined in Table 1. Table 2 reports key summary statistics for the firms in the sample. It should be noted that because CEO Age and CEO tenure data comes from the *IRRC* database, I only have have age and tenure data for 652 of the firms in my final sample.

Panel A of Table 2 summarizes the key firm characteristics. The mean (median) firm market value is $3,982 ($343) million. The mean firm age (FIRM_AGE) is 14.2, and the mean market-to-book value (MTB) is 2.21. Panel B of Table 2 reports summary data on CEO, outsider director and institutional ownership. On average CEOs own about 5% of company stock, outside directors own about 1.5% and institutions own about 46%. Panel C of Table 2 reports summary statistics for Board and CEO characteristics. The mean CEO age for my sample is 53.9.

Table 3 shows the correlation between the key proxy variables used in the empirical tests of Section 5. As expected there is a substantial amount of correlation between the determinants that I choose to focus on. For example, there is positive correlation between MTB and the variables R&D and RETSTD; there is a negative correlation between MTB and FIRM_AGE. Similarly, the ratio of R&D expenses to assets decreases with firm age. Overall, young, growth firms are more likely to be R&D-intensive and have a higher standard deviation of returns.

Perhaps the most interesting result from Table 3 is the correlation between the percentage of insiders (INISDER) and the proxies for the determinants of board structure. INSIDER is positively correlated with R&D, RETSTD, MTB and negatively correlated with FIRM_AGE. This is consistent with endogenous determinants hypotheses discussed in the previous section. In 2001, prior to the enactment of SOX and the exchange regulations, young, growth firms, in uncertain environments face high costs of monitoring or benefit less from outside director monitoring and thus tend to have fewer outside directors.

3.4 Empirical Analysis and Results

Testing the hypotheses developed in the previous section require some measure of the wealth effect of the exchange regulation across a cross section of firms. In this section, I test my hypotheses using two different approaches.

3.4.1 Methodology

The portfolio approach

Most prior studies that have attempted to measure the wealth effects of SOX and the exchange regulations have relied on measuring the abnormal returns strictly around the dates associated with the congressional passage of SOX and some of the dates associated with events connected with its eventual passage. One obvious drawback of that approach is the difficulty inherent in identifying key dates associated with the development and eventual adoption of SOX and the other exchange regulations. This difficulty is further complicated by the uncertainty as to when relevant information was incorporated into prices (Binder (1985)). Another problem is that since the regulatory events occur to all firms simultaneously, statistical inference can be biased because returns are contemporaneously correlated

One way to overcome some of the drawbacks of this methodology is to use a portfolio approach (as suggested by Schwert (1981)), with a relatively long event window (of several months). Under this approach, firms are grouped into portfolios based on how much we expect to them to benefit from, or be adversely affected by SOX or exchange requirements. This means that I rank the firms based on a proxy for a determinant of board composition, for example, monitoring cost. I then calculate the daily return of each portfolio that is formed. The resulting time series of daily excess returns ($R_p - R_f$) is regressed on three factors from Fama and French (1993): the excess return on the market ($R_m - R_f$); the return difference between a portfolio of "small" and "big" stocks (SMB) and the return difference between a portfolio of "high" and "low" book-to-market stocks (HML). I augment this with a momentum factor as proposed by Carhart (1997) which is the return difference between a portfolio of stocks with high returns in the past year and a portfolio of stocks with low returns in the past year (UMD). Thus, I run time-series regressions of the form:

$$R_{pt} - R_{ft} = \alpha + \beta_m(R_{mt} - R_{ft}) + \beta_s SMB_t + \beta_h HML_t + \beta_u UMD_t + \epsilon_t \tag{3.1}$$

over the window that spans the development of the regulations. The intercept (α) measures monthly abnormal return given the model in (4.1).

However, focusing on individual determinants or proxies may have some drawbacks. While there is some correlation between the different determinants, the correlation between them is not perfect. For example, there may be young firms with low R&D expenses or older firms with high market-to-book values. Thus sorting firms on only one determinant may attenuate the cross-sectional variation in the wealth effects of the regulations.

One way to overcome this is to use a **composite index** to capture the relative cost or benefits of having outside directors. To compute this composite index, I sort all the firms based on the proxies for the determinants of board structure discussed in Section 3. I choose market-to-book (MTB), R&D expenditure, standard deviation of stock returns

(RETSTD), as proxies for monitoring cost; size (MVE) and Firm Age (FIRM_AGE) as proxies for private benefits of control and firm complexity. In addition, I rank firms based on the proportion of insiders (INSIDER); this is a measure of how much of an immediate adjustment the firm will have to make to comply with the new regulations. I expect firms that have more insiders to face direct costs of compliance with the new regulations as they attempt to recruit suitable outside directors. I also include one of the control variables, director ownership, (DIR_OWN) which serves to reduce the need for outside monitoring, by constraining the CEO from consuming private benefits. So firms are ranked on the following dimensions: MVE (from smallest to largest), MTB (from highest to lowest), R&D intensity (from highest to lowest), RETSTD (from highest to lowest), FIRM_AGE (from youngest to oldest), INSIDER (from most to least) and DIR_OWN (from highest to lowest).

Next, I sort firm into deciles based on each of the determinants and assign an index between 0 and 9 to each firm depending on which the decile the firm falls into, within each dimension. I construct a composite index by summing the indices across all the dimensions for each firm. Details of the construction of the composite index, as well as examples from individual firms are discussed in an appendix to the paper.

Following the construction of the composite index, I sort the firms into portfolio quartiles based on their ranking on the composite index, such that Quartile 1 has the firms that rank lowest on this composite index and Quartile 4 has the firms with highest ranking on the composite index. So by the construction of the composite index, Quartile 1 contains the firms that are predicted to benefit the least (or be most adversely affected) by the exchange regulations, Quartile 4 contains the firms that are predicted to be least adversely affected.

Panel A of Table 4 gives the summary statistics of firm characteristics of the portfolios formed based on the composite index. The mean market value of equity (MVE) ranges from $500 million in Quartile to just under $7.5 billion in Quartile 4. The mean Market-to-book values (MTB) vary from 3.5 in Quartile 1 to just under 1.5 in Quartile 4. Firms range in age from a mean of 6.3 years in Quartile 1 to 26 years in Quartile. Firms in Quartile 1 have an average R&D intensity of 0.18 and this falls to practically zero in Quartile 4.

Panel B of Table 4 shows quite clearly that prior to the passage of the new rules, the portfolio of high monitoring costs/low benefits firms (Quartile 1) includes firms that had boards that relied significantly less on outside monitoring than those firms with low monitoring/high benefits of outside director monitoring (Quartile 4). The board data reflects board composition in 2001, which was before the new regulations were passed. As we move from Quartile 4 to Quartile 1, the average number of insiders on the board increases by over 60%, from 23% of the board to 37% of the board. Quartile 1 contains four times as many firms with insider-dominated boards as does Quartile 4. The data also shows that while a third of the firms in Quartile 4 already had the independent committees required by the regulations in place, only 5% of the firms in Quartile 1 already had those independent committees just prior to the introduction of the new regulations. Overall, my firms are sorted such that Quartile 1 tends to have the smallest, youngest firms with the highest growth opportunities, highest R&D intensity *and* also the least likely to have plenty of outsiders on their boards - precisely the firms which are predicted to have the highest costs/lowest benefits from outside monitoring. Quartile 4 has the opposite.

After sorting the firms into portfolios, daily (equally weighted) portfolio excess returns are regressed on the three Fama-French factors and a momentum factor, as specified in equation (4.1). I estimate these regressions over the period in which the regulations were proposed, developed and enacted. This window is chosen to be wide enough to include the dates when this regulations were first considered, right up the time when their passage became certain.

In choosing the event window, I surveyed the recent literature and press reports about the time-line of the passage of SOX and the exchange regulations. As noted by Zhang (2005), the earliest official report of the possibility of a major regulatory comes from the Wall Street Journal of January 17, 2002. Eventually, SOX was passed by both the House and the Senate on July 25, 2002. Similarly Chhaochharia and Grinstein (2007) report that the NYSE board approved what substantively forms the new exchange listing requirements on August 1, 2002. Between these dates there was a lot of debate on the final form of the regulations. However, based on these dates, I choose an event window between January 15, 2002 and August 15, 2002 to incorporate all the possible dates during which the regulations were proposed, developed and eventually enacted, and all the dates on which the market will have incorporated all value relevant information.

THE CAR APPROACH

The CAR methodology requires the identification of significant dates in 2002 when information about the form of regulations, their likelihood of adoption or their actual adoption is believed to have become available to the market at large. The CAR from a short window around each of these key dates is measured for each firm.

The key steps involved in implementing the CAR methodology are as follows:

1. Identify all key dates associated with the development and eventual passage of recent exchange regulations.
2. Calculate the CAR from a short window around each of these key announcements.
3. For each firm, sum the CARs associated with all event dates, to obtain a total CAR (TCAR).
4. Carry out a cross-sectional regression of the form:

$$\text{TCAR} = \alpha_0 + \alpha_1 \text{MCOST}_i + \alpha_2 \text{PBEN}_i + \alpha_3 \text{FCOMP}_i + \epsilon_i \qquad (3.2)$$

where TCAR is the total CAR for firm i for all the key event dates between in 2002; FCOMP_i, MCOST_i, and PBEN_i represent, for firm i, measures of firm complexity, monitoring costs, and private benefits. From equation (4.2), the sign and significance of α_j, $j = 1, \ldots, 3$, can be evaluated to test hypotheses H1 to H3.

As discussed in the previous section, one of the problems with this approach is the difficulty in selecting appropriate dates for when value relevant information about the proposed regulations actually became available. Although, the final bill was passed in the Senate by a vote of 97 to 0, there was extensive debate on the form of SOX, in both the Senate and the House. In fact, Zhang (2005) writes that the relative speedy and near unanimous passage of the Act was ensured by approaching mid-term elections and fear among Republicans that Democrats would use it as a campaign issue. Thus any particular event date selected for tests under the CAR approach might not be value relevant as the market may have already incorporated the information into prices.

In spite of the difficulty in pin-pointing value relevant dates, I have used some of the recent literature and reports on SOX and the exchange regulations to identify the key dates that, in my opinion, mark the key highlights of the development of the regulations. Table 6, list the key dates associated with the development of both the exchange listing requirements (Panel A) and SOX (Panel B). These dates are similar to those used in Chhaochharia and Grinstein (2007), Zhang (2005) and Li, Pincus, and Rego (2005)

In order to measure the cumulative abnormal reaction, I use the covariance analysis model. This method of analysis is discussed in some detail in Boardman, Vertinsky, and Whistler (1997). The model is particular suitable to a regulatory event that includes multiple event dates. The model is used in a number of studies that have looked at wealth effects surrounding regulatory changes including Schipper, Thompson and Weil (1987), Mitchell and Mulherin (1988) and Chhaochharia and Grinstein (2007)

The covariance analysis model imposes some structure on the true but unobservable abnormal returns; specifically it assumes that abnormal returns can be decomposed as follows:

$$\epsilon_t = \delta_t D_t + \xi_t \tag{3.3}$$

where $D_t = 1$ during the event window, and 0 otherwise; δ is a shift parameter; and ξ_t is an error. This model assumes that there is a shift in the daily mean return to the security during an event window and the mean returns when no event is taking place.

Assuming that the Fama-French 3-factor with momentum model holds for expected returns, the covariance model can be written:

$$R_j = \alpha_j \mathbf{I} + \beta_{1,j} R_m + \beta_{2,j} SMB + \beta_{3,j} HML + \beta_{4,j} UMD + D\delta_j + \xi_j, \qquad j = 1, \ldots, J \quad (3.4)$$

where R_j is a $T \times 1$ vector of daily excess returns to security j; R_m, SMB, HML and UMD are $T \times 1$ vectors of value-weighted market returns, size (small minus big) factors, book-to-market (high minus lows) factors and momentum (up minus down) factors respectively; D is a $T \times K$ matrix of information variables for K event dates; δ_j is a $K \times 1$ vector of event parameters; ξ_j is a $T \times 1$ vector of errors assumed to be independent of all the variables on the right hand side and independently identically distributed normal with mean zero.

The regression of equation (4.4) is run for all the firms in the sample, the total cumulative abnormal return (TCAR) for each firm, j, for the multi-date regulatory event is obtained as:

$$\text{TCAR}_j = \sum_{i=1}^{i=K} \delta_{i,j} \quad (3.5)$$

In my sample, I use a window of $(-1, 0)$ around the event date. (This implies that $D_t = 1$ on the day of the event and the day before). After obtaining the $TCAR$ for each firm in the sample, and using the proxy variables we defined for monitoring cost, private benefits and firm complexity, we can now fully specify the regression outlined in equation (4.6) as follows:

$$\begin{aligned} \text{TCAR} \;=\; & \alpha + \beta_1 \text{LogMVE} + \beta_2 \text{MTB} + \beta_3 \text{RETSTD} + \beta_4 \text{R\&D} + \beta_5 \text{Debt} + \beta_6 \text{DIR\_OWN} \\ & + \beta_7 \text{FIRM\_AGE} + \beta_8 \text{FCF} + \beta_9 \text{LogSEGMENTS} + \beta_{10} \text{CEO\_OWN} \\ & + \beta_{11} \text{INST\_OWN} + \beta_{12} \text{PERFORMANCE} + \beta_{13} \text{CEO\_CHAIR} + \beta_{14} \text{CEO\_AGE} \\ & + \beta_{15} \text{CEO\_TENURE} + \beta_{16} \text{INDEP} + \epsilon \quad (3.6) \end{aligned}$$

In addition to the proxies I used for the costs and benefits of outside director monitoring in the portfolio approach I include free cash flow (FCF) as a proxy for private benefits and the log of number of business segments (LogSEGMENTS) as proxy for firm complexity. Hermalin and Weisbach (1988) propose a model in which board structure might be an outcome of a negotiation, or bargaining process between the CEO and shareholders. In my regression specification, I include the following proxies for CEO influence: the firm's performance (PERFORMANCE), a dummy variable that equals 1 if the CEO is also the chair of the board (CEO_CHAIR), CEO tenure (CEO_TENURE) and CEO Age (CEO_AGE). I also include a dummy variable, INDEP, which takes a value of 1 if less than 50% of the board consists of executives of the firm and 0 otherwise.

It is worth noting again that a number of very important caveats apply in making any inference from the CAR approach. As noted already, inference depends very much on my having correctly identified the value relevant dates outlined in Table 6. In addition, the fact that the regulation happens to all firms at the same time could lead to biased estimates and test statistics since returns will be contemporaneously correlated across firms. Finally the OLS estimation does not control for unobserved heterogeneity in board composition and this could bias our results. Consider the market-to-book (MTB) variable which is a proxy for monitoring costs. My hypothesis is that outside directors would be less beneficial for such a firm and my prediction from estimating (4.6) would be that $\beta_2 < 0$. However, there might be unobserved firm-specific reasons why such a firm might actually be better off with more outside director monitoring, thus biasing me against finding support for my hypothesis.

The portfolio methodology described in the previous section largely overcomes the problems associated with the CAR methodology and as such most of my inference in this paper will be made from the results of the portfolio methodology. Nevertheless, subject to the caveats noted above, the CAR approach offers, at least qualitatively, another metric for assessing the cross-sectional variation in the effects of the recent governance regulations.

3.4.2 Results

Results of the Portfolio approach

The results, which are shown in Table 5, provide strong support for my hypotheses that firms that will benefit less from having more outsiders will be more adversely affected by the regulations. Panel A gives the results from the regression of daily portfolio excess returns on just the market factor. Panel B reports the results from the regression of daily excess returns on all three Fama-French factors. Panel C reports the results from the regression of daily excess returns on all three Fama-French factors and Carhat's momentum factor. In all specifications, I find that as we move from the portfolio that is most likely to be most constrained by SOX and the exchange regulations to the one that is least likely, α_p increases monotonically. The results suggest that the benefits of the regulation were much less for those firms that had little to benefit from regulations. Using the portfolio alphas obtained from the regressions of excess returns on the Fama-French and momentum factors, we find that a portfolio that bought the firms in Quartile 4 and shorted the firms in Quartile 1 would have yielded a significantly positive α of 0.114%. This corresponds to an total return of 17.2% over the eight month period between January and August, a number that is economically significant (The returns are measured over a 140 day trading period, so this number is obtained as $1.00114^{140} - 1$).

The results clearly suggest that for those firms in Quartile 1 (which by construction are most likely to be the smallest, riskiest, high growth firms, with high director ownership and least compliant with the requirements of the regulation), the costs of the regulation exceed the benefits. In contrast, for large, mature firms with low director ownership that already have a large number of independent directors (Quartiles 3 and 4), SOX and the exchange regulations appear not to have been harmful.

While we can be relatively confident in making inference from the cross-sectional differences in portfolio αs, we should exercise caution in making any inference with regards to the absolute value of any individual portfolio's abnormal return. The expected returns model controls for the cross-sectional variation in expected returns; it offers little guide as to how the overall market would have done without the regulations. Thus, the key inference from my analysis is that there is significant cross-sectional variation in the effect of SOX and the recent exchange regulations. The difference between the impact on firms with high monitoring costs and low benefits of outside monitoring and those firms with the opposite set of characteristics are statistically and economically significant. This finding lends strong support to the argument that cross-sectional differences in levels of outside director involvement that obtained before SOX was not random or inefficient but reflected endogenous choices made by firms with respect to their operating and contracting environments.

RESULTS OF THE CAR APPROACH

Table 7 gives the results from carrying out the regression specified in equation (4.6). In Models 1 and 2, the TCAR is obtained by summing the CARs for just the dates associated with the development of the exchange listing rules. In Models 3 and 4, the TCAR is obtained by summing the CARS for the dates associated with the development of both the exchange rules and SOX.

Hypothesis H1 proposes that the total CAR (TCAR) will be negatively related to monitoring cost. In my estimation, I use the standard deviation of returns (RETSTD), market-to-book ratio (MTB) and R&D expenditure (R&D) as proxies for monitoring cost. The results in Table 7 provide some evidence to support H1. The estimated coefficient for MTB is negative and significant in Models 1, 2 and 4. The estimated coefficient of R&D is also negative and significant in Models 1 and 3.

Hypothesis H2 proposes that the TCAR will be positively related to CEO private benefits. I use free cash flow (FCF), DEBT and FIRM_AGE as proxies for private benefits. The results in Table 7 provide some evidence to support H2. In three of the four specifications, the coefficient on FIRM_AGE is positive and significant. In addition, the coefficient on DEBT is positive and significant in Model 2.

Hypothesis H3 proposes that TCAR will be positively related to firm complexity and scope of operations. I use firm size (MVE), firm age (FIRM_AGE) and the number of business segments (SEGMENTS) as proxies for firm scope. The results in Table 7 provide strong evidence is support of H3. The coefficient on FIRM_AGE is positive and significant in both Models 1, 2 and 3. In addition, the coefficient on firm size is positive in three of the four models (although it is insignificant in Model 2, probably because that sample is skewed towards the larger firms in the overall sample).

Overall, the results from the CAR approach provide additional evidence that firms with high monitoring costs, and small firms, with limited scope of operations appear to benefit less (or be more adversely affected) by the recent exchange regulations that impose outside dominated boards on firms. The results strongly support those obtained from the monitoring-cost sorted portfolio tests of the previous section.

3.4.3 Robustness Checks

Alternative Explanations: Firm Size and the Cross-sectional differences in wealth effects

One of the major issues in the public debate on the costs and benefits of SOX and the exchange listing requirements revolves round the 'fixed' costs of complying with all (not just the board related-aspects) of the regulations. The fixed compliance costs (for example, additional fees to auditors, spending on information technology, costs of recruiting and educating new outside directors on business processes) may fall disproportionately on smaller firms. My argument in this paper is that the cross-sectional variation in the effects of the regulation is related to the cross-sectional differences in the costs and benefits of outside director monitoring of which size is only one of the factors. However, it can be argued that these cross-sectional differences simply arise "mechanically" because the uniform fixed costs of complying with the new rules and regulations are proportionally higher for smaller firms than for larger firms.

To test if my results are simply an artefact of the fixed costs of regulatory compliance, I divide the full sample into four size quartiles. If it is the case that all other costs (or benefits) of the regulations are the same across firms except the fixed costs of compliance and size is a proxy for the fixed costs, we should expect to see a negative relationship between size and the market reaction to SOX. Size should largely explain the results presented in Table 5.

I run the portfolio regressions for each of the size quartiles over the event window between January 15, 2002 and August 15, 2002. The portfolio abnormal returns (α) are 0.084, −0.039, −0.010, 0.076 for Quartiles 1, 2, 3 and 4 respectively. The difference between Quartiles 4 and 1 is insignificant and we do not see the same monotonic increase in abnormal returns across the portfolios that I report in Table 5. This suggests that fixed costs of complying with the regulations do not fully explain the cross-sectional differences in the effects of the new rules and regulations. It lends further support to the hypotheses that the cross-sectional differences in the value effects of the new rules and regulations can be explained by cross-sectional differences in the relative costs and benefits of having outside directors.

Abnormal returns, governance regulation and riskfactors

It is possible that the abnormal returns measured around the development of the new rules and regulations do not reflect the effect of these new regulations, but capture some unobserved differences in risk inherent in the portfolios, as they are constructed. An argument could be made that some of proxies for board determinants could also be proxies for risk. If this was the case then the pattern of abnormal returns that we observe for the event window (where the abnormal returns for the high cost/low benefit of monitoring portfolio are negative when compared to the low cost/high benefit portfolio) would be observed in other time periods.

In order to test this, I carry out the calendar time portfolio regressions for the composite-index sorted portfolio for the entire period from January 2001 to December 2005, excluding the regulatory event window of January 2002 to August 2002. The abnormal returns (α_p) obtained are dramatically different from those obtained for the event window. I obtain an α of 0.09% for Quartile 1, 0.08% for Quartile 2, 0.06% for

Quartile 4 and 0.03% for Quartile 4. I do not observe the same monotonically increase from Quartile 1 to Quartile 4 that I observe for the event window. These results suggest that the cross-sectional differences in abnormal returns obtained over the event window are not due to some unobserved risk factors and increases the likelihood that they are due to the event itself.

3.5 Conclusion

This paper investigates the cross-sectional variation in the wealth effect of SOX and the new exchange listing requirements in 2002. I propose that the provisions in SOX and the exchange rules that are designed to impose a higher level of outsider director involvement on all firms will be less beneficial to firms that have high costs of, and low benefits, from outside director monitoring. Using the economic determinants of board structure (monitoring costs, private benefits, and firm complexity) as a measure of the costs and benefits of outside director monitoring, I find evidence that the wealth effects of the regulations is related to the costs and benefits of outside director monitoring. Firms with high outside monitoring costs and low benefits of outside monitoring earn lower risk-adjusted returns than firms with lower outside monitoring costs and higher benefits of outside monitoring, over the window spanning the development of the regulations. The results also suggest that for firms where the cost of monitoring is extremely high relative to the benefits, the reaction to the regulations could actually be negative.

There are a number of caveats that apply in interpreting these results. First of all, my results reflect cross-sectional variation in announcement returns across firms. It is quite possible that the regulations may be welfare enhancing (or welfare decreasing) for the market as a whole. There is no expected returns model that can predict how the entire market would have performed in the absence of these regulations. Nevertheless, whatever the overall benefits of SOX, my results clearly show that there is cross-sectional variation in the wealth effects that is related to costs and benefits of outside director monitoring.

Secondly, it is possible that there are other costs and benefits of the regulations that vary across my sample of firms, but is not related to the costs and benefits of outside director monitoring. SOX and the exchange listing requirements do contain a number of non-board related provisions and I do not completely eliminate the possibility that my results are driven by other factors. However, inference from my findings is still valid and consistent if we assume that the non-board costs or benefits are orthogonal the to costs and benefits of outside director monitoring.

This study can be extended in a number of ways. In this paper, I have suggested that the new regulations have an impact, not just by forcing firms to increase the nominal number of outside directors, but by tightening the definition of independence and requiring greater outsider involvement. A complementary extension of this project will be to document if this has happened to any significant degree. Additionally, this paper focuses exclusively on board structures. If firms choose their governance as part of a joint value maximizing package, the impact of SOX and the exchange listing rules on other aspects of corporate governance will provide a clearer picture of their longer term impact.

Table 3.1: **Definition of Variables Used in the Study**

MVE	=	Market Value of Equity
MTB	=	Market Value of Equity / Book Value of Equity
R&D	=	R&D expenditure/Total Assets (set to zero, if missing
RETSTD	=	Standard deviation of monthly stock returns
FCF	=	Free cash flow as defined by Lehn and Poulsen (1989) scaled by Total assets
PERFORMANCE	=	Average industry return on assets over 2000 and 2001
DEBT	=	Long Term Debt/Total Assets
SEGMENTS	=	Number of firm's business segments
FIRM_AGE	=	Number of years since firm was first listed on CRSP
CEO_AGE	=	CEO's Age
CEO_TENURE	=	CEO Tenure
CEO_Own	=	Percentage of firm's shares held by the CEO
DIR_OWN	=	Percentage of firm's shares held by outside directors
INST_OWN	=	Percentage of firm's shares held by institutional investors
INSIDER	=	Proportion of board consisting of executive directors
INDEP	=	Dummy variable = 1 if < 50% of board are insiders, 0 otherwise
CEO_CHAIR	=	Dummy variable = 1 if the CEO is Chairman of the boar, 0 otherwise

Table 3.2: **Summary Statistics For Sample**

This table reports summary statistics for the full sample (except for CEO_AGE and CEO_TENURE for which there is data for 652 firms). From *Disclosure* , I start out with 3,571 firm that have board composition, leadership and ownership data for the year 2001. This data is merged with COMPUSTAT and CRSP. This leaves a sample of 1,526 firms that have board data, stock returns data and sufficient accounting data. Panel A reports summary firm characteristics. MVE is Market Value of Equity (in $MM). MTB is the Market-to-Book ratio of equity. R&D is the ratio of R&D expense to total assets. FCF is free cash flow scaled by total assets. RETSTD is the standard deviation of the monthly stock return for the year 2001. PERFORMANCE is the average annual industry adjusted earnings before interest and taxes scaled by total assets over the 2-year period preceding the 2001 proxy date. DEBT is total long-term debt divided by total assets. SEGMENTS is the number of business segments. FIRM_AGE is the number of years since the firm first appeared on *CRSP*. Panel B reports shares owned by each group divided by total shares outstanding for the firm. Panel C reports summary board and CEO characteristics. INSIDER is the proportion of the board composed of executive directors. INDEP is a dummy variable that takes a value of 1 if INSIDER < 0.5, 0 otherwise. CEO_AGE is the CEO's age. CEO_TENURE is the number of years since the CEO has been on the board.

Variable	Mean	Median
Panel A - Firm Characteristics		
MVE	3,982.3	340.3
MTB	2.208	1.387
FCF	0.024	0.081
RETSTD	0.216	0.179
R&D	0.066	0.010
PERFORMANCE	0.019	0.042
DEBT	0.014	0.031
SEGMENTS	2.6	1.0
FIRM_AGE	14.2	9.0
Panel B - Ownership		
CEO_OWN	0.047	0.006
DIR_OWN	0.015	0.001
INST_OWN	0.458	0.464
Panel C - Board and CEO Characteristics		
INSIDER	0.307	0.285
INDEP	0.86	1.00
CEO_AGE	53.9	54.0
CEO_TENURE	13.1	7.0

Table 3.3: **Correlation Matrix of Key Variables**

Variables are as defined in Table 3.1. p-values are in parentheses. a, b, and c denote significance at the 1%, 5% and 10% significance levels respectively.

	MVE	MTB	R&D	RETSTD	INSIDER	FIRM_AGE	DIR_OWN
MVE	1.000						
MTB	0.124^a $(< .001)$	1.000					
R&D	-0.004 (0.867)	0.325^a $(< .001)$	1.000				
RETSTD	-0.081^a (0.002)	0.145^a $(< .001)$	0.389^a $(< .001)$	1.000			
INSIDER	-0.018 (0.478)	0.037 (0.154)	0.061^b (0.016)	0.073^a (0.004)	1.000		
FIRM_AGE	0.159^a $(< .001)$	-0.123^a $(< .001)$	-0.227^a $(< .001)$	-0.339^a $(< .001)$	-0.132^a $(< .001)$	1.000	
DIR_OWN	-0.053^b (0.037)	-0.046^c (0.073)	-0.028 (0.273)	-0.002 (0.929)	0.044^c (0.085)	-0.076^a (0.003)	1.000

Table 3.4: **Summary Statistics of Composite-Index Sorted Portfolios**

This tables repots the summary statistics for each quartile of our composite index sorted portfolios. MVE is Market Value of Equity (in $MM). MTB is the Market-to-Book ratio of equity. RETSTD is the standard deviation of the monthly stock return for the year 2001. R&D is the ratio of R&D expense to total assets. FIRM_AGE is the number of years since the firm first appeared on *CRSP*. INSIDER is the proportion of the board composed of executive directors. DIR_OWN is the percentage of the firm's shares held by outside directors. The composite index is constructed as follows: Firms are assigned an index between 0 and 9 based on their rank on the following dimensions: MVE (from smallest to largest), MTB (from highest to lowest), R&D intensity (from highest to lowest), RETSTD (from highest to lowest), FIRM_AGE (from youngest to oldest), INSIDER (from least to most) and DIR_OWN (from lowest to highest). A composite index is constructed by summing the indices across all the dimensions for each firm. The firms are now sorted into portfolio quartiles based on their ranking on the composite index, such that the lowest quartile (Quartile 1) has the firms that rank lowest on the composite index, and the highest quartile (Quartile 4) has the firms with the highest ranking on the composite index. Additional details of the construction of the composite index are contained in an appendix to the paper. Board committee data is taken from the IRRC database; other board data comes from DISCLOSURE. a, b and c represent significance at the 1%, 5% and 10% respectively.

Panel A - Firm Characteristics

	Mean (Median)					
Quartile	MVE	MTB	R&D	FIRM_AGE	RETSTD	DIR_OWN
1	521.8	3.55	0.18	6.33	0.35	0.027
	(144.8)	(2.32)	(0.13)	(5.00)	(0.31)	(0.004)
2	3,438.3	2.15	0.05	10.39	0.23	0.017
	(213.0)	(1.51)	(0.02)	(8.00)	(0.21)	(0.003)
3	4,454.9	1.72	0.02	14.00	0.17	0.013
	(312.8)	(1.09)	(0.00)	(10.00)	(0.16)	(0.001)
4	7,413.2	1.46	0.01	25.99	0.12	0.003
	(1,173.6)	(1.04)	(0.00)	(29.00)	(0.12)	(0.000)
$4-1^{*}$	6,891.4^{a}	-2.09^{a}	-0.17^{a}	19.66^{a}	-0.23^{a}	-0.024^{a}
	(1,028.8)	(-1.28)	(-0.13)	(24.00)	(-0.19)	(-0.004)

Panel B - Board Characteristics

Quartile	Percentage of directors that are insiders	Percentage with insider-dominated boards	Percentage with independent audit committees	Percentage with independent compensation committees	Percentage with independent nominating committees	Percentage with all** independent committees
1	36.91%	21.82%	70.07%	57.69%	7.69%	5.13%
	($N=381$)	($N=381$)	($N=78$)	($N=78$)	($N=78$)	($N=78$)
2	32.72%	15.80%	69.92%	66.16%	14.29%	14.29%
	($N=355$)	($N=355$)	($N=133$)	($N=133$)	($N=133$)	($N=133$)
3	30.44%	13.17%	71.18%	75.14%	29.38%	25.42%
	($N=404$)	($N=404$)	($N=177$)	($N=177$)	($N=177$)	($N=177$)
4	22.82%	4.89%	70.67%	71.42%	42.48%	32.71%
	($N=388$)	($N=388$)	($N=266$)	($N=266$)	($N=266$)	($N=266$)
$4-1^{*}$	$-14.09\%^{a}$	$-16.93\%^{a}$	0.60%	13.73%^{b}	34.79%^{a}	27.58%^{a}

Notes

* The level of significance of the difference between quartile 4 and 1 is based on a t-test of the difference in means.

** All refers to audit, compensation and nominating committees.

Table 3.5: **Cross-Sectional Variation in Wealth Effects Around Announcements related to the SOX and the Exchange Regulations – The Portfolio Approach**
This table reports results from calendar time portfolio regressions where the dependent variables are composite-index sorted portfolio returns, R_p, in excess of the risk-free rate, R_f. The composite index is constructed as follows: Firms are assigned an index between 0 and 9 based on their rank on the following dimensions: MVE (from smallest to largest), MTB (from highest to lowest), R&D intensity (from highest to lowest), RETSTD (from highest to lowest), FIRM_AGE (from youngest to oldest), INSIDER (from least to most) and DIR_OWN (from lowest to highest). The composite index is constructed by summing the indices across all the dimensions for each firm. The firms are now sorted into portfolio quartiles based on their ranking on the composite index, such that the lowest quartile (Quartile 1) has the firms predicted to have the highest cost/lowest benefit of outside directors, and the highest quartile (Quartile 4) has the firms predicted to have the lowest cost/highest benefit of outside directors. I calculate the daily excess return of the portfolios that are formed. The resulting time series of daily excess returns ($R_p - R_f$) is regressed on three factors from Fama and French (1993): the excess return on the market ($R_m - R_f$); the return difference between a portfolio of "small" and "big" stocks (SMB) and the return difference between a portfolio of "high" and "low" book-to-market stocks (HML). We augment this with a momentum factor as proposed by Carhart (1997) which is the return difference between a portfolio of stocks with high returns in the past year and a portfolio of stocks with low returns in the past year (UMD). The intercept (α) measures daily abnormal return given the model (in percentage terms). Panel A gives the results from the regression of daily excess returns on just the market factor. Panel B reports the results from the regression of daily excess portfolio returns on all three Fama-French factors. Panel C reports the results from the regression of daily excess returns on all three Fama-French factors and Carhat's momentum factor. The regression is carried out over the period from January 15 to August 15. The t-statistics are reported in brackets, and the number of firms in each portfolio is reported in parentheses. The implied 8-month AR $[(1+\alpha_p)^{140}-1]$ reported in Panel C is the estimated average buy-and-hold return from earning the intercept return every day for eight months (140 trading days). a, b and c represent significance at the 1%, 5% and 10% levels respectively.

	Panel A		Panel B	
	$R_{pt} - R_{ft} = \alpha_p + \beta_m(R_{mt} - R_{ft}) + \epsilon_t$		$R_{pt} - R_{ft} = \alpha_p + \beta_m(R_{mt} - R_{ft}) + \beta_s SMB_t + \beta_h HML_t + \epsilon_t$	
Quartile	α_p [t-stat]	Adj. R^2 (N-obs)	α_p [t-stat]	Adj. R^2 (N-obs)
1	−0.173 [−2.62]^a	0.80 (381)	−0.156 [−3.03]^a	0.87 (381)
2	−0.027 [−0.61]	0.85 (353)	−0.014 [−0.44]	0.92 (353)
3	0.076 [1.91]^c	0.82 (404)	0.074 [3.63]^a	0.95 (404)
4	0.096 [2.30]^b	0.81 (388)	0.087 [3.10]^a	0.92 (388)
4−1	0.269 [3.65]^a		0.243 [3.56]^a	

Panel C

$$R_{pt} - R_{ft} = \alpha_p + \beta_m(R_{mt} - R_{ft}) + \beta_s SMB_t + \beta_h HML_t + \beta_u UMD_t + \epsilon_t$$

Quartile	α_p [t-stat]	Adj. R^2 (N-obs)	Implied 8-month AR(%)
1	−0.060 [−1.67][c]	0.91 (381)	−8.05
2	0.040 [1.33]	0.94 (353)	5.75
3	0.054 [2.57][a]	0.96 (404)	7.85
4	0.057 [2.39][a]	0.95 (388)	8.31
4−1	0.114 [2.29][a]		17.29

Table 3.6: **Key Events Associated with the Passage of SOX and the new Exchange Listing Requirements**

Date	Event
Panel A: Events Associated with the Passage of New Exchange Listing Requirements	
02/13/2002	SEC asks NYSE and NASDAQ to review their corporate governance requirements
04/12/2002	NASDAQ executive committee approves first round of new corporate governance proposals
05/22/2002	NASDAQ board approves the proposals
06/06/2002	NYSE committee unveils its governance rule proposal with the following main provisions: (1) Majority of independent directors on boards; (2) Stricter definition of independence; (3) Existence of three main committees and their independence; (4) Executive sessions without management
07/24/2002	NASDAQ board approves second round of proposals
08/01/2002	NYSE board approves proposals
Panel B: Events Associated with the Passage of SOX	
01/17/2002	SEC Chairman proposes an accounting overhaul plan
02/13/2002	Oxley introduces an accounting reform bill in the House Financial Services Committee
04/24/2002	Oxley's bill passed in the house
05/08/2002	Sarbanes circulates his reform bill in the Senate Banking Committee
07/15/2002	Senate passes Sarbanes' bill 97 to 0
07/24/2002	Senate and House agree on final bill.

Table 3.7: **Cross-Sectional Variation in Wealth Effects Around Announcements related to the Exchange Regulations**

This table reports cross-sectional regressions of firm total cumulative abnormal reaction (TCAR) on various firm characteristics and board characteristics. The dependent variable is each firm's total cumulative abnormal reaction (TCAR). The cumulative abnormal reaction is calculated for each firm for (-1,0) window around each of the key dates listed in Table 3, and a total cumulative abnormal reaction (TCAR) is obtained by summing the cumulative abnormal reactions obtained around each date. In Models 1 and 2, the TCAR is obtained by summing the CARs for just the dates associated with the development of the exchange listing rules. In Models 3 and 4, the TCAR is obtained by summing the CARS for the dates associated with both the exchange rules and SOX. The independent variables are as defined in Tables 1 and 2. a, b, and c denote significance at the 1%, 5% and 10% significance level.

		Exchange Rules only		SOX and Exchange Rules	
	Prediction	Model 1	Model 2	Model 3	Model 4
Variable	of Hypotheses	(N = 1526)	(N = 652)	(N = 1526)	(N = 652)
LogMVE	+	0.7185^{b}	0.2432	1.0503^{a}	0.7818^{c}
		(0.0142)	(0.5106)	(0.0013)	(0.0558)
MTB	−	-0.4565^{b}	-0.7699^{b}	−0.0207	-0.9138^{c}
		(0.0278)	(0.0185)	(0.9610)	(0.0784)
FCF	+	-10.0553^{c}	−1.3162	−9.4332	−7.4688
		(0.0609)	(0.8371)	(0.1571)	(0.5565)
RETSTD	−	−4.2766	6.7293	−7.3085	6.3757
		(0.2790)	(0.3059)	(0.1130)	(0.4073)
R&D	−	-13.8334^{b}	−6.7796	-15.6863^{c}	20.0631
		(0.0273)	(0.7712)	(0.0786)	(0.1763)
PERFORMANCE	+	3.1837	−0.4064	−1.6707	5.2906
		(0.4807)	(0.9394)	(0.7931)	(0.5054)
DEBT	+	1.4015	7.7857^{b}	3.6869	5.2976
		(0.5641)	(0.0292)	(0.5344)	(0.2965)
LogSEGMENTS	+	0.1871	0.3393	−0.6177	0.0703
		(0.7609)	(0.6305)	(0.5029)	(0.9513)
FIRM_AGE	+	0.2428^{c}	0.3285^{c}	0.5684^{c}	0.4702
		(0.0977)	(0.0798)	(0.0503)	(0.1212)
CEO_Chair	+	1.8275^{b}	2.1021^{c}	1.9861^{c}	1.0662
		(0.0385)	(0.0547)	(0.0823)	(0.4387)
CEO_Own	−	−6.2592	7.3871	7.3871	−19.3977
		(0.2459)	(0.7457)	(0.6754)	(0.2334)
DIR_OWN	−	−18.0732	-31.5965^{b}	−14.2933	−35.1299
		(0.0479)	(0.1393)	(0.2594)	(0.2460)
INST_OWN	−	−1.2727	−2.3530	−3.5251	−6.5451
		(0.5184)	(0.3920)	(0.1263)	(0.0629)
INDEP	+	1.3082	1.6528	−1.0069	0.5633
		(0.2856)	(0.3366)	(0.7560)	(0.7662)
CEO_AGE	+		0.0631		0.1518^{b}
			(0.3582)		(0.0423)
CEO_TENURE	+		−0.0059		−0.0088
			(0.7188)		(0.6418)
R^2		3.47%	6.09%	1.55%	4.30%

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Appendix

Construction of the composite index to measure the relative costs and benefits of outside directors

The aim of the composite index is to capture the relative trade-offs between the costs and benefits of outside directors on firm's board. I sort firms on five dimensions which have been suggested by prior literature as proxies for the costs and benefits of outside director monitoring - Size (MVE), Growth Opportunities (MTB), R&D Intensity (R&D), Firm Age (AGE) and Firm Risk (RETSTD). I also sort firms on two control variables: the ex-ante proportion of inside directors (INSIDER) and Director Ownership (DIR_OWN).

Along each of these dimensions, I sort the firms into deciles. The lowest decile consists of those firms predicted to have the the highest cost/lowest benefit from outside directors, while the highest decile consists of those predicted to have the lowest cost/highest benefit from outside directors. So firms, are sorted, on each dimension, as follows:

- Size (MVE): smallest to biggest
- Growth Opportunities (MTB): highest to lowest
- R&D Intensity (R&D): highest to lowest
- Firm Age (AGE): youngest to oldest
- Firm Risk (RETSTD): highest to lowest
- Number of inside directors (INSIDER): least to most
- Director Ownership (DIR_OWN): highest to lowest

Next, I assign a number between 0 and 9 to each firm based on the decile it falls into when ranked on each dimension. This number represents the firm rank within each dimension. Finally to obtain the composite index for each firm, I simply sum the ranks across all dimensions.

As an example, I illustrate in the table below, the computation of this composite index for two firms: Universal Display Corporation (which is Quartile 1) and International Paper Corporation (which is in Quartile 4). Universal Display Corporation is a leading organic light emitting device (OLED) technology developer with a broad intellectual property portfolio, years of experience in OLED research and development, and entrepreneurial management expertise. International Paper has significant global businesses in paper and paper distribution, packaging and forest products, including building materials. The company has operations in nearly 40 countries, employs approximately 83,000 people worldwide and exports its products to more than 120 nations. Sales of almost $25 billion annually are derived from businesses located primarily in the United States, Europe, Latin America, Asia/Pacific and Canada.

	Rank							Composite
	MVE	MTB	R&D	AGE	RETSTD	INSIDER	DIR_OWN	Index
Universal Display	3	1	0	4	0	1	1	10
International Paper	9	6	6	9	5	9	7	50