CF
7/31/07
1:00 pm

When Are Outside Directors Effective?*

Ran Duchin, John G. Matsusaka, and Oguzhan Ozbas

University of Southern California

Theory suggests that the effectiveness of outside directors depends on how informed they are about the firm. Well-informed outside directors can monitor insiders and help control agency problems, but poorly informed directors may push the firm down unprofitable paths. This paper documents that the effect of outside directors on firm performance depends on their cost of acquiring information: outside directors improve performance when the information cost is low and reduce performance when the information cost is high. We address the standard endogeneity problem between performance and board composition by focusing on firms that were required to increase the number of outsider directors as a result of Sarbanes-Oxley and other regulatory changes. We also document that firms compose their boards as if they understand that outsider effectiveness varies with information costs, though less so in recent years due to compliance pressures.

July 9, 2007

---

* This is a rough draft. Please do not cite without permission. We thank USC for financial support. Contact the authors at Marshall School of Business, University of Southern California, Los Angeles, CA 90089-1427, duchin@usc.edu, matsusak@usc.edu, ozbas@usc.edu.

1. Introduction

Outside directors are the great hope of corporate governance reformers. Because of their independence from the CEO, outside directors are believed to be willing to stand up to the CEO when necessary to protect shareholder interests. New regulations beginning with the Sarbanes-Oxley Act of 2002 (SOX) and including rules promulgated by the Securities and Exchange Commission, New York Stock Exchange, and National Association of Securities Dealers, incorporate the idea that outside shareholders are important custodians of shareholder interests by requiring greater participation of outside directors on the board and key committees. Yet it has long been recognized that the effectiveness of outside directors is limited by their inferior information compared to corporate insiders (Berle and Means, 1932; Fama and Jensen, 1983). Indeed, the notion that outsiders cannot effectively monitor and control agency problems has been a central premise of corporate finance research for decades.

While it is generally recognized, at least among scholars, that having more outside directors may not always be better, there is little empirical evidence that reveals when outside directors are likely to be effective and ineffective. In fact, it is notoriously difficult to find reliable evidence that outside directors matter at all for performance (Hermalin and Weisbach, 2003; Field and Keys, 2003). One reason for the dearth of evidence may be the endogeneity of board composition. Poor performance might cause an increase in board independence, as in Hermalin and Weisbach (1998), and changes in other factors may cause comovements in board composition and firm performance, as in Harris and Raviv (forthcoming). The endogeneity of outsider representation on boards

makes it difficult to identify a line of causality running from boards to performance, and therefore difficult to determine when outsiders are and are not effective.

The purpose of this paper is to provide empirical estimates of the effectiveness of outside directors. Our key methodological innovation is an identification strategy that cuts through the endogeneity problem, and allows us to recover estimates of the impact of outside directors on firm performance. Specifically, we use the fact that some firms were forced to increase the number of outsiders on their boards by SOX and other regulatory changes beginning in 2002. For example, SOX requires audit committees to be comprised entirely of independent directors, and new NYSE and the NASD regulations require boards to have a majority of independent directors. In response to these new regulations, many firms had to increase the representation of outside directors on their boards. Because these changes in board composition are exogenous to firm performance, we can use them to identify the effect of outsider directors on performance, and sidestep the endogeneity problem to a significant degree.

We are especially interested in how the effectiveness of outside directors depends on the information environment. Recent theoretical research on boards highlights the central role of information in determining the effectiveness of outside directors, and reinforces the idea that outsiders can even hurt a firm's performance if their information is poor enough (Raheja, 2005; Harris and Raviv, forthcoming). Theory suggests that when outside directors are able to acquire information at relatively low cost, they can be effective, but when information is very costly to acquire, they will be ineffective or possibly hurt performance. Our basic approach is to identify firms where insiders appear to be more informed than outsiders (using measures of asymmetric information, such as

analyst forecast variance) and compare them to firms where information asymmetry appears modest. For each group of firms, we estimate the relation between performance and the fraction of outsiders on the board.

Our main finding is that adding outside directors to the board does not help or hurt performance on average, but that outsiders significantly improve performance when their information cost is likely to be low, and reduce performance when their information cost is likely to be high. That is, in firms with significant asymmetry of information, an increase in the number of outsiders causes performance to decline, while in firms without significant asymmetry of information, an increase in outsiders causes performance to increase. We show that this relation holds for several different performance measures, including earnings and Q, and for several different measures of information asymmetry, and the magnitudes are nontrivial. A one standard deviation increase in the fraction of outside directors on the board is associated with 0.022 lower ROA in firms with significant asymmetry of information and 0.016 higher ROA in firms without significant information asymmetry, controlling for other determinants of performance. Similarly, a one standard deviation increase in board independence is associated with 17.8 percent lower Q in high information asymmetry firms, and 11 percent higher Q in low information asymmetry firms. These estimates provide support for the idea that outside directors can improve governance, and thus some support for recent regulations, but add an important caveat by documenting situations where adding outside directors can be counterproductive. Our findings also suggest that the literature's failure to find a robust connection between board composition and firm performance may have been because the effects cancel out on average, when not conditioned on information.

In light of evidence that outside directors are effective in some situations and ineffective in other situations, it is natural to wonder whether firms take this into account when constituting their boards. A rapidly expanding empirical literature has studied the determinants of board composition, and a number of correlations have emerged (e.g. Boone et al., forthcoming; Linck et al., forthcoming). We extend this literature by investigating the role of asymmetric information, something that has not been explored previously.[1] Our evidence suggests that firms do take information conditions into account: firms with severe asymmetry of information have fewer outsiders on their boards than firms with modest asymmetry of information. This evidence suggests that to some degree boards are constituted in order to maximize value, supporting the message in Raheja (2005) and Harris and Raviv (forthcoming). However, our finding that externally driven changes in the number of outsiders can increase performance suggests that boards are not constituted entirely with an eye toward value maximization.

The paper is organized as follows. Section 2 discusses recent regulatory changes since SOX, and highlights new rules that have caused changes in outside directors. Section 3 sketches the theory underlying our analysis. Section 4 discusses the data, and goes into some detail about how asymmetric information is measured. Section 5 reports evidence on the connection between outside directors and firm performance. Section 6 reports evidence on the determinants of board composition. Section 7 discusses implications.

[1] Several studies (most recently, Boone et al. (forthcoming), Coles et al. (forthcoming), and Linck et al. (forthcoming)) have investigated whether information uncertainty, typically measured by the volatility of a firm's stock price, predicts board composition, with mixed results. We are interested not in information uncertainty, which can be thought of as an information problem that faces all parties, but in information *asymmetry*, the degree to which insiders are more knowledgeable than outsiders.

2. New Regulations on Independent Directors

SOX and the SEC and exchange regulations that it engendered represent perhaps the most significant overhaul of securities law in the United States since the Great Depression. The new regulations are broadly intended to improve corporate governance, and cover a variety of subjects, including accounting oversight, auditor independence, financial disclosure, corporate fraud, and corporate tax returns. Of particular interest for our purposes are new requirements concerning independent directors. Table I summarizes the key provisions. SOX requires corporate audit committees to consist entirely of independent directors, where independence is defined as a person who does not "accept any consulting, advisory, or other compensatory fee from the issuer" and is not "an affiliated person of the issuer or any subsidiary thereof," other than in his or her capacity as a director (Section 301). NYSE and Nasdaq regulations approved by the SEC in 2003 go beyond SOX and require a majority of directors on the board to be independent. They also set minimal participation levels for independent directors on the compensation and nominating committees, and expand the definition of independence to be a director who "has no material relationship with the listed company (either directly or as a partner, shareholder or officer of an organization that has a relationship with the company)." A director is not considered independent if, among other things, he or she or an immediate family member was an employee in the previous three years (other than as a director), he or she or an immediate family member is connected to the firm's auditor, or he or she works for a company that does business with the firm.

Firms responded to the new regulations by significantly increasing the representation of outside directors on their boards. Figure 1 and Table II show the change in composition of corporate boards and committees from 1996 to 2005, based on data from the Investor Responsibility Research Center (IRRC). In these data, a director is "independent" if he or she is not an employee of the company and is not "linked" to the firm (that is, is not a former employee, employee of an organization that receives charitable gifts from the company, employee of a customer or supplier to the company, relative of an executive director, and so on). Figure 1 shows that from 1996 to 2000, the number of firms with a majority of independent directors on their boards was fairly stable in the 72-74 percent range. In 2000, roughly 76 percent of firms had a board with a majority of outside directors. By 2005, the most recent year for which data are available, 94 percent had boards controlled by outsiders. A similar pattern appears for the mean percentage of outside directors across all firms that was stable in the 59 to 61 percent range from 1996 to 2000, and rose to 71 percent in 2005. Table II shows that committees also became more independent after SOX. Over the period 1998-2005, representation of independent directors on audit committees rose from 81 to 95 percent, on compensation committees rose from 85 to 94 percent, and on nominating committees rose from 72 to 92 percent.

Our empirical strategy is based on the observation that some firms, but not all, were forced to change the composition in their boards by the new regulations. Firms can be classified into treatment and control groups depending on whether they were in compliance or not with the new regulations when they were introduced. We use this idea to conduct several experiments, the most natural of which is an instrumental variables

approach where firm (non)compliance with the new regulations is used to identify an exogenous shift in the fraction of outside directors. The resulting variation in board composition allows us to generate estimates of the effect of outside directors on firm performance that are largely free from the standard endogeneity concerns.

3. Theory

Empirical research on boards for the most part has been guided by intuitions rather than formal models. Theoretical work on board composition is limited. Recently, however, several papers have appeared that attempt to model the functions and composition of boards. In Hermalin and Weisbach (1998), the function of boards is to evaluate the quality of the CEO and determine whether to retain or replace the CEO. In Raheja (2005), the function of boards is to evaluate and approve projects proposed by management, and choose the CEO's successor. In Harris and Raviv (forthcoming), the function of boards is to evaluate projects proposed by management, and decide whether to approve the projects. All three papers assume that outsiders have interests more closely aligned with those of shareholders, but outsiders have access to less information or have a higher cost of acquiring information than insiders. Insiders receive private benefits from actions that can compromise firm value. The optimal mix of insiders and outsiders trades off the inferior information of outsiders with their lower susceptibility to agency problems. All three models imply that it is optimal to increase the number of outsiders when outsiders become more informed or their cost of acquiring information declines.

One limitation of these papers as a foundation for empirical work is that they study *optimal* board composition. In such a framework, exogenously imposed changes in

board composition like SOX can only reduce value. The models rule out (almost by definition) the premise of recent regulatory changes that boards are not composed optimally. Recent regulations appear to be motivated by the Berle-Means notion that boards are the creatures of incumbent management. Since one question of interest is whether boards are in fact optimally composed or can be improved by outside regulations, we need a framework that encompasses both possibilities. Here we sketch a simple reduced form model that incorporates the lessons of the recent literature on optimal boards, but also allows for managers to distort board composition. The purpose of the model is to structure the empirical analysis.

The optimal board composition literature suggests that firm value depends on the cost outsiders must pay to become informed, *C*, and on whether the board is controlled by insiders or outsiders, $B \in \{IN, OUT\}$.[2] To incorporate this insight, we represent firm value as $V_B(C)$. Define $\Delta(C) = V_{OUT}(C) - V_{IN}(C)$ to be the value of an outsider-controlled firm relative to the value of an insider-controlled firm. Following the literature, $\partial V_B / \partial C < 0$ (firm value is lower when outsiders' information costs are high) and $\Delta_C \equiv \partial \Delta / \partial C < 0$ (high outsider information costs hurt outsider-controlled firms more than insider-controlled firms). We also assume that Δ can be positive and negative for some values of *C*, so that both insider and outsider control can both be optimal. Figure 2 depicts the value of the firm conditional on information costs and board control.

This setup implies there is a critical information cost C^* such that for $C < C^*$, outsider control is optimal and for $C > C^*$ insider control is optimal. Outsider control is

[2] We follow Harris and Raviv (forthcoming) here by focusing on who controls the board rather than the precise ratio or insiders to outsiders. We believe the intuitions are similar in both cases.

associated with low information costs. If boards are constituted in the optimal way, an exogenous change from insider to outsider control – the policy experiment associated with SOX and various other new regulations – reduces firm value.

To incorporate the possibility that boards are not constituted optimally, but rather represent the desire of the incumbent CEO to stifle dissent, we suppose that the CEO chooses the percentage of outsiders to maximize his or her own utility. The CEO's utility function is

$$U_B(C) = \begin{cases} V_{IN}(C) + \alpha & \text{if} \quad B = IN; \\ V_{OUT}(C) & \text{if} \quad B = OUT. \end{cases}$$

The CEO cares about firm value (because the CEO is also a shareholder, cares about his or her reputation, etc.) but also receives a private benefit from insider control given by α, which we treat as a random variable with a differentiable distribution *F*. When $\alpha = 0$, the CEO chooses the board to maximize value.

The CEO creates an outsider controlled board if $U_{OUT}(C) > U_{IN}(C)$. For $\alpha > 0$, this changes the critical information cost value to C_α, as shown in Figure 2, making insider control more likely for any given *C*. The probability of an outsider controlled board is then $p = \Pr(U_{OUT}(C) > U_{IN}(C)) = \Pr(\Delta > \alpha) = F(\Delta)$. It is straightforward to show that $\partial p / \partial C = F' \Delta_C < 0$. The probability of outsider control responds to the cost of information in the optimal direction: as it becomes more costly for outsiders to become informed, outsider control becomes less likely. This observation implies that we cannot distinguish optimal from suboptimal board composition based on the relation between

board composition and information costs in the cross-section or across time. Even boards that are not constituted optimally respond to information costs in the same qualitative way as optimal boards.

We are particularly interested in how exogenous changes in board composition affect value at different firms depending on their information environments. To study this theoretically, consider how firm value responds to an exogenous change from insider to outsider control. As Figure 2 shows, when $C < C^*$, $V_{OUT} > V_{IN}$ so the change in control increases the firm's value. In this region, insider control is not optimal, and the regulation counteracts the CEO's agency problem and helps shareholders. When $C > C^*$, $V_{OUT} < V_{IN}$ so the change in control reduces the firm's value. In this region, insider control is optimal. By forcing the firm to an inefficient governance arrangement, the regulation reduces the firm's value.

These theoretical relations between information and board composition are the foundation for our empirical tests. The main insight from the analysis is that the effect of SOX and other new regulations should depend on the information environment. For firms with low information costs, an exogenous shift toward outsider control should be associated with higher value and improved performance – the policy exercise forces these firms with suboptimal insider control to have optimal outsider control. In contrast, for firms with high information costs, the change should reduce value and hurt performance – the policy exercise forces these firms with optimal insider control to have suboptimal outsider control. In addition, the analysis implies that the wealth consequences are monotonically related to information costs.

4. Data

Our analysis uses three primary data sources. Information on directors and boards comes from the Investor Responsibility Research Center (IRRC), information to construct our information asymmetry variables is taken from the I/B/E/S Detail database, and data on firm performance is taken from Compustat Industrial Annual and CRSP Monthly Returns. We investigate three different measures of performance: return on assets (ROA), Tobin's Q, and annual stock returns compounded using monthly returns from CRSP. Control variables include board size, firm age (number of years since the firm's first appearance on Compustat with valid asset data), leverage ratio (debt divided by book assets), and the log of firm size (measured by market value of equity).[3] Our final sample covers the period from 1996 to 2005, and contains 15,820 firm-year-observations on 2,897 firms. The sample period is primarily determined by the IRRC data, which run from 1996 to 2005.[4] Panel A of Table III reports summary statistics for the firms-years in our sample.

We use three variables to measure outsiders' cost of becoming informed, which we sometimes refer to as the amount of information asymmetry. The variables follow Krishnaswami and Subramanian (1999) and are based on the availability, homogeneity and accuracy of analysts' quarterly earnings forecasts. The first measure is the number of

[3] Specifically, ROA = Data Item 13 / Data Item 6, Tobin's Q = (Data Item 6 + Data Item 25 * Data Item 199 – Data Item 60 – Data Item 74) / Data Item 6, book leverage ratio = (Data Item 9 + Data Item 34) / (Item 9 + Data Item 34 + Data Item 60 + Data Item 130), and firm size = Data Item 25 * Data Item 199.

[4] The IRRC database provides annual data for the years 1996-2005 on directors in 3,037 firms (152,718 director-year observations), derived from corporate bylaws and charters, proxy statements, annual reports, and SEC filings such as 10-Ks and 10-Qs. For details, see Gompers, Ishii and Metrick (2003). We drop director-year observations with missing director id or director type (Employee, Linked or Affiliated, Independent).

analysts who posted forecasts about the firm in a given year. We postulate that more information is available to outsiders about the firm when it is followed by more analysts. The second measure is the forecast error, defined as the absolute difference between the mean monthly earnings forecast and the actual quarterly earnings per share, normalized by the firm's total book assets. Large forecast errors indicate high levels of information asymmetry. The third measure is the standard deviation of forecasts across analysts. A lack of consensus among analysts (high standard deviation) points to a shortage of information about the firm.[5] We conduct our analysis using the individual measures as well as an index that combines the measures by averaging the firm's percent ranking according to each of the measures.

Much of our analysis examines performance during the period 2000-2005, which begins before SOX was adopted and ends after SOX was implemented. As background, Panel B of Table III provides a comparison of firms that were and were not in compliance with SOX in 2000. Thirty-six percent of sample firms were not in compliance with SOX in 2000, and presumably were forced to increase the representation of outsiders on their boards over the next several years. The average board contained 10 members in both compliant and noncompliant firms, but noncompliant firms had 17 percent fewer independent directors. To the extent that noncompliant boards were avoiding outside directors because it was optimal to do so, theory suggests that noncompliant boards would have higher information costs. All three of the asymmetric information variables suggest lower costs for noncompliant firms, however, although the differences are not

[5] We count forecasts from the same I/B/E/S director id and the same brokerage house as a single analyst. We drop observations with missing data on the firm's CUSIP number. We use the most last earnings forecast before the actual earnings announcement.

statistically significant. We investigate this difference more rigorously later in the paper when we study the determinants of board composition. Firm fundamentals are fairly similar in the compliant and noncompliant samples. On average, ROA is 14.9 percent for compliant firms compared to 15.4 percent for noncompliant firms, Q is 2.2 for compliant versus 2.4 for noncompliant firms, and annual stock returns are 29 percent for both compliant and noncompliant firms.

5. Evidence on Outside Directors and Firm Performance

We begin with nonparametric evidence before turning to the regressions. Table IV reports the performance during 2000-2005 of firms that were not compliant with SOX in 2000. We study performance out to 2005 to allow time for the new governance structures to affect performance. We consider three performance measures (ΔROA, Δlog(Q), and stock returns),[6] and divide firms into three groups according to how costly it is for outsiders to acquire information about the firm (low, medium, high).[7] Panels A, B, and C measure information cost by number of analysts, analyst forecast dispersion, and analyst forecast error. Panel D classifies firms according to the information cost index.

The table shows that the performance of firms that were forced to increase representation of outsiders by SOX varied systematically with the cost of information. Firms with a low cost of information performed best, followed by firms with a medium

[6] For Tobin's Q, we compute log changes so that the estimated regression coefficients have a percentage interpretation. For stock returns, we compute cumulative 5-year returns from the end of fiscal year 2000 to the end of fiscal year 2005

[7] Because the number of analysts is strongly correlated with firm size, and firm size is correlated with performance, we adjust the number of analysts for firm size by regressing the number of analysts on firm size and using the residuals from that regression to partition firms in Panel A (and to construct the index in Panel D).

cost of information, and firms with a high cost of information performed worst. For example, using the information index (Panel D), firms with a low information cost experienced no decline in ROA during the period, while firms with a high information cost experienced a 5 percent decline in ROA. Similarly, Q increased by 8 percent for low information cost firms, but fell by 13 percent for medium information cost firms, and fell by 23 percent for high information cost firms. All firms experienced stock price appreciation during the sample period, but the return was lower for firms with higher information costs (163 percent for low cost firms, 82 percent for medium cost firms, and 52 percent for high cost firms). The table also reports the t-statistics for the hypothesis that the means are different across information categories. Most of the means are different from each other at conventional levels of statistical significance, and the mean for low information exceeds the mean for high information in all 12 comparisons at the 10 percent level of significance or better. We also find, but do not report, a similar pattern if instead of considering firms that were not compliant with SOX's requirement of a fully independent audit committee, we consider firms that were not compliant with exchange requirements to have a majority of independent directors on the board. In short, the negative correlation between performance and information cost holds for almost every measure of performance and information in the table, suggesting rather strongly that the effects of increasing outsider representation depend on the cost of information.

Table IV sheds light on the performance of firms that were forced to increase outsider representation relative to each other. Because the results do not benchmark against firms that were not forced to increase outsider representation, however, the results do not provide estimates of how outsiders affect performance overall. We next turn to our

main regressions that use the full sample and instrumental variables to estimate the marginal effect of outsiders on performance.

As discussed in Section 3, theory suggests that firm performance is determined according to the following model:

$$(1) \qquad V_{jt} = \alpha C_j + \beta I_{jt} + \gamma C_j I_{jt} + ... + e_{jt},$$

where *j* indexes a firm, *t* indexes a year, *V* is a measure of performance, *I* is a variable indicating board independence, and *C* represents the cost of information. Note that performance and independence vary over time, but information cost does not.[8] The effect of outside directors on performance is

$$\left.\frac{dV}{dI}\right|_C = \beta + \gamma C .$$

We are interested in two questions. The first is whether outside directors influence performance, that is, if $dV/dI = 0$. Since the effect of outside directors depends on *C*, we will need to estimate effects for different levels of information cost. The second question is whether the marginal effect depends on information cost. This is tested by investigating whether $dV/dI\,|_C = dV/dI\,|_{C'}$, which boils down to whether $\gamma = 0$.

Instead of estimating (1), we estimate first differences:

[8] Less than two percent of the firms in our sample went from being classified as low (high) information cost firms in 2000 to being classified as high (low) information cost firms in 2005.

(2) $$\Delta V_j = \beta \Delta I_j + \gamma C \Delta I_j + ... + \Delta e_j ,$$

where $\Delta X \equiv X_{2005} - X_{2000}$. Equation (2) removes firm-specific fixed effects, and the information cost variable remains only in the interaction term.

To address the endogeneity problem associated with *I*, we estimate a first stage regression that identifies exogenous changes in board composition based on compliance with SOX, and then use fitted changes in board composition from the first-stage regression to explain changes in firm performance in second-stage regressions. A key identifying assumption underlying our analysis is that a firm's compliance status does not affect its performance other than through its effect on board composition. Provided that this identifying assumption is valid, our results are largely immune to the widely recognized concerns in the literature that (i) board composition and firm performance are jointly determined (Hermalin and Weisbach, 1998), and (ii) the two are jointly affected by other factors (Harris and Raviv, forthcoming). More specifically, we use a dummy variable equal to one if a firm did not comply with SOX in 2000 (two years before the enactment of the law) to identify exogenous changes in board composition (fraction of independent directors) and board control (whether the board has a majority of outsider directors or not).[9] Some firms that were compliant with SOX may have faced pressure from activist investors and others to increase outsider representation, something our approach would not capture. To the extent that our "compliant" firms were also increasing the independence of their boards, it will make it harder for us to detect effects. In this sense, our results can be seen as biased down.

[9] Taking differences further addresses potential omitted variables problems.

Table V reports the estimates. Column (1) reports the first stage regression that predicts the change in fraction of outsiders on the board. Noncompliance with SOX is a strong predictor: firms that did not comply with SOX increased the percentage of outside directors on their boards by 11.3 percent during the sample period, an effect that is different from zero at better than the 1 percent level of statistical significance.

The remaining columns regress changes in firm performance on fitted changes in board composition. The performance variable is indicated at the top of each column. Regressions (2)-(4) do not include information cost variables. These regressions are quite similar to the ones that have been studied in the literature – the only difference is that the first-stage regression provides us with changes in board composition that are exogenous to changes in firm performance. Consistent with the prior literature, we do not find strong relations between performance and board composition. An increase in the fraction of independent directors seems to decrease both return on assets and Tobin's Q (although the results are not statistically significant), and increase stock returns.

Regressions (5)-(7) report our central results. In these regressions, we allow the effect of outside directors to depend on the cost of acquiring information, as suggested by theory, by introducing a term that interacts changes in the percentage of outsider with the information index. The information cost index is based on the three measures of information asymmetry as discussed above and takes on values from one to three, with high values indicating high information costs.

Two important findings emerge from these estimates. First, the coefficient on the interaction term is negative and different from zero at high levels of statistical significance. As predicted by theory, the marginal effect of outside directors depends on

how costly it is for such directors to acquire information about the firm. Second, the estimates reveal that changes in board composition have a material impact on firm performance. Table VI reports the marginal effects for low, medium, and high values of the information cost index. For firms with low information costs (index value equal to one), a ten percent increase in outside directors (roughly comparable to the impact of SOX on noncompliant firms) is associated with 0.0289 higher ROA, a 19.29 percent increase in Q, and 87.67 percent higher stock returns over the sample period. All of these effects are different from zero at the 5 percent level or better. Conversely, for firms with high information costs (index value equal to three), an increase in outside directors appears detrimental to performance. According to the estimates, a ten percent increase in outside directors is associated with 0.0391 lower ROA, 31.26 percent lower Q, and 69.35 percent lower stock returns over the sample period. All three values are different from zero at the 1 percent level of significance. The marginal effect for "medium" information cost (index value equal to two) is small in magnitude and statistically distinguishable from zero only for Q.

The two central findings of Table V – that outside directors matter for performance and the effect depends on the information environment – turn out to be robust to a variety of changes in specification. Table VII reports several natural variants. Each column of each panel reports the coefficients and t-statistics on the change in independent directors and interaction between independence and information from instrumental variables regressions analogous to those in columns (5)-(7) of Table V. The control variables are the same as in Table V, but to conserve space, only the two coefficients related to board independence are reported. The regressions in Panels A, B,

and C employ specific measures of information cost/asymmetry instead of the information cost index that aggregates the three measures. The interaction term is negative for all three information cost measures and all three performance measures, and different from zero at the 5 percent level of significance or better in eight of nine cases. In Panel D, the first stage regression considers a firm to be noncompliant if it had less than a majority of outside directors in 2000. Thus, compliance is defined with respect to exchange regulations rather than SOX. Approximately 17 percent of firms were noncompliant according to both definitions, but 10 percent of firms were compliant with SOX but not compliant with exchange regulations and 19 percent were compliant with exchange regulations but not compliant with SOX. The estimates in Panel D show that the estimated effect of independent directors is roughly similar for both definitions of compliance. Independent directors are associated with improved performance when information costs are low and worse performance when information costs are high. The results are weaker with the exchange definition of compliance, suggesting that the SOX requirements may have been more important than the exchange requirements.

Our analysis to this point focuses on the fraction of independent directors on the board. However, the effect of independent directors is likely to be nonlinear: a 10 percent increase in outsiders may have more effect going from 45 percent to 55 percent than going from 90 percent to 100 percent. Theory and the new regulations suggest what might be critical is whether or not outsiders comprise a majority of the board. Table VIII explores this possibility by estimating the effect of a change in control (our shorthand for having a majority of directors) rather than the effect of an increase in the fraction of outsiders on the board. We assume that the board is under the control of outside directors

if the board has a majority of independent directors, and define a change in board control as +1 if control passes from insiders to outsiders, 0 if control stays the same, and -1 if control passes from outsiders to insiders. As before, we identify exogenous changes in board control based on compliance with SOX in a first-stage regression and then use fitted changes in board control to explain changes in firm performance.

Each column in Table VIII reports estimates from a single regression. Column (1) reports the first stage regression. Between 2000 and 2005, board control passed from insiders to outsiders at many firms. The important fact for our analysis is that a switch in board control was more likely at a noncompliant firm than a switch at a compliant firm. The first-stage regression shows that a change in board control was 24.8 percent more likely at a noncompliant firm than it was at a compliant firm.

The regressions in the remaining columns use fitted changes in board control from the first-stage regression. Paralleling the structure of Table V, the regression in columns (2)-(4) do not condition on information. We do not find a robust relation between board control and firm performance in these regressions. A change in board control from insiders to outsiders is associated with a lower ROA and Q (though the effect is not statistically significant) and an increase in stock returns.

The regressions in columns (5)-(7) allow the effect of board control to vary with the information environment by including a term that interacts the change in board control with the information cost index. For all three measures of performance, the marginal effect of control varies with the information environment: the interaction coefficients are negative in all three columns and different from zero at better than the 1 percent level in each case. The regressions also indicate that outsider control improves

performance when information costs are low and hurts performance when information costs are high, and the magnitudes of the effects are large. For firms with low information costs, a change from insider to outsider control increases return on assets by 0.122, increases Q by 77.8 percent, and increases stock returns over the period by 387.3 percent. All of these effects are different from zero at the 1 percent level. For firms with high information costs, a shift from insider to outsider control is detrimental to performance: return on assets falls by 0.17, Q falls by 131.4 percent, and stock returns are 305.5 percent lower. All three values are different from zero at the 1 percent level of significance. These findings are highly consistent with the evidence on fraction of outsiders in Table V, and reinforce the main message: exogenous changes in outsider representation on corporate boards matters for performance, but whether it helps or hurts depends on how costly it is for outsiders to become informed. Board control and board composition appear to be two sides of the same coin, not only in theory as the literature suggests, but also in the data.

Our finding of large, statistically significant, and robust effects of board composition on performance stands in stark contrast to much of the previous literature. One reason for the difference is suggested by our finding that board composition effects appear only when conditioned on information cost (as seen by comparing in Table V or VIII columns (5)-(7) that condition on information cost with columns (2)-(4) that do not include information cost). This may help explain the prior literature's failure to find a robust connection between board composition and firm performance. Board composition effects depend on information cost, but appear to cancel out on average. Unless the

estimation strategy explicitly accounts for the offsetting effects, the estimates will tend to be biased toward zero.

Another reason previous studies may not have found an effect of board composition may be the lack of a policy experiment like SOX. Without an instrument to identify changes in board composition that are exogenous to changes in firm performance, previous studies may have suffered from attenuating biases due to the endogeneity of board composition and firm performance. We investigate this possibility in Table IX by replicating the analysis in Table V without the first-stage regression. A comparison of the two tables suggests that endogeneity of board composition may be a significant problem. The estimated performance effect from a change in board composition is much smaller and naturally less statistically significant in Table IX than Table V. In column (5), for instance, the marginal effect of an increase in independent directors on ROA is 0.051 for low information cost firms, about one-sixth the magnitude found in Table V. To summarize, it appears that detecting the effect of board composition on performance requires both a method to address the endogeneity problem, and conditioning on information cost.

6. Information Costs and the Determinants of Board Composition

Given our findings about the importance of asymmetric information in explaining the way firms were affected by SOX, it is natural to ask whether firms take information cost considerations into account when composing their boards. Theory suggests that optimal board composition should respond to information considerations, specifically, that firms with lower information costs should put more outsiders on their boards.

Nevertheless, the evidence in the previous section shows that an exogenous increase in outsiders improves performance for some firms. This suggests that firms might not choose their boards to maximize performance. Instead, managers may seek to insulate themselves from oversight by placing too many insiders on the board.

The purpose of this section is to investigate to what extent board composition responds optimally to the information environment. We address this issue using the full panel of board composition data from IRRC (1996-2005) and our various measures of asymmetric information. Table X shows the mean fraction of independent directors in 1996, 2000 and 2005 across three information cost bins formed on the basis of analyst coverage, analyst forecast dispersion, analyst forecast error, and the information cost index. One pattern that emerges is that regardless of how information cost is measured, the mean fraction of independent directors monotonically declines from the low cost bin to the high cost bin. For example, ranking firms on the basis of the index, the mean fraction of independent directors at firms in 1996 in the low bin is 6.9 percent more than that at firms in the high bin. The difference is statistically significant at the 1 percent significance level. The observed negative relation between the fraction of independent directors and the level of information asymmetry is consistent with theory, although the effects do not appear to be large, suggesting that either many firms choose their boards of directors optimally but asymmetric information considerations are not important, or that asymmetric information considerations are important but few firms choose their boards of directors to maximize value.

The second interesting pattern that emerges from Table X is that regardless of the asymmetric information variable used to rank firms, the spread between the low bin and

the high bin declines over time and loses its statistical significance. For example, using the information cost index, the spread between the low bin and the high bin declines from 6.9 percent in 1996 to 2.0 percent in 2005. The statistical significance of the spread also drops sharply: the t-statistic is 4.8 in 1996 and only 1.9 in 2005.

Outsider representation has been trending up over time. To separate time trends from information cost effects, Table XI reports regressions of board composition on information costs that include year fixed effects. Each column is a regression, and the regressions differ in how information cost is measured, as indicated at the top of each column. In parentheses beneath the coefficient estimates are t-statistics based on robust standard errors that account for the correlation of residuals within individual firm clusters. In Panel A, the dependent variable is the fraction of outsiders on the board. In Panel B, the dependent variable is the likelihood of an independently controlled board. The regressions reinforce the conclusion from the nonparametric estimates: firms with high information cost use fewer independent directors than firms with low information cost, but the magnitude of the differences is small. The fraction of independent directors at high information cost firms is roughly 3 percent lower than the fraction in low information cost firms. The probability of independent board control at firms with high information cost is roughly 7 percent less than that at firms with low information cost. These results are consistent with the notion that firms take information costs into account when choosing their boards, but not to the extent theory-driven optimality considerations would imply.

Table XII examines whether the declining effect over time of information asymmetry on board composition is a statistically significant phenomenon by estimating

panel regressions explaining the fraction of independent directors with information cost variables and years interactions. As before, we include year fixed effects and compute robust standard errors. For all information cost measures, the relation between the fraction of independent directors and information cost weakens over time: the interaction coefficient is always positive and statistically significant at the 5 percent level or better. The pressure to comply with SOX appears to have forced some firms to pay less attention to information considerations when choosing their boards of directors. We also estimated (but do not report) analogous logit regressions explaining the likelihood of an independent controlled board, and found the connection between information and independence weakening over time.

7. Discussion

Several new regulations beginning with Sarbanes-Oxley require increased representation of outsiders on corporate boards and committees. Previous research has not been able to identify a robust effect of board composition on performance, however. It is widely recognized that one problem in identifying an effect of board composition on performance is the endogeneity of boards: firms may change the number of outsiders in response to a performance change, and other factors can cause comovements between board composition and performance.

This paper estimates the effect of outside directors on firm performance, and provides what may be the first robust, significant evidence that outside directors matter for performance. Our analysis is built on two methodological innovations. First, we use the fact that recent regulatory changes forced some firms to increase the number of

outside directors to identify exogenous changes in board composition. This experiment allows us to avoid the endogeneity problem that has plagued previous research. Second, we adopt an econometric model that allows the effect of board composition to depend on the information environment. Theory suggests that outside directors are most valuable when their cost of becoming informed is low, but outsiders can be detrimental to performance when their cost of becoming informed is high. We examine one thousand firms over the period 2000-2005, and find that exogenous increases in outside directors improve performance (measured three different ways) when information costs are low and hurts performance when information costs are high.

The findings point to several conclusions. The finding that exogenous changes in outsiders hurt some firms suggest that some firms keep the number of outside directors low for optimal reasons, and the one-size-fits-all approach of the new regulations may not be ideal. The finding that some firms perform better when they are forced to take on more outside directors suggests that these firms are not composing their boards in order to maximize value, but rather may be trying to insulate management from oversight. This suggests that market forces alone may not be enough to bring about value maximization in all firms, and the new regulations may be beneficial for shareholders of some firms.

References

Berle, Adolph A. and Gardiner C. Means, The Modern Corporation and Private Property, New York, NY: The Macmillan Company, 1932.

Bhagat, S., and B. Black, 1999, "The Uncertain Relationship between Board Composition and Firm Performance," *Business Lawyer*, 54, 921-963.

Boone, Audra L., Laura Casares Field, Jonathan M. Karpoff, and Charu G. Raheja, "The Determinants of Corporate Board Size and Composition: An Empirical Analysis," *Journal of Financial Economics*, forthcoming.

Chhaochhaira, V. and Y. Grinstein, 2006, "Corporate governance and firm value: the impact of the 2002 governance rules," *Forthcoming Journal of Finance*.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen, "Boards: Does One Size Fit All?," *Journal of Financial Economics*, forthcoming.

Eisenberg, T., S. Sundgren, and M. Wells, 1998, "Larger Board Size and Decreasing Firm Value in Small Firms," *Journal of Financial Economics*, 48, 35-54.

Fama, Eugene F. and Michael C. Jensen, "Separation of Ownership and Control," *Journal of Law and Economics*, June 1983, Vol. 26(2), 301-325.

Fields, M. Andew and Phyllis Y. Keys, "The Emergence of Corporate Governance from Wall St. to Main St.: Outside Directors, Board Diversity, Earnings Management, and Managerial Incentives to Bear Risk," *The Financial Review*, 2003, Vol. 38(1), 1-24.

Gompers, Paul A., Andrew Metrick, and Joy L. Ishii, 2003, "Corporate Governance and Equity Prices," *The Quarterly Journal of Economics*, 118(1), 107-155.

Grinstein, Y. and E. Tolkowsky, 2004, "The Role of the Board of Directors in the Capital Budgeting Process – Evidence from S&P 500 Firms," *working paper*, Johnson Graduate School of Management, Cornell University.

Harris, Milton and Artur Raviv, "A Theory of Board Control and Size," *Review of Financial Studies*, forthcoming.

Hermalin, Benjamin E. and Michael S. Weisbach, "Endogenously Chosen Boards of Directors and Their Monitoring of the CEO," *American Economic Review*, March 1998, Vol. 88(1), 96-118.

Hermalin, Benjamin E. and Michael S. Weisbach, "Boards of Directors as an Endogenously Determined Institution: A Survey of the Economic Literature," *Economic Policy Review (Federal Reserve Board of New York)*, April 2003, 7-26.

Holmstrom, B., and S. Kaplan, 2003, "The state of U.S. corporate governance: What's right and what's wrong?," *Journal of Applied Corporate Finance*, 15, 8-20.

Jain, P. K., and Rezaee, Z., 2006, "The Sarbanes-Oxley Act of 2002 and Capital Market Behaviour: Early Evidence," *Contemporary Accounting Research*, 23, 629-654.

Klein, A., 1998, "Firm Performance and Board Committee Structure," Journal of Law and Economics, 41, 275-299.

Krishnaswami, S., Subramaniam, V., 1999, "Information Asymmetry, Valuation, and the Corporate Spin-off Decision," *Journal of Financial Economics*, 53, 73-112.

Li, H., Pincus, M.P.K, and Rego, S.O., 2004, "Market reaction to events surrounding the Sarbanes-Oxley Act of 2002: Overall and as a function of earnings management and audit committee effectiveness," *Working paper*, University of Iowa.

Linck, James S., Jeffry M. Netter, and Tina Yang, "The Determinants of Board Structure," *Journal of Financial Economics*, forthcoming.

Raheja, Charu G., "Determinants of Board Size and Composition: A Theory of Corporate Boards," *Journal of Financial and Quantitative Analysis*, June 2005, Vol. 40(2), 283-306.

Rosenstein, S. and J. Wyatt, 1990, "Outside Directors, Board Independence, and Shareholder Wealth," *Journal of Financial Economics*, 26, 175-191.

Shivdasani, A. and D. Yermack, 1999, "CEO Involvement in the Selection of New Board Members: An Empirical Analysis," *Journal of Finance*, 54, 1829-1853.

Yermack, D., 1996, "Higher Market Valuation of Companies with a Small Board of Directors," *Journal of Financial Economics*, 40, 185-212.

Yermack, D., 2004, "Remuneration, Retention, and Reputation Incentives for Outside Directors," *Journal of Finance*, 59, 2281-2308.

Zhang, I.X, 2005, "Economic consequences of the Sarbanes-Oxley act of 2002", *AEI Brookings Joint Center for Regulatory Studies*, 05-07.

Figure 1

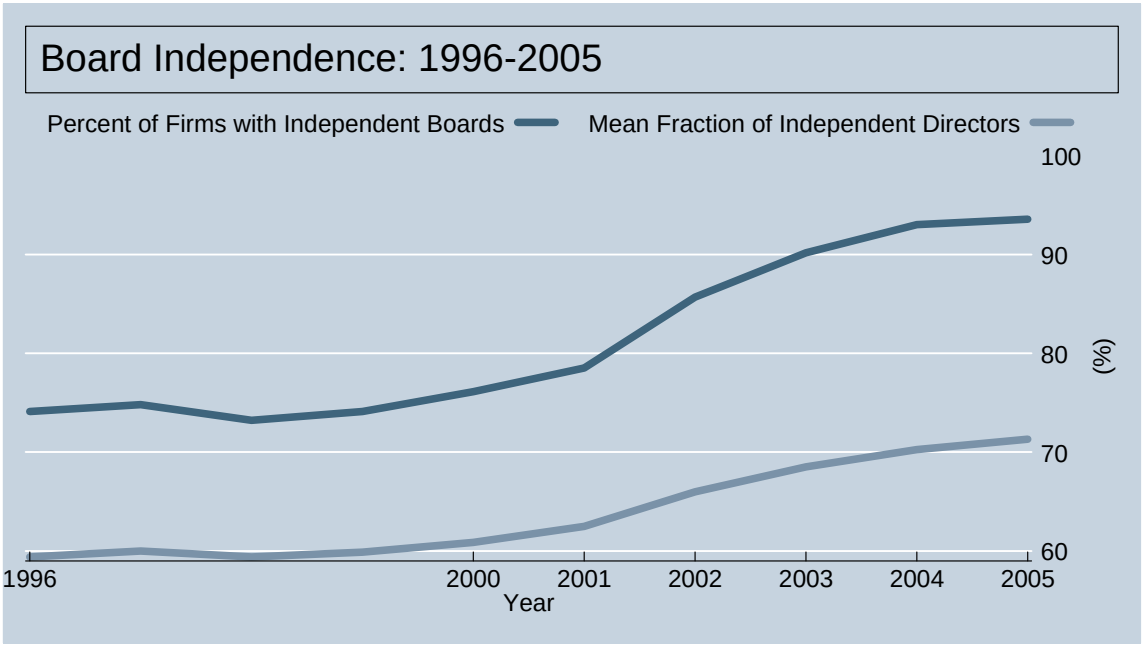
Board Independence: 1996-2005
Percent of Firms with Independent Boards
Mean Fraction of Independent Directors
100
90
80
70
60
(%)
1996
2000
2001
2002
2003
2004
2005
Year

Figure 2

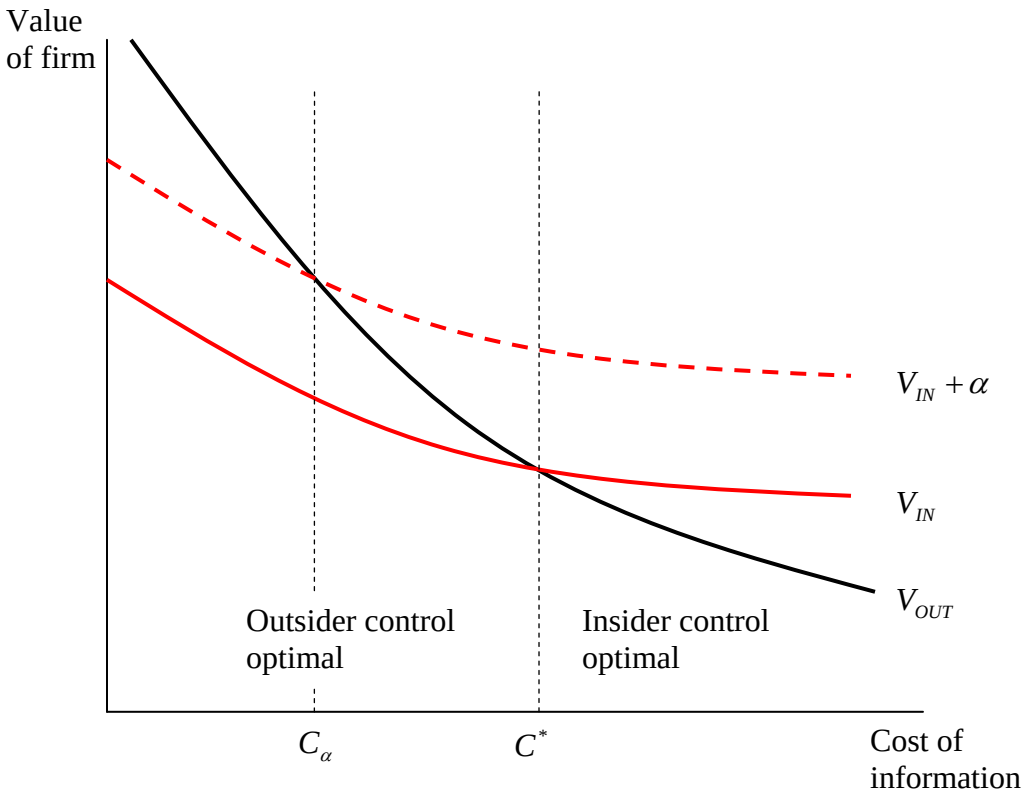
Value
of firm
$V_{IN} + \alpha$
V_{IN}
V_{OUT}
Outsider control
optimal
Insider control
optimal
C_α
C^*
Cost of
information

Table I
Regulations Concerning Board Independence

Regulation	Year Adopted	Definition of Independence	Minimum Number of Independent Directors: Board of Directors	Audit Committee	Compensation Committee	Nominating Committee
Sarbanes-Oxley	2002	Person who does not accept any fee from issuer (other than as director) and is not an "affiliated person of the issuer or any subsidiary."	…	100%	…	…
NYSE	2003	Person who has "no material relationship" with company.	Majority	100%	100%	100%
Nasdaq	2003	Person who does not have a relationship with company that would interfere with "independent judgment."	Majority	100%	Majority	Majority

Note. Foreign private issuers and controlled companies are exempted from listing standards not required by SOX. Also exempt are limited partnerships, companies in bankruptcy, closed-end and open-end funds.

Table II

Independent Directors on Corporate Boards and Board Committees, 1996-2005

This table reports the mean board size and mean percentage of independent directors on corporate boards and key committees based on data from the Investor Responsibility Research Center.

		Independent Directors, Percent			
Year	Board Size	Board	Audit Committee	Compensation Committee	Nominating Committee
1996	10.27	59.4	…	…	...
1997	9.84	60.1	…	...	...
1998	9.63	59.4	81.2	85.3	72.3
1999	9.62	59.9	82.3	85.1	71.7
2000	9.48	60.9	84.9	86.6	73.0
2001	9.28	62.5	88.0	87.5	75.3
2002	9.39	66.0	90.0	90.1	79.2
2003	9.38	68.5	92.3	91.9	86.7
2004	9.37	70.2	94.5	93.4	91.4
2005	9.24	71.3	95.3	94.0	91.7
1996-2005	9.55	63.6	88.2	89.0	81.2

Table III

Summary Statistics

Panel A reports summary statistics for all firm-years, 1996-2005. Panel B compares firms that were and were not in compliance with SOX in 2000, using data from 2000. A firm was compliant if its audit committee consisted entirely of independent directors. Dispersion of analyst forecasts is the standard deviation of quarterly EPS forecasts prior to announcement normalized by assets per share. Analyst forecast error is the absolute difference between the consensus forecast prior to announcement and the actual quarterly EPS normalized by assets per share.

Panel A: All Firm Years			
	N	Mean	S.D.
Fraction of independent directors	15,820	0.636	0.184
Number of board members	15,820	9.55	3.00
Number of analysts	13,786	15.16	10.85
Dispersion of analyst forecasts	12,713	0.0992	0.1355
Analyst forecast error	13,346	0.2135	0.3765
Return on assets	15,135	0.1256	0.0959
Q	15,276	1.93	1.78
Annual return	13,775	0.1449	0.5610
Market capitalization ($ millions)	15,279	7,000	23,072
Operating cash flow ($ millions)	15,035	497	1,786
Assets ($ millions)	15,368	11,923	56,860
Book leverage ratio	15,322	0.3905	2.1724
Age	15,368	25.54	15.79

Panel B: Comparison of Compliant and Noncompliant Firms in 2000

	Compliant Firms		Noncompliant Firms		
	Mean	S.D.	Mean	S.D.	t-statistic for difference
Fraction of independent directors	0.697	0.152	0.527	0.173	15.79
Number of board members	9.63	2.90	9.91	3.05	1.42
Number of analysts	16.06	11.34	16.64	11.12	0.77
Analyst forecast dispersion	0.0849	0.1148	0.0678	0.0918	2.45
Analyst forecast error	0.1636	0.2199	0.1550	0.2850	0.48
Return on assets	0.149	0.093	0.154	0.088	0.83
Q	2.16	2.00	2.39	2.63	1.46
Market capitalization ($ Mils)	8,372	26,347	13,358	47,271	1.86
Operating cash flow ($ Mils)	585	1,681	752	2,411	1.16
Assets ($ Mils)	12,012	48,737	15,714	67,340	0.93
Book leverage ratio	0.4141	0.7095	0.3220	1.1833	1.36
Age	26.84	16.38	26.03	15.41	0.78

Table IV

Performance during 2000-2005 of Firms Not Compliant with SOX in 2000

This table reports the mean performance during 2000-2005 of firms that were not in compliance with SOX's requirement of a fully independent audit committee in 2000. The three performance measures are return on assets (ROA), natural log of Tobin's Q, and stock return. Firms are partitioned according to whether an outsider's cost of acquiring information (the amount of information asymmetry) is low, medium, or high. The t-statistics are for the hypotheses that the means are equal across information cost categories.

Panel A: Information Cost (Number of Analysts)

				t-statistic for difference		
	Low	Medium	High	L-M	M-H	L-H
Δ ROA	-0.00	-0.01	-0.03	0.91	2.20	3.04
Δ log(Q)	0.01	-0.10	-0.16	1.59	0.99	2.56
Stock return	1.59	0.96	0.55	2.23	1.57	3.73

Panel B: Information Cost (Dispersion of Analyst Forecasts)

				t-statistic for difference		
	Low	Medium	High	L-M	M-H	L-H
Δ ROA	-0.00	-0.02	-0.04	1.84	1.35	2.99
Δ log(Q)	-0.01	-0.07	-0.28	1.15	2.92	4.01
Stock return	1.31	0.93	0.54	1.44	1.25	2.56

Panel C: Information Cost (Analyst Forecast Error)

				t-statistic for difference		
	Low	Medium	High	L-M	M-H	L-H
Δ ROA	-0.00	-0.02	-0.05	1.36	2.77	4.14
Δ log(Q)	0.01	-0.12	-0.23	2.12	1.66	3.66
Stock return	1.37	0.62	0.84	2.88	-0.73	1.81

Panel D: Information Cost (Index)

				t-statistic for difference		
	Low	Medium	High	L-M	M-H	L-H
Δ ROA	0.00	-0.02	-0.05	2.44	2.59	4.23
Δ log(Q)	0.08	-0.13	-0.23	3.72	1.31	4.06
Stock return	1.63	0.81	0.52	3.14	0.99	3.39

Table V

Effect of Independent Directors on Firm Performance during 2000-2005

This table presents estimates from regressing firm performance during 2000-2005 on the change in the fraction of independent directors. Each column reports estimates from a single regression, with t-statistics in parentheses beneath the coefficient estimates. The first stage (column (1)) regresses changes in the fraction of independent directors on a dummy variable equal to one if the firm did not comply with the SOX requirement of a fully independent audit committee in 2000, and other variables. The second stage uses the fitted change in the fraction of independent directors from the first stage as an explanatory variable. The information cost variable is an index that represents how costly it is for outsiders to acquire information about the firm.

		Dependent Variable					
	First stage	Δ ROA	Δ log(Q)	Stock return	Δ ROA	Δ log(Q)	Stock return
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dummy = 1 if firm did not comply with SOX in 2000	0.113 (11.80)	…	…	…	…	…	…
Δ Independent directors	…	-0.007 (0.16)	-0.301 (1.31)	1.517 (1.70)	0.629 (4.80)	4.455 (6.94)	16.618 (6.49)
Δ Independent directors × Information cost	…	…	…	…	-0.340 (5.20)	-2.527 (7.91)	-7.851 (6.19)
Board size	-0.003 (1.72)	0.002 (1.76)	0.025 (5.21)	0.025 (1.34)	0.001 (1.03)	0.018 (3.72)	0.001 (0.04)
Leverage ratio	0.001 (0.13)	0.010 (3.81)	0.054 (4.00)	0.065 (1.31)	0.010 (3.67)	0.051 (3.89)	0.055 (1.11)
Firm age	-0.001 (2.61)	0.00 (0.63)	0.005 (5.54)	0.003 (0.83)	0.000 (0.04)	0.006 (6.66)	0.007 (1.96)
Market value of equity, logarithm	0.002 (0.69)	-0.004 (2.60)	-0.155 (18.63)	-0.395 (11.95)	-0.008 (4.24)	-0.183 (20.40)	-0.484 (13.26)
Constant	0.080 (3.40)	0.001 (0.05)	0.780 (11.58)	3.464 (12.97)	0.032 (2.09)	1.045 (13.89)	4.288 (14.03)
R^2	.124	.018	.283	.148	.047	.338	.189
Observations	1,060	989	996	885	903	911	810

Table VI

Marginal Effect of an Increase in Outside Directors on Performance

This table reports the marginal effect on performance during 2000-2005 associated with an increase in the fraction of outside directors, using the estimates in columns (5)-(7) of Table V. t-statistics are in parentheses beneath the marginal effects.

	Dependent Variable		
	Δ ROA	Δ log(Q)	Stock return
Low information cost (index = 1)	0.289	1.929	8.767
	(3.91)	(5.31)	(6.05)
Medium information cost (index = 2)	-0.051	-0.599	0.916
	(1.05)	(2.55)	(0.98)
High information cost (index = 3)	-0.391	-3.126	-6.935
	(4.45)	(7.30)	(4.10)

Table VII

Effect of Independent Directors on Firm Performance, Alternative Specifications

This table presents estimates from regressing firm performance during 2000-2005 on the fraction of independent directors. Each column reports estimates from a single regression, with t-statistics in parentheses beneath the coefficient estimates. Each regress include the following explanatory variables whose coefficients are not reported: board size, leverage ratio, firm age, market value of equity, and a constant. The fraction of independent directors is a fitted value from a first stage regression (not reported) that regresses changes in the fraction of independent directors on a dummy variable equal to one if the firm did not comply with the SOX requirement of a fully independent audit committee in 2000. The panels differ in how information cost is measured. In panel D, the first stage regression uses noncompliance with the requirement to have a majority of outside directors on the board instead of noncompliance with SOX.

	Δ ROA	Δ log(Q)	Stock return
Panel A: Information Cost Measured by Number of Analysts			
Δ Independent directors	-0.249	-1.345	-4.677
	(2.30)	(2.52)	(2.13)
Δ Independent directors × Information cost	-0.097	-0.419	-2.592
	(2.50)	(2.18)	(3.26)
Panel B: Information Cost Measured by Dispersion of Analyst Forecasts			
Δ Independent directors	0.026	0.192	3.033
	(0.52)	(0.77)	(3.05)
Δ Independent directors × Information cost	-0.574	-7.821	-16.767
	(2.30)	(6.38)	(3.49)
Panel C. Information Cost Measured by Analyst Forecast Error			
Δ Independent directors	0.003	-0.048	2.543
	(0.06)	(0.19)	(2.58)
Δ Independent directors × Information cost	-0.122	-1.461	-4.865
	(1.24)	(3.30)	(2.55)
Panel D. Compliance Measured by Majority of Outsiders on Board			
Δ Independent directors	0.455	3.15	10.984
	(3.95)	(5.51)	(4.86)
Δ Independent directors × Information cost index	-0.219	-1.537	-4.848
	(3.85)	(5.46)	(4.37)

Table VIII

Effect of Board Control on Firm Performance during 2000-2005

This table presents estimates from regressing firm performance during 2000-2005 on changes in board control from non-independent to independent. Each column reports estimates from a single regression, with t-statistics in parentheses beneath the coefficient estimates. The first stage (column (1)) regresses changes in the board control (+1 insider to outsider, 0 no change, -1 outsider to insider) on a dummy variable equal to one if the firm did not comply with the SOX requirement of a fully independent audit committee in 2000 (and other variables). The second stage uses the fitted change in board control from the first stage as an explanatory variable. The information cost variable is an index that represents how costly it is for outsiders to acquire information about the firm.

		Dependent Variable					
	First stage	Δ ROA	Δ log(Q)	Stock return	Δ ROA	Δ log(Q)	Stock return
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dummy = 1 if firm did not comply with SOX in 2000	0.248 (8.73)	…	…	…	…	…	…
Δ Control (insider to outsider)	…	-0.003 (0.16)	-0.137 (1.31)	0.693 (1.70)	0.268 (4.58)	1.824 (6.33)	7.337 (6.41)
Δ Control × Information cost	…	…	…	…	-0.146 (4.98)	-1.046 (7.29)	-3.464 (6.11)
Board size	-0.009 (1.78)	0.002 (1.74)	0.025 (5.09)	0.027 (1.43)	0.001 (1.18)	0.019 (3.89)	0.006 (0.32)
Leverage ratio	-0.027 (1.80)	0.010 (3.65)	0.050 (3.59)	0.085 (1.65)	0.008 (2.98)	0.038 (2.73)	0.047 (0.90)
Firm age	-0.004 (4.06)	0.00 (0.61)	0.005 (4.82)	0.004 (1.14)	0.000 (0.15)	0.006 (5.72)	0.008 (2.17)
Market value of equity, logarithm	0.003 (0.34)	-0.004 (2.61)	-0.155 (18.69)	-0.394 (11.94)	-0.007 (4.03)	-0.179 (20.13)	-0.473 (13.13)
Constant	0.265 (3.80)	0.001 (0.07)	0.792 (11.12)	3.402 (12.04)	0.029 (21.79)	1.021 (13.04)	4.145 (13.08)
R^2	.092	.018	.283	.148	.045	.331	.188
Observations	1,060	989	996	885	903	911	810

Table IX

Effect of Independent Directors on Firm Performance, without Instrumental Variables

This table presents estimates from regressing firm performance during 2000-2005 on the change in the fraction of independent directors. Each column reports estimates from a single regression, with t-statistics in parentheses beneath the coefficient estimates. The information cost variable is an index that represents how costly it is for outsiders to acquire information about the firm.

	Dependent Variable					
	Δ ROA	Δ log(Q)	Stock return	Δ ROA	Δ log(Q)	Stock return
	(2)	(3)	(4)	(5)	(6)	(7)
Δ Independent directors	0.002	0.006	0.261	0.105	0.922	2.553
	(0.12)	(0.08)	(0.86)	(1.50)	(2.67)	(1.88)
Δ Independent directors × Information cost	…	…	…	-0.054	-0.460	-1.147
				(1.52)	(2.62)	(1.66)
Board size	0.002	0.026	0.023	0.002	0.025	0.018
	(1.79)	(5.35)	(1.21)	(1.86)	(4.94)	(0.91)
Leverage ratio	0.010	0.055	0.063	0.010	0.053	0.056
	(3.82)	(4.05)	(1.26)	(3.71)	(3.93)	(1.10)
Firm age	0.000	0.005	0.002	0.000	0.006	0.004
	(0.59)	(6.05)	(0.47)	(0.35)	(6.53)	(1.10)
Market value of equity, logarithm	-0.004	-0.156	-0.392	-0.005	-0.166	-0.417
	(2.63)	(18.80)	(11.86)	(2.94)	(18.62)	(11.62)
Constant	0.018	0.748	3.600	0.004	0.810	3.777
	(0.02)	(11.79)	(14.33)	(0.26)	(11.85)	(13.77)
R^2	.018	.282	.146	.021	.297	.150
Observations	989	996	885	903	911	810

Table X

Cross-Tabulation of Board Composition and Information Cost

This table presents average fraction of independent directors across information cost bins, using the full panel of board composition data from IRRC (1996-2005).

		Average Percent of Independent Directors		
		1996	2000	2005
Number of analysts	Low	63.8	62.8	72.2
	Medium	58.7	61.3	70.8
	High	55.2	59.7	70.9
	Low - High	8.6	3.1	1.3
	(t-stat)	(6.14)	(2.54)	(1.36)
Dispersion of analyst forecasts	Low	61.4	61.5	72.1
	Medium	60.6	62.9	71.9
	High	57.1	60.2	70.9
	Low - High	4.3	1.3	1.2
	(t-stat)	(2.88)	(1.01)	(1.21)
Analyst forecast error	Low	62.1	63.1	72.0
	Medium	59.3	61.7	71.8
	High	56.9	59.2	71.0
	Low - High	5.2	3.9	1.0
	(t-stat)	(3.57)	(3.17)	(1.07)
Information cost index	Low	62.3	62.9	71.4
	Medium	58.7	61.1	72.5
	High	55.4	59.1	69.4
	Low - High	6.9	3.8	2.0
	(t-stat)	(4.80)	(3.12)	(1.91)

Table XI

Regressions of Board Composition on Information Cost

Panel A reports estimates from a regression of the fraction of independent directors on information cost. Panel B reports estimates from a logit regression of board control on information cost. Each column in a panel is a regression. The information cost measure is indicated at the top of each column. The sample covers 1996-2005 and all regressions include year fixed effects.

Panel A: Regressions Explaining the Fraction of Independent Directors

	Information Cost Measure			
	Number of Analysts	Dispersion of Analyst Forecasts	Analyst Forecast Error	Index
Dummy = 1 for medium information cost	-0.019	0.001	-0.009	-0.015
	(5.29)	(0.35)	(2.30)	(4.13)
Dummy =1 for high information cost	-0.036	-0.014	-0.025	-0.033
	(9.67)	(3.77)	(6.80)	(8.78)
Constant	0.611	0.606	0.601	0.606
	(105.75)	(102.66)	(99.11)	(106.93)
R^2	0.067	0.065	0.061	0.066
Observations	13,786	13,346	12,713	13,861

Panel B: Logit Regressions Explaining the Likelihood of an Independent Controlled Board

	Information Cost Measure			
Variable name	Number of Analysts	Dispersion of Analyst Forecasts	Analyst Forecast Error	Index
Dummy =1 for medium information cost	-0.255	-0.059	-0.176	-0.259
	(5.06)	(1.13)	(3.43)	(5.37)
Dummy = 1 for high information cost	-0.423	-0.217	-0.336	-0.424
	(8.48)	(4.20)	(6.66)	(8.39)
Constant	0.912	0.831	0.880	0.886
	(12.71)	(10.99)	(12.00)	(12.67)
Observations	13,786	12,713	13,346	13,861

Table XII

Relation between Board Composition and Information Cost over Time

This table reports regressions of the fraction of independent directors on information costs. The sample covers 1996-2005.

	Measure of Information Cost			
	Number of Analysts	Dispersion of Analyst Forecasts	Analyst Forecast Error	Index
Information cost	-6.683	-18.351	-7.508	-7.472
	(5.26)	(2.07)	(2.32)	(4.39)
Information cost × year	0.003	0.009	0.004	0.004
	(5.24)	(2.06)	(2.31)	(4.38)
1997 dummy	0.015	0.004	0.004	-0.003
	(1.93)	(0.48)	(0.57)	(0.34)
1998 dummy	0.019	0.000	0.000	0.01
	(2.40)	(0.08)	(0.05)	(1.78)
1999 dummy	0.032	0.004	0.006	-0.016
	(3.75)	(0.49)	(0.78)	(1.83)
2000 dummy	0.052	0.016	0.019	-0.010
	(5.58)	(2.09)	(2.58)	(1.02)
2001 dummy	0.079	0.033	0.036	0.000
	(7.60)	(4.31)	(5.02)	(0.01)
2002 dummy	0.115	0.059	0.063	0.022
	(9.81)	(7.38)	(8.35)	(1.75)
2003 dummy	0.149	0.086	0.089	0.040
	(11.54)	(10.75)	(11.80)	(2.88)
2004 dummy	0.174	0.099	0.104	0.050
	(12.20)	(12.25)	(13.69)	(3.20)
2005 dummy	0.192	0.112	0.116	0.052
	(12.27)	(13.22)	(14.88)	(3.07)
Constant	0.509	0.607	0.602	0.673
	(52.45)	(100.54)	(106.48)	(63.11)
R^2	0.071	0.062	0.065	0.068
Observations	13,786	12,713	13,346	13,861