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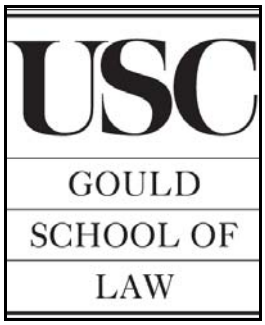

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New regulations and corporate governance activists have called for more outside directors on boards and committees, yet existing research has failed to find convincing evidence that outside directors improve firm performance. This paper estimates the effect of outside directors using a new empirical strategy that controls for the well known endogeneity problem in board composition by focusing on firms that were required to increase the number of outside directors as a result of new regulations. We find that the effect of outside directors on performance depends on their cost of acquiring information: outside directors are effective when the cost of acquiring information is low and are ineffective when the cost of acquiring information is high. We also find that firms compose their boards as if they understand that outsider effectiveness varies with information costs.

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I. Introduction

An important goal of corporate governance reformers is to increase the representation of outside directors on corporate boards and committees. Because outside director are independent from management, they are believed to be willing to stand up to the CEO when necessary to protect shareholder interests. A new group of regulations, including the Sarbanes-Oxley Act of 2002 (SOX) and rules promulgated by the Securities and Exchange Commission, New York Stock Exchange (NYSE), and National Association of Securities Dealers, incorporate the idea that outside directors are important custodians of shareholder interests by requiring greater participation of outside directors on the board and key committees.

Yet the goal of increasing the number of outsiders is viewed with skepticism by some observers. Theoretically, it has long been recognized that the effectiveness of outside directors is limited by their inferior information compared to corporate insiders, and the notion that outsiders cannot effectively monitor and control agency problems has been a central premise of corporate finance research for decades (Berle and Means, 1932; Fama and Jensen, 1983; Jensen, 1993).[1] Empirically, it is notoriously difficult to find reliable evidence that outside directors matter at all for performance, with most studies finding small, statistically insignificant correlations (Bhagat and Black, 2002; Hermalin and Weisbach, 2003; Field and Keys, 2003). Also, it seems possible that setting numerical targets for outside directors may be little more than window dressing because

[1] For example, Jensen (1993, p. 864): "Serious information problems limit the effectiveness of board members in the typical large corporation. For example, the CEO almost always determines the agenda and the information given to the board. This limitation on information severely hinders the ability of even highly talented board members to contribute effectively to the monitoring and evaluation of the CEO and the company's strategy."

insiders can select directors that are independent according to regulatory definitions but are still unduly influenced by management. Increasing outsider representation on boards may simply be "quack corporate governance" (Romano, 2005).

The evidence that informs much of the skepticism, however, has its own limitations. Perhaps most important, board composition is endogenous. Although most studies fail to find a significant connection between board independence and firm performance, such a connection would be difficult to identify even if it existed if poor performance causes an increase in board independence, as in Hermalin and Weisbach (1998), or if changes in other factors cause comovements in board composition and firm performance, as in Harris and Raviv (forthcoming). In addition, it seems unlikely that an increase in outside directors would have a uniform impact across firms. Some firms may have constituted their boards to maximize value, in which case an increase in outside directors would be harmful, while in other firms managers may have constituted their boards with too few outsiders in order to minimize oversight, in which case an increase in outsiders would be helpful. Thus, we might not expect to see uniform performance effects associated with changes in board composition across all firms, but different effects among different subsamples of firms.

The purpose of this paper is to provide new empirical estimates of the effectiveness of outside directors that address both of these limitations of the previous literature, and sheds light on the conditions under which outside directors are effective. To address the problem of board endogeneity, we employ an identification strategy that takes advantage of exogenous increases in the number of outside directors due to recent regulatory changes. Specifically, we use the fact that some firms were forced to increase

the number of outsiders on their boards in response to several regulations adopted between 1999 and 2003. NYSE and Nasdaq regulations adopted in 1999 require audit committees to be comprised entirely of independent directors, a requirement that was extended and strengthened by SOX in 2002. In 2003, NYSE and NASD adopted additional rules that require boards to have a majority of independent directors.[2]

With an identification strategy that controls for endogeneity, we are able to turn to the substantive question of when outside directors are likely to be effective. Our approach is motivated by recent theoretical research that suggests the effectiveness of outside directors depends on the information environment (Hermalin and Weisbach, 1998; Raheja, 2005; Adams and Ferreira, 2007; Harris and Raviv, forthcoming). It is a central premise of corporate finance research that insiders often have information that outsiders do not (e.g., Myers and Majluf (1984)). 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.[3] Our basic approach is to identify firms where the cost of becoming informed is likely to be high and compare them to firms where the cost of information is likely to be low. For each group of firms, we estimate the relation between performance and the percentage of outsiders on the board, using exogenous changes due to the new regulations to identify the effects.

[2] The idea of using regulatory changes to identify exogenous changes in board structure also motivates Dahya and McConnell (2007) that links changes in performance among U.K. firms to changes in board independence recommended by the Cadbury Report of 1992. They find large positive improvements in ROA and stock returns associated with increases in outsiders.

[3] Long-run trends are broadly consistent with this view. Legal scholars such as Gordon (2007) have observed that the secular increase in the informativeness of stock prices and analyst coverage over the period 1950-2005 coincide with a greater representation of independent directors.

Our main finding is that adding outside directors to the board does not help or hurt performance on average, consistent with the previous literature (even after controlling for endogeneity), but that outsiders significantly improve performance when their information cost is low, and hurt performance when their information cost is high. These findings are quite robust. We show that they appear whether performance is measured by earnings, Tobin's Q, or stock return, and for several different information cost measures. The estimated magnitudes are nontrivial: a 10 percent increase in the percentage of outside directors on the board is associated with 1.3 percent higher ROA in firms with an information cost in the lowest quartile compared to 1.7 percent lower ROA in firms with an information cost in the highest quartile, controlling for other determinants of performance. Similarly, a 10 percent increase in board independence is associated with 8.1 percent higher Q in low information cost firms compared to 15.8 percent lower Q in high information cost firms.

Our central findings suggest that outsider effectiveness depends on the cost of acquiring information about the firm. The main information cost proxies we employ are based on analyst forecasts (errors, variance, number). We also explore several alternative information cost variables in order to understand the nature of the information problem that seems to influence outsider effectiveness. To distinguish information costs that face outsiders but not insiders (asymmetric information) from fundamental uncertainty, we allow outside director effectiveness to depend on stock return volatility, which is sometimes used to measure fundamental uncertainty in the empirical literature on corporate boards. We find that stock return volatility adds little explanatory power, suggesting that asymmetric information is the central driver, consistent with the emphasis

of recent theory. We also include the market-to-book ratio to capture information costs associated with growth opportunities, and a measure of intangible assets to capture information costs associated with intangibility. Our estimates suggest that outside director effectiveness depends on the market-to-book ratio as well as analyst forecast errors and variance, but does not depend on intangibility of assets.

We explore several possible sources of spurious correlation. All our regressions include industry controls so the information cost variables are not simply industry proxies. To investigate the possibility that our outside director effects are actually capturing changes in director expertise, we introduce direct measures of financial, corporate, and academic expertise. To consider the possibility that the performance differences we detect are due to unmeasured SOX effects that impact low information cost firms more than high information cost firms, we allow performance changes to depend directly on information costs. The central finding that outsider effectiveness depends on information cost survives these attempts to make the result disappear.

Finally, we explore a related implication of the view that the effectiveness of outside directors depends on the cost of information. If our evidence that outsider effectiveness depends on information costs is not spurious, we would expect firms to take information cost into account when constituting their boards. To test this implication, we estimate the relation between board composition and our measure of information cost. We find that firms do take information conditions into account: firms with a higher cost of acquiring information have fewer outsiders on their boards than firms with a lower cost of acquiring information.

The evidence we report suggests that outside directors can improve governance, and that the insider-outsider ratio may be more than window dressing. It seems that in firms where outsiders were able to acquire information at low cost, boards have been constituted with too many insiders, and the mandated increase in outsider representation was a boon for shareholders. In contrast, in firms where outsiders suffer from severe information disadvantages, the mandates appear to have harmed shareholder interests. Our evidence thus provides some support for regulations that require increased representation of outsiders on corporate boards and committees, but they include an important caveat by documenting situations in which increases in outside directors can be counterproductive. Consistent with recent theory, it may be optimal for some boards to be controlled by insiders, and forcing outsider control can reduce firm value. 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 terms of theory, our evidence suggests that to some degree boards are constituted to maximize value and information cost considerations appear to be an important factor in those decisions, which supports the message of Raheja (2005), Adams and Ferreira (2007), 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 II discusses recent regulatory changes, highlights new rules that have altered the composition of corporate boards and committees, and presents testable predictions from four competing views of boards.

Section III provides a simple theoretical framework that helps interpret the empirical evidence. Section IV discusses the data, and goes into some detail about how the cost of acquiring information is measured. Section V reports evidence on the connection between outside directors and firm performance. Section VI explores the nature of the information costs that influence director effectiveness. Section VII reports several exercises that investigate possible sources of spurious correlation. Section VIII reports evidence that board composition is related to information costs. Section IX discusses implications.

II. New Regulations and Testable Predictions

SOX and the exchange rules that it engendered represent perhaps the most significant overhaul of public company regulations in the United States since the Great Depression. At their core, the new regulations are intended to improve the auditing of U.S. public companies, and cover a variety of subjects, including auditor oversight, disclosure rules, auditor-client relationship, and criminal penalties (Coates, 2007). Of particular interest for our purposes are new requirements concerning independent directors. Table 1 summarizes the key provisions. Although SOX is the central piece of legislation, the reform movement began a few years earlier (1999) when the NYSE and Nasdaq required corporate audit committees to consist entirely of independent directors, a requirement written into law by SOX. 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).[4] 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 phasing in of the new regulations by significantly increasing the representation of independent directors on their boards and committees over time. Figure 1 shows the change in the 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 ("firms with independent boards") was fairly stable

[4] The main SOX requirements on audit committee independence were part of the recommendations issued by the Blue Ribbon Committee on Improving the Effectiveness of Corporate Audit Committees in February 1999. The SEC approved new exchange listing standards in December 1999 requiring firms to have fully independent audit committees. The rules at the time grandfathered then-serving audit committee members until their re-election or replacement.

in the 72-74 percent range. In 2000, roughly 76 percent of firms had a board with a majority of independent directors. By 2005, the most recent year for which data are available, 94 percent of boards had a majority of independent directors. A similar pattern appears for the mean percentage of independent directors across all firms: it was stable in the 59 to 61 percent range from 1996 to 2000, and rose to 71 percent in 2005. Committees also became more independent. Over the period 1998-2005, representation of independent directors rose from 81 to 95 percent on audit committees, from 85 to 94 percent on compensation committees, and from 72 to 92 percent on nominating committees.

Our identification strategy is based on the observation that some firms, but not all, were forced to change the composition of 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. This idea motivates an instrumental variables approach where firm (non)compliance with the new regulations is used to identify an exogenous shift in the percentage 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.

Our main analysis uses noncompliance with the requirement of a fully independent audit committee to identify exogenous increases in the representation of outside directors on the corporation's board.[5] However, it is possible that noncompliant

[5] We also estimated the empirical models using noncompliance with other exchange regulations, and the results were similar. In contrast to the audit committee requirement, these other regulations do not apply

firms could create a fully independent audit committee by assigning existing independent board members to the audit committee. To get a sense of how firms actually brought their audit committees into compliance, we compared the composition of boards in 2000 and 2005. Board independence increased by about 16 percent at noncompliant firms (from 52 percent to 68 percent) during the period. In contrast, board independence increased by only 4 percent at compliant firms (from 70 percent to 74 percent) during the same period. It appears that firms responded to the new rules by adding independent directors to the board, and not just by assigning existing independent directors to the audit committee. We also note that the average size of corporate boards was approximately constant for both compliant and noncompliant firms from 2000 to 2005, implying that the change in board composition was brought about by replacing nonindependent directors with independent directors.

Our analysis seeks to shed light on four competing views about how boards work. According to the window-dressing view, held by skeptics of recent reforms and expressed by Romano (2005), setting numerical targets for independent directors through regulation will not improve corporate governance because managers can select directors that are independent according to regulatory definitions but are still unduly influenced by management. For example, a director who is a personal friend of the CEO could be independent in the eyes of the law, but not inclined to challenge the CEO. From this perspective, the 16 percent average increase in board independence from 2000 to 2005 at noncompliant firms represents a shell game in which managers are able to put their allies on the board as independent directors, much like the often-cited example of Disney

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uniformly to all issuers (domestic versus foreign, large versus small firms, controlled versus uncontrolled), making them noisier instruments.

appointing to its board the principal of a school attended by CEO Michael Eisner's children (Byrne et al., 1997). The window-dressing view predicts that an increase in measured board independence has no effect on performance.

The entrenchment view, held by some legislators who voted for SOX and regulators who provided expert advice, predicts that an increase in board independence has a positive effect on performance. Outside directors are expected to be reliable monitors of management, act independently and look after shareholder interests, so increasing their representation on boards should improve corporate governance, reduce agency problems, and improve firm performance. In addition, outside directors may improve performance by bringing with them skills that complement those of management. We call this the entrenchment view because it is based on the assumption that market forces alone are unable to bring about a value-maximizing level of management oversight. Given that the amount of talent and capital that can target agency-plagued firms in the market for corporate control is limited, setting numerical targets for outside directors through regulation can be an effective way of bringing about wholesale value-enhancing change.

We call the opposite view, that boards are constituted to maximize value, the optimization view. According to this view, managers trade off the strengths and weaknesses of inside and outside directors in order to maximize shareholder value, and forcing firms to increase the number of outside directors would destroy value. So, a mandated increase in board independence is predicted to hurt performance.

Last but not least is the tradeoff view, which combines the lessons of recent information-based theories (Hermalin and Weisbach, 1998; Raheja, 2005; Adams and

Ferreira, 2007; Harris and Raviv, forthcoming) with the possibility that managers distort board composition to reduce oversight. The tradeoff view predicts that the effect of an increase in board independence will depend on information conditions. When the information environment allows outsiders to become informed at a reasonable cost, they can serve as effective monitors and advisors. Greater board independence beyond the level preferred by oversight-averse managers then results in improved performance. In contrast, when the information environment makes it difficult for outsiders to serve effectively, the tradeoff view predicts that greater board independence will hurt performance.

The tradeoff view is an extension of recent models, but its predictions are not entirely obvious. Because the tradeoff model turns out to provide the best explanation for the empirical patterns we find, the next section provides a simple version of the theory that helps frame the empirical analysis.

III. Reduced-Form Model of the Tradeoff View

Most empirical research on boards has been guided by intuitions rather than explicit models, in part because theoretical work on board composition is limited. Recently, 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. In Adams and Ferreira (2007), boards advise and monitor the CEO, who values advising but dislikes monitoring. These 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. The 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 (by assumption) 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. The model that follows incorporates the lessons about from recent theory about information costs with the insight from agency theory that the CEO may be overly hesitant to appoint outsiders to the board.

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, $B \in \{IN, OUT\}$.[6] 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 the cost of acquiring information is high) and $\Delta_C \equiv \partial \Delta / \partial C < 0$ (a high information cost hurts outsider-controlled firms more than insider-controlled firms). We also assume that Δ can be positive for some values of *C* and negative for other values, 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. If boards are constituted to maximize value, an exogenous change from insider to outsider control – the policy experiment associated with the new regulations – reduces firm value.

To incorporate the possibility that boards are not constituted optimally, but also partly reflect 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

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

[6] We follow Harris and Raviv (forthcoming) here by focusing on who controls the board rather than the precise ratio of insiders to outsiders, our main empirical measure. Focusing on the precise ratio of insiders to outsiders yields a richer set of predictions, but the wealth consequences always remain monotonically related to information costs.

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 value-maximizing 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 value maximizing boards.

Our empirical question is how an exogenous change in board composition affects value at different firms depending on their information environments. To study this theoretically, consider 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. The empirical prediction is that (a) for firms with low information costs, an exogenous increase in board independence should be associated with higher value and improved performance – the policy exercise forces firms with suboptimal insider control to have optimal outsider control, and (b) 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.

IV. Data

Our analysis uses three primary data sources. Information on directors and boards comes from the Investor Responsibility Research Center (IRRC), information to construct information cost variables is taken from I/B/E/S, and data on firm performance is taken from Compustat and CRSP. Our main analysis examines performance changes over the period 2000-2005. We use 2000 as the benchmark year because the regulatory innovations began in December 1999 when the exchanges adopted the recommendations of the Blue Ribbon Committee. We then study performance out to 2005 to allow time for the additional regulations to be adopted and phased in. We investigate three different measures of performance: return on assets (ROA), Tobin's Q, and stock returns. For Tobin's Q, we compute log changes so that the estimated regression coefficients have a percentage interpretation. For stock returns, we compute average monthly returns from the end of fiscal year 2000 to the end of fiscal year 2005. All three measures are reported as percentages throughout the paper. 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 the market value of equity).[7] We winsorize all variables at the 1st and 99th percentiles (the results are similar if we do not winsorize the variables). Our sample covers the period from 1996 to 2005, and contains 15,820 firm-year-observations for 2,897 firms. The sample period is primarily determined by the IRRC data, which run from 1996 to 2005.[8] Panel A of Table 2 reports summary statistics for the whole sample.

Our main analysis focuses on three variables that are intended to measure an outsider's cost of becoming informed. 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 analysts who posted forecasts about the firm in a given year.[9] We postulate that more information is available to outsiders about the firm when it is followed by more analysts. The second measure is the dispersion of analyst forecasts, measured as the standard deviation of earnings forecasts across analysts prior to a quarterly earnings announcement, normalized

[7] 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.

[8] 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 et al. (2003). We drop director-year observations with missing director identifier or director type (Employee, Linked or Affiliated, Independent).

[9] We count forecasts from the same I/B/E/S analyst identifier and the same brokerage house as a single analyst. Because the number of analysts is strongly correlated with firm size, and firm size is correlated with performance, we use a size-adjusted number of analysts in Section IV when constructing the information index and when studying performance. Specifically, we regress the number of analysts on firm size and use the residuals from that regression as the number of analysts.

by the firm's total book assets and averaged across four quarters in a given year. A lack of consensus among analysts (high standard deviation) suggests it is difficult for outsiders to become informed about the firm. The third measure is the analyst forecast error, measured as the absolute difference between the mean analyst earnings forecast prior to a quarterly earnings announcement and the actual earnings, normalized by the firm's total book assets and averaged across four quarters in a given year. Large forecast errors indicate a greater difficulty of becoming informed. We also construct an information cost index that combines the three separate measures by averaging a firm's percentile ranking in the sample according to each measure (for the number of analysts, the reverse ranking is used). We then scale the index to range from zero (low) to one (high). We consider several other information cost measures in the robustness section of the paper.

An important issue in an experiment like ours is whether treatment and control firms are somehow different in a systematic way. To get a sense of observable differences, Panel B of Table 2 compares 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. Because compliance status depends on the number of independent directors, the fact that noncompliant firms had 17 percent fewer independent directors than compliant firms is expected. Only a few other differences emerge. The average board contained about 10 members in both compliant and noncompliant firms. Return on assets was lower, Q was lower, and stock return was higher in compliant than noncompliant firms, but these differences fall short of conventional levels of statistical significance. All three information cost variables suggest that information was more costly to acquire for compliant than noncompliant firms, but only one difference (analyst forecast dispersion)

can be statistically distinguished from zero. Compliant firms were smaller than noncompliant firms on average, with a significant difference when size is measured by market capitalization but not when measured by assets. Book leverage ratio and firm age were not significantly different in compliant and noncompliant firms. Compliant and noncompliant firms appear to be fairly similar. Our regressions attempt to control for observable differences that appear in Table 2. To control for the possibility of unobservable time invariant determinants of performance, we study changes in return on assets, Q, and stock return from 2000 to 2005, essentially differencing out time invariant factors. The robustness section of the paper explores the possibility of time-varying factors.

Since we are going to be comparing changes in performance during 2000-2005 with changes in board composition, essentially a difference-in-difference approach, it is also important consider whether the performance of noncompliant (treatment) and compliant (control) firms were following similar trends before treatment, that is, whether the parallel trends assumption holds. Figure 3 shows the trends visually, plotting the industry-adjusted ROA of noncompliant and compliant firms relative to 1996. As can be seen, the compliant and noncompliant firms were on similar trajectories until about 2000, when a sharp break appears. This suggests that the parallel trends assumption is valid, and more formal comparisons (not reported) generally point toward the same conclusion. The divergence between low and high information cost firms shows that our main results controlling for a number of factors are already in the data nonparametrically. It is also worth noting that the divergence is fairly consistent during 2000-2005, indicating that the results are not driven by events in any one particular year.

V. Evidence on Outside Directors and Firm Performance

A. Main Results

Having described the new regulations affecting boards and our data sources, we now turn to estimating the effect of greater board representation of outside directors on firm performance. Recall that the window-dressing view predicts no effect, the entrenchment view predicts a uniformly positive effect, the optimization view predicts a uniformly negative effect, and the tradeoff view predicts different effects conditional on information costs.

Our baseline empirical model assumes that performance is determined according to:

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

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. Equation (1) assumes that performance and independence vary over time, but information cost does not.[10] The marginal effect of outside directors on performance is $dV / dI = \beta + \gamma C$. 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 need to estimate effects for different levels of information cost. The second question is

[10] 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.

whether the marginal effect depends on information cost. This is tested by investigating whether $\partial^2 V / \partial I \partial C$, which boils down to whether $\gamma = 0$.

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

(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. We also include industry fixed effects for the 48 Fama-French (1997) industries to control for the possibility that the information cost index, instead of capturing firm-level informational cost, proxies for industries that performed badly over the sample period for other reasons. The results turn out to be essentially the same with or without industry dummies. The regressions also control for various factors previously found to be correlated with performance, including board size, leverage ratio, firm age, and firm size in 2000. Standard errors are corrected to allow for clustering of the error terms at the industry level.

To address the endogeneity problem associated with board composition, we estimate a first-stage regression that identifies exogenous changes in board composition from 2000 to 2005 based on compliance with SOX in 2000, and then use fitted changes in board composition from the first-stage regression to explain changes in firm performance from 2000 to 2005 in the second-stage regressions. Using compliance with SOX in 2000 allows us capture the full impact of the new regulations on board composition starting with the rules approved by the SEC in December 1999 (the rules grandfathered then-serving board members until their re-election or replacement and

Figure 1 shows that the immediate response in 2000 was not significant). Our approach does not capture changes in board composition in SOX-compliant firms that may have been driven by pressure from activist investors and others. This omission makes it harder to detect effects, and can be seen as biasing our results toward zero.

Before reporting our results, we note that an alternative estimation approach would be to estimate a panel regression over the entire 1996-2005 period with firm fixed effects to identify the effect of exogenous changes in board composition caused by the new regulations. We find that such panel regressions yield quantitatively similar results. This is not entirely surprising because the sharp break between the performance of noncompliant and compliant firms does not take place before 2000 (Figure 3). The benefit of our approach, namely of reducing the sample to just one before-versus-after observation per firm, is that we avoid a possibly severe serial correlation problem that arises when using long time series in differences-in-differences estimation (Bertrand, Duflo and Mullainathan, 2004).

Table 3 reports our estimates. Column (1) reports the first-stage regression that predicts the change in percentage of outsiders on the board. Noncompliance with SOX is a strong predictor: firms that did not comply with SOX in 2000 increased outside directors by 11.4 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 similar to those in the existing literature – the only difference is that the first-stage regression provides changes in board

composition that are exogenous with respect to changes in firm performance. Consistent with the prior literature, we do not find a strong relation between performance and board composition. An increase in the percentage of independent directors seems to have a tiny positive effect on return on assets, a negative effect on Tobin's Q, and a positive effect on stock returns although none of the effects can be distinguished from zero at conventional levels of statistical significance.

Columns (5)-(7) contain our central results. In these regressions, we allow the effect of outside directors to depend on the cost of acquiring information by introducing a term that interacts the changes in percentage of outsiders with the information cost index. Recall that the information cost index is based on the three measures of information cost and takes on values from zero to one, with high values indicating a high information cost. 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 the tradeoff view, the marginal effect of outside directors depends on how costly it is for outsiders to acquire information about the firm.

Second, the estimates reveal that changes in board composition have a material impact on firm performance. The coefficients imply a nontrivial effect of outside directors on performance. For firms in the lowest information cost quartile (with a mean information cost index of 0.23), a 10 percent increase in the percentage of outside directors (roughly comparable to the impact of the new regulations on noncompliant firms) is associated with 1.3 percent higher ROA, 8.1 percent higher Q, and 3.8 percent higher annual stock returns over the sample period. All of these effects are different from zero at the 5 percent level or better. One interpretation of this evidence is that before the

new regulations took effect corporate insiders were restricting the representation of outsiders on their boards in order to reduce oversight, and this restriction resulted in decisions that reduced firm performance. For firms in the highest information cost quartile (with a mean information cost index of 0.74), a 10 percent increase in the percentage of outside directors is associated with 1.7 percent lower ROA, 15.8 percent lower Q, and 2.4 percent lower annual stock returns over the sample period. All three values are different from zero at the 5 percent level or better. This evidence is consistent with the view that before the new regulations took effect high information cost firms were optimally filling their boards with insiders, and the new regulations forced them to shift to an inefficient board structure. The marginal effect for the median information cost firm is small in magnitude and statistically distinguishable from zero only for Q.

Table 3's evidence of a large, statistically significant connection between board independence and performance stands in contrast to much of the previous literature. One reason for the difference appears to be the dependence of outsider effectiveness on information cost. Outsiders appear to help performance when the cost of information is low, and hurt performance when the cost of information is high, but the positive and negative effects cancel out on average. Previous studies have not conditioned on information, and as a result, were only able to detect the unconditional effect of outsiders, which appears to be close to zero. Another possible reason we detect significant outsider effects may be due to our identification strategy that uses (non)compliance to identify exogenous changes in board composition. Without an instrument to identify exogenous

changes in board composition, previous studies may have suffered from attenuating biases due to the endogeneity of board composition and firm performance.[11]

To shed some light on why our results differ from previous research, we re-estimated the main regressions in Table 3 without using the first-stage regression to identify exogenous changes in board composition. The results are in Table 4. The unconditional relation between performance and board composition in columns (2)-(4) of Table 4 is small and not statistically significant. When conditioned on information (columns (5)-(7)), the coefficients on board independence take the same signs as in Table 3, but are three to ten times smaller in magnitude. In column (5) of Table 4, for instance, a 10 percent increase in the percentage of independent directors is associated with a 0.4 percent increase in return on assets for low information cost firms, compared to a 1.3 percent increase in column (5) of Table 3, which uses the instrument. A negative impact of information cost on outsider effectiveness appears in Table 4 even without an instrument, but only the interaction coefficient in column (6) is significantly different from zero. A comparison of Tables 3 and 4 suggests that endogeneity of board composition may be a significant problem, but the dependence of board effectiveness on information cost is equally important. Detecting the effect of board composition on

[11] It is perhaps worth restating that our ability to estimate the effectiveness of independent directors relies on the absence of systematic pre-treatment differences between noncompliant and compliant firms that may account for differences in post-treatment performance. As mentioned above, the fact that we do not observe a divergence between the performance of noncompliant and compliant firms before 2000 provides some support for our approach. Further support comes from our finding of significant results associated with post-treatment stock returns. In an efficient market, pre-treatment differences that are unobservable to us as econometricians but observable to market participants are incorporated into prices before treatment and hence cannot account for post-treatment return differences.

performance appears to require both a method to address the endogeneity problem and conditioning on information cost.

B. Robustness

The two central findings of Table 3 – 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. We next report, in Table 5, the results of several robustness exercises. Each column of each panel reports the coefficients from a single regression in which the dependent variable is change in performance during 2000-2005, as before. The control variables are the same as in Table 3, but to conserve space, we only report the coefficients on board independence and independence interacted with information cost.

The regressions in panels A, B, and C use the individual measures of information cost instead of the index that aggregates the three measures. To maintain comparability with the index-based results, we rank firms according to each measure and rescale the percentile rankings to fall between zero (low) and one (high). As can be seen, the interaction term is negative for all three information cost measures and all three performance measures, and different from zero at the 1 percent level of significance in all nine cases. Thus, the basic patterns are not dependent on precisely which of our information cost measures we use.

A second issue has to do with our definition of compliance. Our main regressions identify exogenous changes in board independence by whether a firm complied with the requirement of a fully independent audit committee. In panel D, we consider instead compliance with exchange regulations approved in 2003 that required a majority of

outside directors on the board. Approximately 17 percent of firms were noncompliant according to both definitions, but 10 percent of firms were compliant with the audit committee requirement but not compliant with the board majority requirement, and 19 percent were compliant with the board majority requirement but not compliant with the audit committee requirement. This new definition of compliance changes the instrumental variable in the first-stage regression (now it is a dummy equal to one if the firm did not have a majority of independent directors in 2000) but the empirical approach is otherwise the same. The estimated effects of independent directors that appear in panel D are qualitatively similar to those in Table 3. Independent directors are associated with improved performance when the information cost is low and worse performance when the information cost is high. The coefficients are smaller in magnitude with the board majority definition of compliance from 2003 than the audit committee definition from 1999, suggesting that the earlier requirements may have had more impact in practice.

A third issue concerns whether the numbers of independent directors has to reach a critical level for performance to change. Our analysis to this point focuses on the percentage of independent directors on the board, implicitly assuming that the effect of independent directors on performance is linear. However, the new exchange regulations and voting theory suggest that what might be critical is whether or not outsiders comprise a majority of the board (that is, a change in outsiders from 45 percent to 55 percent might matter more than a change from 85 percent to 95 percent). The regressions in panel E explore this possibility by using changes in board control as an explanatory variable in second-stage regressions instead of changes in the percentage of outsiders. We define a change in board control as +100 if the board changes from a majority of insiders to a

majority of outsiders, 0 if the identity of the majority does not change, and -100 if it changes from a majority of outsiders to a majority of insiders. As before, we identify exogenous changes in board control based on compliance with the requirement of a fully independent audit committee in a first-stage regression and then use fitted changes in board control to explain changes in firm performance. We do not report the first-stage regression, but the estimates indicate that a switch in board control was 23.4 percent more likely at a noncompliant firm than a compliant firm, distinguishable from zero at better than the 1 percent level.

The estimates in Panel E show that for all three measures of performance, the effect of a change in control varies with the information environment: the interaction coefficients are negative in all three columns and different from zero at 1 percent level in each case. The regressions also indicate that outsider control improves performance when the information cost is low and hurts performance when the information cost is high, and the magnitudes of the effects are large: for firms in the lowest information cost quartile, a change from insider to outsider control (which happens with a roughly 23.4 percent probability at noncompliant firms) is associated with a 1.0 percent increase in return on assets, a 6.7 percent increase in Q, and a 3.9 percent increase in annual stock return. All of these effects are different from zero at the 10 percent level or better. For firms in the highest information cost quartile, a shift from insider to outsider control is associated with a 1.3 percent decline in return on assets, a 15.4 percent fall in Q, and 2.4 percent lower annual stock returns. These values are also different from zero at the 10 percent

level or better. These findings are consistent with our previous evidence, and suggest that changes in board control and board composition are closely linked in the data.[12]

VI. Asymmetric Information and Fundamental Uncertainty

The evidence suggests that the effectiveness of outside directors depends on the cost of acquiring information about the firm, as proxied by the accuracy, availability, and agreement of analyst forecasts. In this section, we attempt to understand the nature of these information costs, for example, whether they represent asymmetric information between insiders and outsiders or fundamental uncertainty that impacts both insiders and outsiders. The recent theoretical literature emphasizes information asymmetry (e.g., Raheja (2005), Harris and Raviv (forthcoming)), while the empirical literature on board composition has tended to focus on fundamental uncertainty, typically measured as the volatility of a firm's stock price (e.g., Boone et al. (forthcoming), Coles et al. (forthcoming), and Linck et al. (forthcoming)).

Our information cost index is likely to compound both information asymmetry and fundamental uncertainty. In an attempt to isolate the different information effects, we reestimated the main regressions with several additional terms that interact the change in board independence with alternative information variables. The first added variable is the volatility of stock returns, defined as the standard deviation of monthly returns in 2000, a commonly used measure of fundamental uncertainty (e.g., Litvak (2007), Boone et al. (forthcoming)). To the extent that stock return volatility captures fundamental

[12] As a final check for the concern that our main specification may somehow be biased to produce the results that we document, we estimated placebo regressions (unreported) for the pre-treatment period 1996-2000. The key coefficients were insignificant.

uncertainty, the coefficient on the analyst forecast-based information index will represent the remaining asymmetric information effect.[13] The second added variable is the market-to-book ratio. It is often argued that the market-to-book ratio captures the presence of future growth opportunities relative to assets, and that future growth opportunities are inherently more difficult to measure than assets in place (Smith and Watts, 1992). Whether this is asymmetric information or fundamental uncertainty is open to debate. The third variable is the fraction of intangible assets, calculated as one minus the value of plant, property, and equipment as a fraction of assets (PPE). Intangible assets are often thought to give rise to asymmetric information (Harris and Raviv, 1991), although it seems possible they could also be a source of fundamental uncertainty if both insiders and outsiders find them difficult to value. All three information variables – stock return volatility, market-to-book, and 1–PPE – are normalized to take on values between zero and one, like our information cost index, so that the coefficients can be directly compared.[14]

Table 6 reports the regression results. As before, each column in each panel represents a single regression of performance on the same control variables as in Table 3, and to conserve space we only report the coefficients of interest. One notable finding is that the analyst-forecast-based information index continues to be negative and different from zero at high levels of statistical significance, and the coefficients are large in

[13] Fama and Jensen (1983) and Linck et al. (forthcoming) argue that firms with significant stock price volatility are likely also to have greater information asymmetry. To the extent that volatility incorporates some information asymmetry, the information cost index will be an underestimate of the asymmetric information effect.

[14] The variables are defined as: market-to-book = (Data Item 6 + Data Item 25 * Data Item 199 – Data Item 60 – Data Item 74) / Data Item 6; PP&E = Data Item 8 / Data Item 6. For each measure (including stock return variance) each firm's percentile ranking was normalized to take on values between 0 and 1.

magnitude. The coefficient on the stock return volatility variable is positive in two regressions and negative in one regression but quantitatively small in all three regressions, statistically insignificant in the Q regression, and on the edges of significance in the other two regressions. The amount of fundamental uncertainty does not appear to have a strong influence on the effectiveness of outside directors. To the extent that stock return volatility is capturing fundamental uncertainty, the coefficient on the analyst-forecast-based information index is likely to represent the effect of asymmetric information on outside director effectiveness. The healthy coefficients on information asymmetry variables lend support to recent theories of Raheja (2005), Adams and Ferreira (2007), and Harris and Raviv (forthcoming).

The coefficient on the market-to-book interaction is negative and statistically different from zero at better than the 5 percent level for all three performance measures. Under the conventional interpretation that market-to-book captures growth opportunities, these findings suggest that one factor influencing outsider effectiveness is the cost of evaluating growth opportunities. When growth opportunities are few, outside directors can be effective, perhaps because they primarily serve a monitoring function. When growth opportunities are abundant, outside directors are likely to be ineffective, perhaps because monitoring is less important than providing advice and consultation.

The coefficients on the intangible assets interaction are small and never close to statistical significance. It could be that intangibility is not an important source of asymmetric information, or this particular type of information asymmetry is not an important determinant of outside director effectiveness.

VII. Are the Information Cost Variables Proxies for Other Factors?

This section considers the possibility that the estimated effect of the information cost variable is spurious, that is, the possibility that the information cost variable is a proxy for some other factor that actually drives the outside director-performance relation.

A. New Economy Firms

One possibility is that the information cost variable is capturing a distinction between "new economy" firms and old economy firms rather than a difference in the cost of acquiring information. New economy firms are young firms based in technology-intensive industries. They may have few analysts following them and less accurate forecasts for life cycle reasons, not because it is inherently more difficult to acquire information about them. If so, an alternative explanation of our findings could be that an increase in outside directors improves the performance of new economy firms (perhaps because of their underdeveloped governance systems), but hurts mature, old economy firms (perhaps because they are near an optimal board composition to begin with).

There are several ways to explore this possibility. The first, which we use in our main regressions, is to include industry fixed effects. As noted above, the main results in Table 3 appear with and without industry fixed effects. Second, we find that there are not many new economy firms in our sample. Following Murphy (2003), we define a new economy firm as a company with a primary SIC code of 3570, 3571, 3572, 3576, 3577, 3661, 3674, 4812, 4813, 5045, 5961, 7370, 7371, 7372, and 7373. Based on this definition, we find that only 11.7 percent of sample firms are classified as new economy, with 13.2 percent in the compliant firm sample and 9.0 percent in the noncompliant firm

sample. Moreover, we find a healthy amount of variation in information cost within industries – the standard deviation of the information cost index is 0.33 among new industry firms and 0.39 among old industry firms – indicating there is not a tight connection between information cost and being a new industry firm.

Table 7 addresses more directly the possibility that the estimated information effect is actually a new economy effect. As before, each column in each panel reports estimates from a single regression. Each regression includes the same control variables as Table 3, including 48 industry fixed effects, but we only report the coefficients of primary interest (meaning we omit the coefficients on board size, leverage ratio, firm age, and market value of equity). In panel A, we exclude all new industry firms (following the definition above) and in panel B, we exclude all "young" firms, defined as companies with less that a 10-year history in Compustat by the year 2000. In both panels, the coefficient on the independence-information cost interaction term remains negative and different from zero at better than the 1 percent level of statistical significance. This is one piece of evidence that the information cost effect is not capturing a distinction between new economy and old economy firms.[15]

As an alternative approach, the regressions in panel C use the full sample but introduce a separate interaction term between the change in independent directors and a dummy variable equal to one for new economy firms. If the information cost effect is actually a proxy for a new economy effect, then the new interaction term would be significant and negative, and would rob the original interaction term of significance.

[15] We also estimated the regressions using the subsample of only new economy firms (and using the subsample of only young firms). The key interaction coefficients remain negative and qualitatively similar, but the estimates are much less precise because of the small sample size.

However, as can be seen, the new interaction term is quantitatively modest, significant only in the Q regression, and its introduction leads to only a modest change in the coefficient on the original interaction variable. Panel D repeats the same exercise, but introduces an interaction term between the change in independent directors and a dummy variable equal to one for young firms. Again, the new interaction coefficient is small and statistically insignificant, and its inclusion has no material effect on the coefficient of the original interaction variable. In short, none of these exercises suggests there is reason to worry that our information cost variable is actually a proxy for new economy versus old economy firms.

B. Director Expertise

A body of empirical research argues that what matters for performance is not the number of outside directors, but their qualifications. For example, DeFond et al. (2005) argue that financial expertise is important, and Fich (2005) argues that business knowledge and experience are critical (see Yermack (2006) for a survey of the literature.) This raises the question whether the connection we find between performance and changes in board independence might in fact be caused by concurrent changes in the qualifications of directors. To explore this possibility, we re-estimate the main equations and add a measure of director qualifications as an explanatory variable, as well as director qualifications interacted with information cost. If the effects we have been attributing to a change in board independence are in fact caused by a change in qualifications, the coefficients on the board independence variables should lose significance.

We consider three types of qualifications that have received attention in the literature: A director is said to have an "academic" qualification if he or she is a professor in a college or university, a "corporate" qualification if he or she is an executive in a corporation, and a "financial" qualification if he or she is employed in a financial or investments-related firm.[16] Between 2000 and 2005, both compliant and noncompliant firms added an average of 0.3 independent directors with academic expertise and one independent director with financial expertise, and both reduced the number of independent directors with corporate expertise (-1.3 directors in compliant firms and -0.8 directors in noncompliant firms on average). Overall, the total number of independent directors with at least one of these qualifications was unchanged in compliant firms and increased by 0.5 at noncompliant firms on average. These numbers imply that roughly half of the independent directors added at noncompliant firms from 2000 to 2005 were qualified directors.

Table 8 reports regressions that control for director qualifications. As before, each column in each panel reports estimates from a single regression. The control variables are the same as in Table 3, but we report only the coefficients of interest, and do not report the first-stage regression. The panels differ by which type of qualification is controlled. The main message from the table is that the coefficients associated with independent directors do not change in an important way when the controls for director qualifications are included. In particular, the key interaction coefficient remains negative and

[16] More specifically, we define independent directors as having academic qualifications if their primary job title in the IRRC database is "professor" or "academic." They are classified as having corporate qualifications if their primary job title is "CEO," "president," "chairman," "COO," "vice president," "partner," "corporate executive" or "consultant." They are classified as having financial qualifications if their primary job title is "investor," "financial," "economist," or "economic."

statistically significant in every regression of every panel. The director qualifications variables are smaller in magnitude and can never be distinguished from zero at conventional levels of statistical significance. In short, Table 8 gives no reason to believe that the observed performance changes are driven by changes in director qualifications rather than changes in director independence.

C. Unmeasured SOX Effects

Another possibility is that our information cost index is absorbing other unmeasured regulatory effects stemming from SOX or other concurrent regulations. For example, it seems possible that the various disclosure requirements of SOX might have had a different effect on low information cost firms than on high information cost firms. Because board independence tended to increase during our sample period, we might detect differential performance associated with increased board independences in low and high information cost firms simply because SOX's disclosure requirements had a different performance impact on low and high information cost firms.[17] Now one problem with this story is that we might expect firms with high information costs to show the most improved performance when required to disclose more information, which would create a spurious effect that runs in the opposite direction of what we find (that is, it would result in a finding that outside directors help high information cost firms and hurt low information cost firms). Nevertheless, a straightforward way to control for the possibility that our results incorporate unmeasured SOX or other regulatory effects is to introduce the information cost index directly into the equation. The coefficient on the

[17] By including market capitalization, our main specification controls for the possibility that the cost of internal controls mandated by SOX may depend on firm size (Chhaochharia and Grinstein, 2007).

level of the information cost index will capture any SOX effects that are conditional on information costs.

Table 9 reports the regressions. They are the same as the central regressions from Table 3 except for the inclusion of the information cost index in levels. The results indicate that information cost levels have a negative effect on all three measures of performance, but distinguishable from zero only for Q. The coefficients associated with independent directors are robust to the inclusion of the information cost levels. In particular, the key interaction coefficient remains negative and statistically significant in every regression, and the magnitudes of the effects are still nontrivial. For example, an increase of 10 percent in the percentage of outside directors on the board is associated with 1.1 percent higher ROA in firms with an information cost in the lowest quartile (compared to 1.3 percent when information cost levels are not included in the regression) and 1.4 lower ROA for firms in the highest quartile (compared to 1.7 percent when information cost levels are not included in the regression). It does not seem that the information cost variable is capturing unmeasured effects associated with SOX or other concurrent regulations.[18]

[18] Another possibility is that the information cost variable might proxy for overly aggressive accounting methods. Outside directors might inhibit aggressive accounting, leading to a decline in reported ROA (as well as Q and stock returns if the market underestimated the extent of the accounting problems). To assess this possibility, we estimated but do not report regressions that included a variable that interacted the change in independent directors and a measure of earnings management in 2000 based on the total accrual measure of Dechow, Sloan and Sweeney (1995). The coefficient on this interaction term was negative and significant, consistent with the aggressive accounting view, but the coefficient on the independence-information cost interaction term remained negative and significant.

D. Systematic Risk

Another issue arises from the use of stock returns as a performance measure. Our estimates do not control for systematic risk, and it seems possible that the information cost index could be correlated with a systematic risk factor for which investors demand compensation. If that were the case, our results in the stock return regressions might in some way be driven by risk rather than information cost (this argument is more complicated than it seems because even if the cost index is correlated with a risk factor, it is not obvious why the impact of outside directors would be dependent on the risk factor.) On the other hand, the consistency of the results across the three different performance measures argues against the idea of spurious relation due to an omitted risk factor because the risk factor would not afflict the ROA measure. Regardless of these a priori arguments, it is nevertheless useful to make an empirical assessment of this issue by directly adjusting for systematic risk.

Table 10 presents the results. As before, each column in each panel reports estimates from a single regression. We use the full set of control variables from Table 3, but report only the coefficients of interest, and we do not report the first-stage regression. The dependent variable in panel A is the average monthly stock return over the period indicated at the top of each column. The dependent variable in panel B is the average monthly return minus the contemporaneous monthly CRSP value-weighted index return. The dependent variable in panel C is the average monthly return minus the return on a matched portfolio from a 5 x 5 size and book-to-market model.

The dependent variable in the first column is the average monthly return over the entire period 2001-2005. Thus, the panel A estimates are the same as those in column (7)

of Table 3. The dependent variable in panels B and panel C are adjusted for systematic risk. The estimates are not different in an important way in panels A, B, C, suggesting that the industry fixed effects were already capturing differences in systematic risk fairly well. More important, the similarity across panels indicates that controlling for systematic risk in the performance variable does not alter the conclusions.

In the remaining columns of Table 10, the dependent variable is the stock return for a given year, as indicated at the top of each column. The purpose of these columns is to check if the results are driven by one or two specific years rather than the entire period.

We are interested in this issue because 2000 and 2001 contained the bursting of the "dot-com" bubble, and could be special cases. In any event, the performance results do not appear to be driven by a single year. The key interaction coefficient is negative in all five years in every panel, and statistically different from zero at the 10 percent level in 12 of 15 cases. The effect seems to be weakest in terms of coefficient magnitude and significance in the years immediately after the passage of SOX, 2003 and 2004, consistent with the idea that stock returns are forward-looking and incorporated the effect of SOX relatively quickly.

VIII. Information Costs and the Determinants of Board Composition

Given our finding that the effectiveness of outside directors depends on the cost of acquiring information about the firm, it is natural to ask whether firms take information cost considerations into account when composing their boards. To the extent that board composition is related to information costs, it lends support to recent

information-based theories. It also provides another reason to believe that our information cost variables are in fact capturing information costs and not something else.

Table 11 addresses this issue by reporting regressions of board composition on information cost using the full panel of board composition data from IRRC (1996-2005). Information cost is indicated with our information cost index, normalized to take on values between zero and one. As before, each column is a regression, and all the regressions include our standard set of controls (board size, leverage ratio, firm age, and firm size). In the first three columns, the dependent variable is the percentage of outsiders on the board. In the last three columns, the dependent variable is the likelihood of a board with a majority of independent directors. Columns (1) and (4) report baseline regressions. Columns (2) and (5) report regressions with year fixed effects to take into account the upward trend in outsider representation over time. Columns (3) and (6) include both year and industry fixed effect, for robustness. All regressions report standard errors that are clustered by firm because we have repeated firm observations in the panel.

The main result from Table 11 is that the coefficient on the information cost index is negative and significantly different from zero in all six regressions. Firms with a high information cost use fewer independent directors than firms with a low information cost, consistent with the idea that firms take information cost into account when constituting their boards. The magnitude of the differences is modest. For example, based on the results in column (3), the percentage of independent directors in firms with an information cost in the highest quartile is roughly 2.8 percent lower than the percentage in firms with an information cost in the lowest quartile. Two forces are likely to bias the estimates against finding an information effect: recent regulations may have constrained

firms to choose board structures that are suboptimal and not fully responsive to information cost conditions, and some managers might ignore information costs because they want to construct their boards to stifle dissent rather than to maximize value.

IX. Discussion

The Sarbanes-Oxley Act and new exchange regulations require firms to increase the representation of outside directors on their boards. This paper takes advantage of the more-or-less exogenous changes in outside directors brought about by the new regulations to identify the effect of board independence on firm performance. By using exogenous changes in board composition, we are able to mitigate the endogeneity problem that has hampered previous attempts to estimate the effect of board independence. One of our findings is that the effect of outside directors on performance is rather small on average. This suggests that the modest effect of board independence found in previous studies is not due primarily to a failure to control for endogeneity of board composition.

Perhaps our main finding, however, is identification of conditions under which outside directors can have a material effect on performance. Consistent with recent theoretical research, we find that outside directors are associated with significantly better performance when their cost of acquiring information is low, and are associated with significantly worse performance when their cost of acquiring information is high. These findings suggests that the failure of previous studies to find an effect of outside directors on performance may have been because they failed to distinguish low and high

information cost environments. That is, it is important to ask not *whether* but *when* are outside directors effective?

The results 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 some 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 some cases, and the new regulations may be beneficial for shareholders of some firms. Along the same lines, our evidence suggests that regulations requiring independent boards are more than window dressing, and that the distinction between inside and independent directors adopted by the new regulations may have teeth.

Our findings suggest that outside directors can have a material effect on firm performance, for better or worse, but we do not identify the mechanism through which those performance changes occur. Among the more important responsibilities of the board are hiring and if necessary firing the CEO, and approving acquisitions of other firms. There is some existing evidence showing that outsider-dominated boards act differently on these issues than insider-dominated boards. For example, Weisbach (1988) finds that outsider-dominated boards are more likely to replace the CEO after poor performance than insider-dominated boards. As for acquisition policy, several studies find a positive relation between announcement returns and board independence (Byrd and Hickman, 1992; Matsusaka, 1993; Cotter et al., 1997). Our findings suggest that the

actions taken by the board and the value consequences of those actions are likely to depend on the information environment, which would seem to be a natural direction for future research.

We conclude by noting some caveats or limitations to our analysis. First, our empirical strategy delivers estimates of the effectiveness of new outside directors *that are added in response to noncompliance with the new regulations*. Independent directors added to the board for other reasons may be different than those added for compliance reasons. Formally, this boils down to a concern about an omitted variable associated with outsiders added for compliance. Our Table 8 regressions partly allay this concern by controlling for director qualifications, but we cannot rule out the possibility of an unobserved variable that makes outsiders added for compliance reasons different from other outsiders. In a related vein, our results do not imply that low information cost firms can continue to improve value indefinitely by adding outside directors, although the ideas in this paper could conceivably be extended to generate estimates of optimal board composition and provide firms with prescriptive advice on improving performance. As for high information cost firms, our evidence suggests that they need to be particularly careful in selecting outside directors because the high cost of information is a significant challenge to their effectiveness.

A second caveat is that our estimates might overstate the effect of board independence because our instrumental variable, compliance with SOX in 2000, may be driving a variety of other unobservable changes in noncompliant firms.[19] That is, the effect we are attributing to changes in independent directors could also include effects

[19] Black et al. (2006) describe a similar problem in their study of a policy experiment in Korea.

from other SOX-related changes. It is less obvious why other SOX-related changes would have differential effects depending on the cost of information. For example, Litvak (2007) argues that SOX had an adverse impact on risky firms because SOX discouraged risk-taking, forcing risky firms to take on a suboptimal amount of risk. Following this argument, if our information cost variable represented risk, then we might expect a differential compliance effect conditional on information cost. The evidence we report in Table 9 suggests that our information cost variables are not simply proxies for risk, so this particular explanation for our findings is unlikely, but the possibility remains that there is some other SOX effect at work that we have not taken into account.

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Table 1

New Regulations Concerning Independent Directors

Regulation	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 2

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, 1996-2005			
	Mean	S.D.	N
Percentage of independent directors	60.36	18.4	15,820
Number of board members	9.55	3.00	15,820
Return on assets (%)	12.56	9.59	15,135
Tobin's Q	1.93	1.78	15,276
Annual stock return (%)	14.52	47.97	12,674
Number of analysts	15.16	10.85	13,786
Dispersion of analyst forecasts	0.099	0.136	12,713
Analyst forecast error	0.214	0.377	13,346
Market capitalization ($ millions)	7,000	23,072	15,279
Assets ($ millions)	11,923	56,860	15,368
Book leverage ratio	0.391	2.17	15,322
Firm age	25.54	15.79	15,368

Panel B: Comparison of Compliant and Noncompliant Firms in 2000					
	Compliant Firms		Noncompliant Firms		
	Mean	S.D.	Mean	S.D.	t-statistic for difference
Percentage of independent directors	69.7	15.2	52.7	17.3	15.79
Number of board members	9.63	2.90	9.91	3.05	1.42
Return on assets (%)	14.86	9.30	15.35	8.76	0.83
Tobin's Q	2.16	2.00	2.39	2.63	1.46
Annual stock return (%)	15.97	40.58	14.70	38.17	0.49
Number of analysts	16.06	11.34	16.64	11.12	0.77
Analyst forecast dispersion	0.085	0.115	0.069	0.092	2.45
Analyst forecast error	0.167	0.220	0.155	0.285	0.48
Market capitalization ($ millions)	8,372	26,347	13,358	47,271	1.86
Assets ($ millions)	12,012	48,737	15,714	67,340	0.93
Book leverage ratio	0.414	0.710	0.322	1.183	1.36
Firm age	26.84	16.38	26.03	15.41	0.78

Table 3

Regressions of Performance on Independent Directors and Information Cost

This table presents estimates from regressing firm performance during 2000-2005 on the change in the percentage of independent directors. Each column reports estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The first stage (column (1)) regresses changes in the percentage 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 changes in the percentage 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. All regressions include industry fixed effects for the 48 Fama-French industries. Standard errors are robust and clustered by industry. Significance levels are indicated: * = 10%' ** = 5%, *** = 1%.

		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	11.383***	…	…	…	…	…	…
	(1.021)						
Δ Independent directors	…	0.001	-0.252	0.005	0.269***	1.918***	0.056***
		(0.029)	(0.223)	(0.005)	(0.099)	(0.330)	(0.009)
Δ Independent directors × Information cost	…				-0.587***	-4.714***	-0.103***
					(0.189)	(0.597)	(0.021)
Board size	-0.098	-0.021	1.415*	0.002	0.001	1.307*	-0.003
	(0.189)	(0.128)	(0.751)	(0.020)	(0.140)	(0.715)	(0.020)
Leverage ratio	0.237	0.967**	5.113***	0.045	1.001***	5.167***	0.045
	(0.478)	(0.388)	(1.140)	(0.059)	(0.342)	(0.632)	(0.068)
Firm age	-0.071**	0.010	0.495***	0.003	0.011	0.562***	0.004
	(0.033)	(0.019)	(0.131)	(0.003)	(0.022)	(0.144)	(0.003)
Market value of equity, logarithm	0.022	-0.365**	-13.936***	-0.361***	-0.442***	-14.985***	-0.384***
	(0.244)	(0.141)	(1.992)	(0.049)	(0.150)	(2.194)	(0.052)
R^2	0.183	0.111	0.369	0.332	0.141	0.413	0.363
Observations	1,054	983	990	880	897	905	805

Table 4

Regressions of Performance on Independent Directors without Instrumental Variables

This table presents estimates from regressing firm performance during 2000-2005 on the change in the percentage of independent directors. Each column reports estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The information cost variable is an index that represents how costly it is for outsiders to acquire information about the firm. All regressions include industry fixed effects for the 48 Fama-French industries. Significance levels are indicated: * = 10%, ** = 5%, *** = 1%.

	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	0.009	0.008	0.003*	0.069*	0.575***	0.010
	(0.012)	(0.057)	(0.002)	(0.040)	(0.192)	(0.006)
Δ Independent directors × Information cost	…	…	…	-0.135	-1.204***	-0.013
				(0.093)	(0.420)	(0.014)
Board size	-0.020	1.420*	0.002	-0.014	1.215	-0.003
	(0.131)	(0.747)	(0.020)	(0.141)	(0.744)	(0.022)
Leverage ratio	0.968**	5.117***	0.045	0.984**	5.060***	0.043
	(0.394)	(1.138)	(0.060)	(0.392)	(1.048)	(0.062)
Firm age	0.011	0.514***	0.002	0.012	0.590***	0.003
	(0.019)	(0.132)	(0.003)	(0.021)	(0.137)	(0.003)
Market value of equity, logarithm	-0.369**	-13.981***	-0.361***	-0.381**	-14.561***	-0.371***
	(0.146)	(2.008)	(0.049)	(0.152)	(2.059)	(0.051)
R^2	0.112	0.368	0.332	0.123	0.380	0.338
Observations	983	990	880	897	905	805

Table 5

Alternative Regressions of Firm Performance on Board Independence

Each column reports coefficient estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The dependent variable is a measure of performance from 2000 to 2005, as indicated at the top of each column. The control variables are the same as those in columns (5)-(7) of Table 3. We do not report the coefficients on industry fixed effects, board size, leverage ratio, firm age, and market value of equity. In panels A-C, the changes in independent directors are fitted values from a first-stage regression of the change in the percentage of independent directors on a dummy for noncompliance with the SOX requirement of a fully independent audit committee in 2000. In panel D, the first-stage regression uses noncompliance with the exchange listing requirement to have a majority of outside directors on the board instead of noncompliance with SOX. In panel E, the change in board control is +100 if it shifted from an insider to an outsider majority, -100 if it shifted from an outsider to an insider majority, and zero otherwise. Significance levels are indicated: * = 10%, ** = 5%, *** = 1%.

	Δ ROA	Δ log(Q)	Stock return
Panel A: Information Cost Measured by Number of Analysts			
Δ Independent directors	0.123**	0.609*	0.036***
	(0.059)	(0.303)	(0.009)
Δ Independent directors × Information cost	-0.222***	-1.617***	-0.053***
	(0.082)	(0.282)	(0.012)
Panel B: Information Cost Measured by Dispersion of Analyst Forecasts			
Δ Independent directors	0.167**	1.023***	0.032***
	(0.072)	(0.287)	(0.006)
Δ Independent directors × Information cost	-0.392***	-3.007***	-0.054***
	(0.136)	(0.449)	(0.014)
Panel C. Information Cost Measured by Analyst Forecast Error			
Δ Independent directors	0.159**	1.114***	0.032***
	(0.075)	(0.264)	(0.007)
Δ Independent directors × Information cost	-0.393***	-3.170***	-0.054***
	(0.142)	(0.490)	(0.018)
Panel D. Compliance Measured by Majority of Outsiders on Board			
Δ Independent directors	0.170**	1.530***	0.032***
	(0.080)	(0.292)	(0.009)
Δ Independent directors × Information cost index	-0.280*	-3.069***	-0.057***
	(0.145)	(0.414)	(0.017)
Panel E. ΔBoard Control Measured by Shift from Majority Insiders to Majority Outsiders			
Δ Board control	0.089**	0.725***	0.024***
	(0.043)	(0.161)	(0.004)
Δ Board control × Information cost index	-0.196**	-1.863***	-0.044***
	(0.085)	(0.325)	(0.008)

Table 6

Uncertainty and Information Asymmetry in Regressions of Performance on Board Independence

Each column reports coefficient estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The dependent variable is a measure of performance from 2000 to 2005, as indicated at the top of each column. The control variables are the same as those in columns (5)-(7) of Table 3. We do not report the coefficients on industry fixed effects, board size, leverage ratio, firm age, and market value of equity. The changes in independent directors are fitted values from a first-stage regression of the change in the percentage of independent directors on a dummy for noncompliance with the SOX requirement of a fully independent audit committee in 2000. Stock return volatility is measured as the standard deviation of monthly returns in 2000. Intangibility is measured as one minus the value of plant, property, and equipment as a fraction of assets. All measures are based on percentile rankings and take on values between zero and one. Significance levels are indicated: * = 10%, ** = 5%, *** = 1%.

	Δ ROA	Δ log(Q)	Stock return
Δ Independent directors	0.397**	4.672***	0.093***
	(0.156)	(0.560)	(0.015)
Δ Independent directors × Information cost	-0.564***	-4.429***	-0.104***
	(0.197)	(0.586)	(0.020)
Δ Independent directors × Stock return volatility	0.170*	-0.012	0.032*
	(0.100)	(0.527)	(0.016)
Δ Independent directors × Market-to-Book	-0.358**	-4.678***	-0.077***
	(0.160)	(0.738)	(0.021)
Δ Independent directors × Intangibility	0.002	-0.334	-0.009
	(0.114)	(0.381)	(0.013)
R^2	0.157	0.488	0.388
Observations	881	883	795

Table 7

New Economy Firms and Regressions of Performance on Board Independence

Each column of each panel reports coefficient estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The dependent variable is a measure of performance from 2000 to 2005, as indicated at the top of each column. The control variables are the same as those in columns (5)-(7) of Table 3. We do not report the coefficients on industry fixed effects, board size, leverage ratio, firm age, and market value of equity. The changes in independent directors are fitted values from a first-stage regression of the change in the percentage of independent directors on a dummy for noncompliance with the SOX requirement of a fully independent audit committee in 2000 (not reported). Panel A excludes new economy firms (as defined in the text), panel B excludes firms with less than 10 years of Compustat data, and panels C and D use the full sample but include another interaction term. Significance levels are indicated: * = 10%; ** = 5%; *** = 1%.

	Δ ROA	Δ log(Q)	Stock return
Panel A: New Economy Firms Excluded from Sample			
Δ Independent directors	0.303***	1.890***	0.059***
	(0.089)	(0.370)	(0.009)
Δ Independent directors × Information cost	-0.588***	-4.313***	-0.096***
	(0.165)	(0.714)	(0.023)
Panel B: Young Firms Excluded from Sample			
Δ Independent directors	0.225***	1.595***	0.057***
	(0.078)	(0.353)	(0.011)
Δ Independent directors × Information cost	-0.446***	-4.133***	-0.103***
	(0.149)	(0.717)	(0.022)
Panel C. Interaction with New Economy Dummy Included			
Δ Independent directors	0.265**	1.965***	0.056***
	(0.100)	(0.339)	(0.009)
Δ Independent directors × Information cost	-0.589***	-4.686***	-0.104***
	(0.187)	(0.606)	(0.020)
Δ Independent directors × New economy dummy	0.061	-0.852***	0.005
	(0.066)	(0.305)	(0.012)
Panel D. Interaction with Young Firm Dummy Included			
Δ Independent directors	0.269**	2.053***	0.056***
	(0.102)	(0.350)	(0.010)
Δ Independent directors × Information cost index	-0.587***	-4.831***	-0.103***
	(0.191)	(0.620)	(0.021)
Δ Independent directors × Young firm dummy	-0.001	-0.559*	-0.001
	(0.082)	(0.293)	(0.010)

Table 8

Regressions of Performance on Board Independence and Director Qualifications

Each column of each panel reports coefficient estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The dependent variable is a measure of performance from 2000 to 2005, as indicated at the top of each column. The control variables are the same as those in columns (5)-(7) of Table 3. We do not report the coefficients on industry fixed effects, board size, leverage ratio, firm age, and market value of equity. The changes in independent directors are fitted values from a first-stage regression of the change in the percentage of independent directors on a dummy for noncompliance with the SOX requirement of a fully independent audit committee in 2000 (not reported). The panels differ in how the percentage of qualified directors is counted. Significance levels are indicated: * = 10%, ** = 5%, *** = 1%.

	Δ ROA	Δ log(Q)	Stock return
Panel A: Academic Qualification			
Δ Independent directors	0.279***	1.929***	0.059***
	(0.102)	(0.370)	(0.010)
Δ Independent directors × Information cost	-0.602***	-4.709***	-0.110***
	(0.197)	(0.688)	(0.022)
Δ Qualified directors	0.021	0.046	-0.002
	(0.060)	(0.356)	(0.008)
Δ Qualified directors × Information cost	-0.048	0.107	0.007
	(0.126)	(0.696)	(0.015)
Panel B: Corporate Qualification			
Δ Independent directors	0.261**	1.722***	0.055***
	(0.100)	(0.353)	(0.010)
Δ Independent directors × Information cost	-0.565***	-4.286***	-0.103***
	(0.199)	(0.674)	(0.021)
Δ Qualified directors	-0.015	-0.145	-0.004
	(0.023)	(0.114)	(0.003)
Δ Qualified directors × Information cost	0.030	0.311	0.004
	(0.054)	(0.234)	(0.006)
Panel C. Financial Qualification			
Δ Independent directors	0.325***	1.888***	0.055***
	(0.104)	(0.434)	(0.011)
Δ Independent directors × Information cost	-0.696***	-4.641***	-0.102***
	(0.200)	(0.854)	(0.023)
Δ Qualified directors	-0.028	-0.108	0.006
	(0.030)	(0.203)	(0.006)
Δ Qualified directors × Information cost	0.066	-0.021	-0.006
	(0.059)	(0.360)	(0.011)
Panel D. Academic, Corporate, or Financial Qualification			
Δ Independent directors	0.284***	1.936***	0.058***
	(0.102)	(0.358)	(0.010)
Δ Independent directors × Information cost index	-0.613***	-4.719***	-0.109***
	(0.196)	(0.633)	(0.021)
Δ Qualified directors	-0.027	-0.158	-0.002
	(0.026)	(0.126)	(0.003)
Δ Qualified directors × Information cost	0.060	0.276	0.003
	(0.060)	(0.231)	(0.006)

Table 9

Regressions of Performance on Independent Directors and Information Cost

Each column reports coefficient estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The dependent variable is a measure of performance from 2000 to 2005, as indicated at the top of each column. The changes in independent directors are fitted values from a first-stage regression of the change in the percentage of independent directors on a dummy for noncompliance with the SOX requirement of a fully independent audit committee in 2000 (not reported). All regressions include industry fixed effects for the 48 Fama-French industries. Significance levels are indicated: * = 10%' ** = 5%, *** = 1%.

	Δ ROA	Δ log(Q)	Stock return
Δ Independent directors	0.225**	0.885**	0.039***
	(0.105)	(0.400)	(0.013)
Information cost	-1.335	-31.970***	-0.460
	(2.390)	(9.895)	(0.379)
Δ Independent directors × Information cost	-0.497**	-2.501***	-0.068**
	(0.213)	(0.765)	(0.029)
Board size	-0.003	1.253*	-0.004
	(0.140)	(0.734)	(0.020)
Leverage ratio	0.998***	5.158***	0.045
	(0.341)	(0.592)	(0.068)
Firm age	0.011	0.562***	0.004
	(0.022)	(0.143)	(0.003)
Market value of equity, log	-0.444***	-15.207***	-0.387***
	(0.147)	(2.265)	(0.050)
R^2	0.141	0.415	0.363
Observations	897	905	805

Table 10

Risk-Adjusted Stock Returns

Each column of each panel reports coefficient estimates from a single regression, with standard errors (robust and clustered by industry) in parentheses. The dependent variable is the average monthly return computed over fiscal year(s), as indicated at the top of each column. The control variables are the same as those in columns (5)-(7) of Table 3. We do not report the coefficients on industry fixed effects, board size, leverage ratio, firm age, and market value of equity. The changes in independent directors are fitted values from a first-stage regression of the change in the percentage of independent directors on a dummy for noncompliance with the SOX requirement of a fully independent audit committee in 2000 (not reported). The panels differ in how systematic risk is controlled. Significance levels are indicated: * = 10%, ** = 5%, *** = 1%.

	FY 2001-2005	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Panel A: Average Raw Monthly Return						
Δ Independent directors	0.056***	0.091***	0.100***	0.003	0.014	0.070***
	(0.009)	(0.024)	(0.020)	(0.021)	(0.022)	(0.018)
Δ Independent directors × Information cost	-0.103***	-0.176***	-0.173***	-0.011	-0.065*	-0.114***
	(0.021)	(0.037)	(0.035)	(0.037)	(0.037)	(0.036)
Panel B: Average Abnormal Monthly Return Relative to CRSP Value-Weighted Index						
Δ Independent directors	0.058***	0.096***	0.099***	0.006	0.013	0.068***
	(0.009)	(0.022)	(0.019)	(0.020)	(0.022)	(0.017)
Δ Independent directors × Information cost	-0.106***	-0.182***	-0.172***	-0.023	-0.059*	-0.111***
	(0.020)	(0.035)	(0.034)	(0.037)	(0.035)	(0.036)
Panel C: Average Abnormal Monthly Return Relative to Size and Book-to-Market 5x5 Portfolio						
Δ Independent directors	0.055***	0.080***	0.096***	0.029	0.017	0.062***
	(0.009)	(0.021)	(0.020)	(0.020)	(0.020)	(0.019)
Δ Independent directors × Information cost	-0.102***	-0.157***	-0.152***	-0.060	-0.060*	-0.108***
	(0.020)	(0.041)	(0.032)	(0.038)	(0.032)	(0.039)

Table 11

Regressions of Board Composition on Information Cost

This table reports estimates from regressions of board composition on information cost during 1996-2005. In the first three columns, the dependent variable is the percentage of independent directors. In the last three columns, the dependent variable is a dummy equal to one if a majority of directors are independent, and the regression is a logit. All regressions report robust standard errors that are clustered by firm. Significance levels are indicated: * = 10%, ** = 5%, *** = 1%.

	Dependent Variable					
	Percentage of independent directors			Majority of independent directors		
	(1)	(2)	(3)	(4)	(5)	(6)
Information index	-5.623***	-5.685***	-5.216***	-0.661***	-0.694***	-0.594***
	(1.465)	(1.418)	(1.442)	(0.176)	(0.179)	(0.191)
Board size	-0.204*	0.032	0.007	0.008	0.031**	0.002
	(0.121)	(0.120)	(0.126)	(0.015)	(0.016)	(0.018)
Leverage ratio	0.089	0.222	0.276	-0.005	0.009	0.000
	(0.164)	(0.229)	(0.246)	(0.018)	(0.025)	(0.017)
Firm age	0.300***	0.287***	0.225***	0.030***	0.030***	0.026***
	(0.022)	(0.022)	(0.025)	(0.003)	(0.003)	(0.003)
Market value of equity, logarithm	0.597***	0.098	0.464**	0.070**	0.015	0.111***
	(0.227)	(0.228)	(0.222)	(0.028)	(0.028)	(0.029)
R^2	0.076	0.130	0.201	…	…	…
Observations	13,467	13,467	13,401	13,467	13,467	13,401
Year fixed effects?	No	Yes	Yes	No	Yes	Yes
Industry fixed effects?	No	No	Yes	No	No	Yes

Figure 1

Mean Board and Committee Independence Percentage: 1996-2005

This figure presents the percentage of firms with independent boards and the mean percentage of independent directors on corporate boards and key committees.

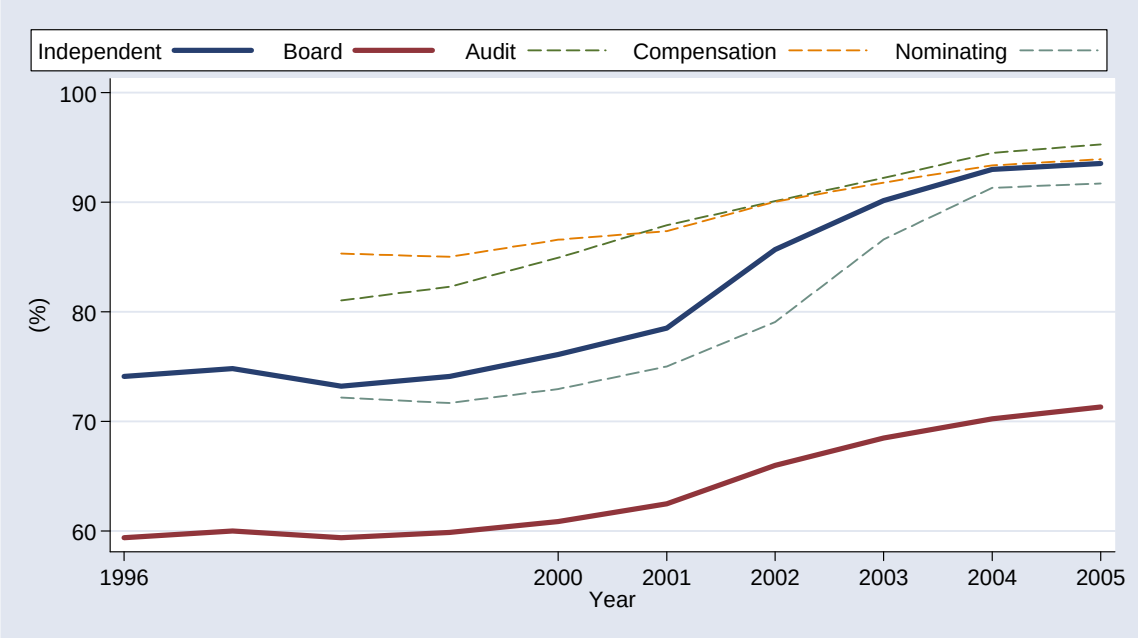

Figure 2

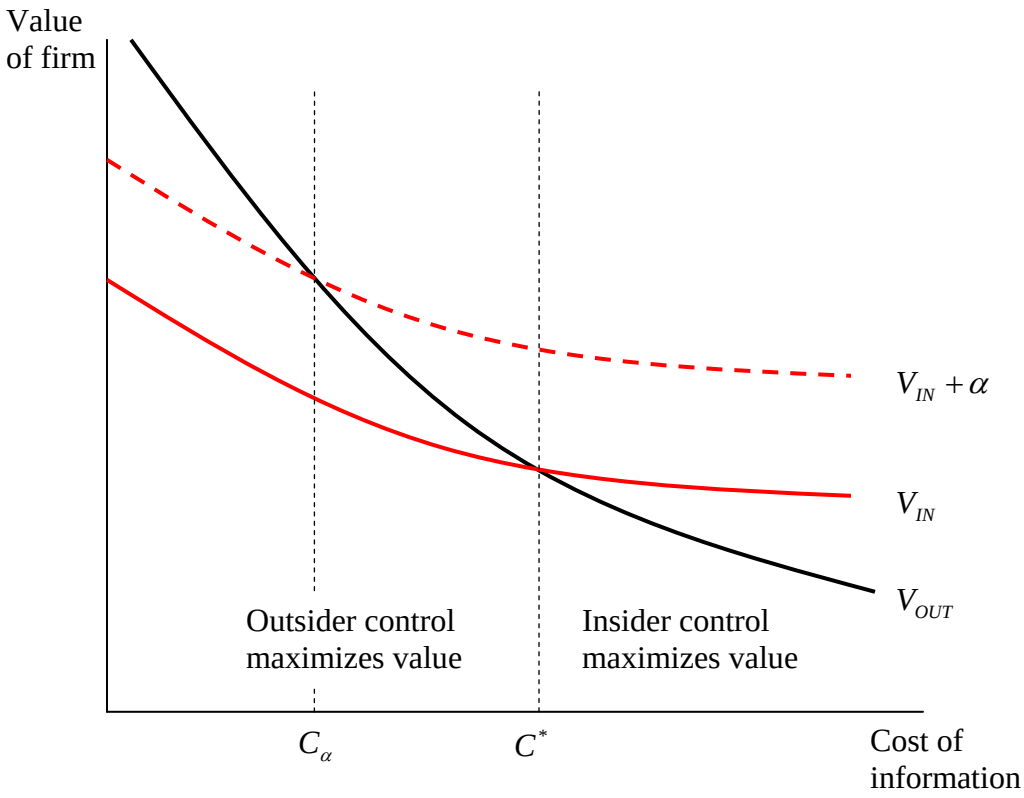
Value
of firm
$V_{IN} + \alpha$
V_{IN}
V_{OUT}
Outsider control
maximizes value
Insider control
maximizes value
C_α
C^*
Cost of
information

Figure 3

Performance of Noncompliant and Compliant Firms: 1996-2005

This figure presents the industry and year adjusted return on assets of noncompliant and compliant firms relative to 1996. Noncompliant firms are classified according to information cost – low (bottom quartile), medium (second and third quartiles) or high (top quartile).