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When are outside directors effective? ☆

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ABSTRACT

This paper uses recent regulations that have required some companies to increase the number of outside directors on their boards to generate estimates of the effect of board independence on performance that are largely free from endogeneity problems. Our main finding is that the effectiveness of outside directors depends on the cost of acquiring information about the firm: when the cost of acquiring information is low, performance increases when outsiders are added to the board, and when the cost of information is high, performance worsens when outsiders are added to the board. The estimates provide some of the cleanest estimates to date that board independence matters, and the finding that board effectiveness depends on information cost supports a nascent theoretical literature emphasizing information asymmetry. We also find that firms compose their boards as if they understand that outsider effectiveness varies with information costs.

1. Introduction

A top priority for corporate governance reformers is to increase the representation of outside directors on corporate boards. Because outside directors are independent from management, they are believed to be willing to stand up to the Chief Executive Officer (CEO) to protect shareholder interests. Recent regulations, including the Sarbanes-Oxley Act of 2002 (SOX) and rules promulgated by the Securities and Exchange Commission (SEC), New York Stock Exchange (NYSE), and National Association of Securities Dealers (NASD), 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

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[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."

matter at all for performance, with most studies finding small, statistically insignificant correlations (Bhagat and Black, 2002; Hermalin and Weisbach, 2003; Fields and Keys, 2003). Also, it seems possible that setting numerical targets for outside directors may be little more than window dressing because insiders can select directors that are independent according to regulatory definitions but still unduly influenced by management. Increasing outsider representation on boards may be simply "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 many 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 (2008). 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.[2]

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 literature. To address the problem of board endogeneity, we take advantage of the fact that some firms were forced to increase the number of outsiders on their boards in response to 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.[3] Our identification strategy is to use the "exogenous" changes in board composition brought about by the new regulations to generate estimates of the effectiveness of board independence that are largely free from endogeneity concerns.

We use this approach to shed light not only on the broad question of *whether* independence matters for boards, but *when* it is likely to matter. Scholars generally recognize two primary roles for boards: monitoring and advising. A nascent stream of theoretical research shows that the effectiveness of outsiders in both functions depends on the information environment (Hermalin and Weisbach, 1998; Raheja, 2005; Adams and Ferreira, 2007; Harris and Raviv, 2008). Specifically, when an outsider's cost of acquiring information about the firm is high, outside directors are less effective at monitoring and providing advice, than when the cost of information is low. To explore this foundational assumption, we construct firm-specific proxies for the cost of becoming informed, and estimate the relation between performance and board independence, conditional on information cost.

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 outsiders significantly improve performance when their information cost is low, and hurt performance when their information cost is high. These findings 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% increase in the percentage of outside directors on the board is associated with 1.3% higher ROA in firms with an information cost in the lowest quartile compared to 1.7% lower ROA in firms with an information cost in the highest quartile, controlling for other determinants of performance. Similarly, a 10% increase in board independence is associated with 8.1% higher *Q* in low information cost firms compared to 15.8% lower *Q* in high information cost firms.

We explore several possible sources of spurious correlation. All of our regressions include industry controls to make sure 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 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. To determine whether our information cost variables are actually capturing firm complexity, we introduce firm size and number of segments into the

[2] This is not intended as a complete list of possible explanations for the mixed evidence on board composition and firm performance. For example, it could be that board composition simply does not matter (although our estimates suggest it does matter). It could be that board composition matters only for major events such as CEO changes or mergers (although one would expect these major events to leave traces in the firm's performance and value). Another possibility is that existing empirical work includes too many control variables that jointly determine performance and board composition, absorbing and obscuring the direct effect of board composition on performance. See Coles, Daniel, and Naveen (2008) for an investigation of this issue using a structural model.

[3] Many papers have exploited natural experiments brought about by regulatory changes to address endogeneity issues. Perhaps the closest paper to ours is Dahya and McConnell (2007) that links changes in performance among U.K. firms to changes in board independence that were recommended by the Cadbury Report of 1992. They find large positive improvements in return on assets (ROA) and stock returns

(*footnote continued*)
associated with increases in outsiders. Linck, Netter, and Yang (2009) use SOX as a natural experiment to study the effect of an increased demand for directors. An alternative strategy to address the endogeneity problem, pursued by Coles, Lemmon, and Wang (2008, Section 7), is to estimate a system of simultaneous equations. Coles, Daniel, and Naveen (2008) also provide a transaction cost explanation as a means of structural identification.

regressions. 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 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.[4]

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 may 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 (2008). However, our finding that externally driven changes in the number of outsiders can increase performance suggests that boards are not constituted entirely with an eye toward value maximization.

The paper is organized as follows. Section 2 discusses recent regulatory changes and develops a reduced-form model that provides a framework for the empirical analysis. Section 3 discusses the data and explains how the information cost variables are constructed. Section 4 reports evidence on the connection between outside directors and firm performance. Section 5 explores other determinants of outsider effectiveness and considers sources of spurious correlation. Section 6 reports evidence that board composition is related to information costs. Section 7 discusses implications.

2. Context and framework

2.1. New regulations

SOX and the exchange rules that it engendered represent one of the most significant revisions 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, regulatory reform 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. A director is defined to be "independent" if he or she 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).[5] 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, the director 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. Fig. 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).

[4] 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.

[5] 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.

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.

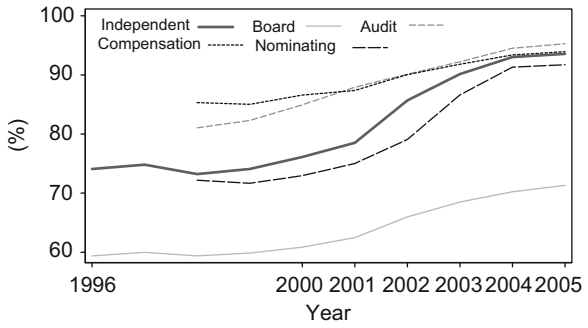

Fig. 1. Mean board and committee independence percentage, 1996–2005. This figure presents the percentage of firms with independent boards and the mean percentage of independent directors on corporate boards and key committees. The sample consists of firm-year observations with available data on directors and boards from IRRC, analyst forecasts from IBES, and financial indicators from Compustat and CRSP.

Fig. 1 shows that from 1996 to 2000, the proportion of firms with a majority of independent directors on their boards ("firms with independent boards") was fairly stable in the 72–74% range. In 2000, roughly 76% of firms had a board with a majority of independent directors. By 2005, the most recent year for which data are available, 94% 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 59–61% range from 1996 to 2000, and rose to 71% in 2005. Committees also became more independent. Over the period 1998–2005, representation of independent directors rose from 81% to 95% on audit committees, from 85% to 94% on compensation committees, and from 72% to 92% on nominating committees.[6]

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 board regulations when they were introduced. Noncompliance with the new board regulations is used as an instrument to identify an exogenous shift in the percentage of outside directors. 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.[7] During the period 2000–2005, board independence increased by 16% at noncompliant firms (from 52% to 68%) compared to a 4% increase at compliant firms (from 70% to 74%).

2.2. Three views of board regulations

Our investigation is motivated by three broad 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 sympathetic to management [sometimes called "co-option"; see Coles, Daniel, and Naveen (2007)]. For example, a director who is a personal friend of the CEO could be independent in the eyes of the law, but unwilling to challenge the CEO. From this perspective, the increase in board independence from 2000 to 2005 represents a shell game in which managers are able to put their allies on the board as independent directors, like the often-cited

[6] See Linck, Netter, and Yang (2008) for additional summary information on the evolution of boards over time. The broad patterns of board evolution in our sample conform to those in Linck et al. except our sample has approximately no change in average board size from 2000 to 2005, while the sample in Linck et al. shows an increase. Since we use different data sources, it is not possible to determine the reason for the discrepancy.

[7] We use the audit committee requirement because it is legally binding on all firms and seems to work well in the data. As discussed below, 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 uniformly to all issuers (domestic versus foreign, large versus small firms, controlled versus uncontrolled), making them noisier instruments.

example of Disney appointing to its board the principal of a school attended by CEO Michael Eisner's children (Byrne, Grover, and Melcher, 1997). According to the window-dressing view, an increase in measured board independence should have no effect on performance.[8]

The *entrenchment view*, held by many supporters of SOX, maintains that managers dislike independent boards and seek to insulate themselves from oversight. This view assumes that market forces alone are unable to bring about a value-maximizing level of board monitoring because of the limited pool of talent and capital that is available to target agency-plagued firms in the market for corporate control. According to this view, managers cannot easily evade the new board regulations, and will have to appoint outside directors who are effective monitors, leading to improved firm performance when boards become more independent.

We call the third 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 advising and monitoring so as to maximize shareholder value. For example, Raheja (2005), Adams and Ferreira (2007), and Harris and Raviv (2008) show how boards can be composed to make the best use of information. According to this view, requiring a firm to increase the number of outside directors would result in a suboptimal board and reduce the firm's performance.

Each of these views is plausible, and they are not necessarily incompatible. For example, a manager might seek to constitute a firm's board in order to trade off the benefits and costs of information while at the same time factoring in how board composition will restrict his or her freedom of action. In order to study this possibility of multiple motives, we need a framework that integrates the three views. The next section develops a reduced-form model that nests the three views, with an emphasis on the role of information, and develops testable implications.

2.3. Reduced-form model

The purpose of this model is to identify testable implications for the case where boards are composed to take into account benefits and costs of information, as stressed by much of the recent theoretical literature, but in which managers also dislike losing control of the board. Our emphasis on information is motivated by the recent theoretical literature. 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 (2008), 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 share the assumption that outsiders have interests closely aligned with shareholders, but outsiders have access to less information or have a higher cost of acquiring information than insiders.[9] 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. As outsiders' cost of acquiring information declines, independent boards become more effective.

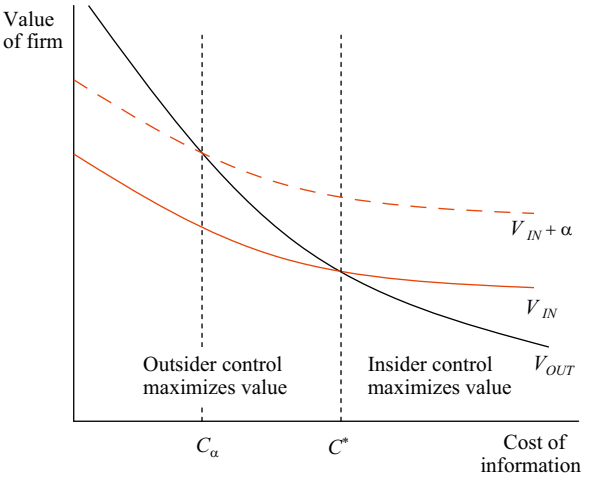

Fig. 2. Reduced-Form Model. This figure provides a graphical illustration of the reduced-form model in Section 2.3, and shows how firm value varies with information cost as a function of board control, which is by either insiders or outsiders. V_{IN} is firm value when the board is controlled by insiders, whereas V_{OUT} is firm value when the board is controlled by outsiders. α is the CEO's private benefit from insider control.

Our model incorporates these lessons by positing that firm value $V_B(C)$ depends on C, the cost outsiders must pay to become informed, and $B \in \{IN, OUT\}$, an indicator for whether the board is controlled by insiders or outsiders.[10] 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 $\Delta_C \equiv \partial\Delta/\partial C < 0$ (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 be optimal. Fig. 2 depicts the value of the firm conditional on information costs and board control.

[8] If boards simply do not matter for performance, the implications are the same as for the window-dressing view: changes in board composition should have no effect on performance.

[9] It is a central premise of corporate finance research that insiders often have information that outsiders do not (Myers and Majluf, 1984), and evidence from trading returns indicates that inside directors are better informed than outside directors (Fu and Yu, 2008).

[10] We follow Harris and Raviv (2008) 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 remain monotonically related to information costs.

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 board composition partly reflects the desire of the incumbent CEO to stifle dissent, we suppose that the CEO chooses board independence to maximize his or her own utility. The CEO's utility function is

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

The CEO cares about firm value (because the CEO is also a shareholder, cares about his or her reputation, etc.) but also receives a private benefit from insider control given by α, which we treat as a random variable with a differentiable distribution F. Implicit in this formulation is the assumption that transaction costs prevent shareholders from completely controlling governance, so as a result the CEO may earn some rents. When $\alpha = 0$, what might be thought of as complete shareholder control, the CEO chooses the board to maximize value.[11]

The CEO creates an outsider-controlled board if $U_{OUT} > U_{IN}$, or $V_{OUT} > V_{IN} + \alpha$. For $\alpha > 0$, this changes the critical information cost value to C_α, as shown in Fig. 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.

To study how changes in board independence affect firm value, consider an exogenous change from insider to outsider control. As Fig. 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 board 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 regulation 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 regulation forces these firms with optimal insider control to have suboptimal outsider control.[12]

To summarize, this setup thus provides a way to address each of the three views of boards. Under the window-dressing view, an increase in board independence should not affect performance; under the entrenchment view, an increase in board independence should always improve performance; under the optimization view, an increase in board independence should always hurt performance, and under the blended entrenchment/optimization view, the effect of an increase in board independence should be conditional on information costs as specified above.

3. Data

Information on directors and boards comes from the Investor Responsibility Research Center (IRRC), information to construct information cost variables is taken from the Institutional Brokers' Estimate System (IBES), and data on firm performance are taken from Compustat and the Center for Research in Security Prices (CRSP). Because the new board rules were adopted over several years through multiple regulations, we focus on performance changes over the period 2000–2005. The benchmark year is 2000 because regulatory innovation began in December 1999 when the exchanges adopted the recommendations of the Blue Ribbon Committee, and the end year is 2005, by which time all of the relevant regulations were adopted and phased in. We investigate three different measures of performance: return on assets (ROA), Tobin's Q, and stock returns. For ROA and Tobin's Q, we compare fiscal year 2000 with fiscal year 2005, and 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. Each of these performance measures have advantages and disadvantages, but we tend to find similar results regardless of which measure we use, suggesting our findings are not due to issues specific to any particular measure.

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).[13] We winsorize all variables at the 1st and 99th percentiles (the results are similar if we

[11] We abstract away from the possibility that α is positively related to C, which could be the case if high information costs make it harder to monitor the CEO.

[12] These predictions require one qualification. For firms with the smallest cost ($C < C_\alpha$), even an entrenched manager will choose outsider control. Because such a firm has already chosen outsider control, forcing an increase in outsiders will neither improve nor hinder performance.

[13] 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.

Table 2
Summary statistics.

Panel A reports summary statistics for the entire sample, which covers the period from 1996 to 2005, and consists of firm-year observations with available data on directors and boards from IRRC, analyst forecasts from IBES, and financial indicators from Compustat and CRSP. 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. Return on assets is operating income before depreciation divided by book assets. Tobin's *Q* is the market value of assets divided by the book value of assets. The number of analysts is a count of analysts who posted forecasts about the firm in a given year. The dispersion of analyst forecasts is measured as the standard deviation of earnings forecasts across analysts prior to a quarterly earnings announcement, normalized by the firm's total book assets and averaged across four quarters in a given year. The analyst forecast error is 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. The book leverage ratio is debt divided by book assets. Firm age is the number of years since the firm's first appearance on Compustat with valid asset data.

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		*t*-Statistic for difference
	Mean	S.D.	Mean	S.D.	
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
Percentage of independent directors on the audit committee	100.0	0.0	63.4	17.2	40.65
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

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 partly determined by the IRRC data, which run from 1996 to 2005.[14] Panel A of Table 2 reports summary statistics for the whole sample.

Our analysis focuses on three variables that are intended to measure an outsider's cost of becoming informed. The variables follow Krishnaswami and Subramaniam (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.[15] 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,

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

[15] We count forecasts from the same IBES 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. Specifically, we use the residuals from a regression of the number of analysts on firm size.

measured as the standard deviation of earnings forecasts across analysts prior to a quarterly earnings announcement, normalized 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).

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 the board regulations of SOX in 2000. Thirty-six percent of sample firms were not in compliance in 2000. Because compliance status depends on the number of independent directors, the fact that noncompliant firms had 17% fewer independent directors than compliant firms is expected. The average board contained about ten 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. 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 compare changes in performance during 2000–2005 with changes in board composition, essentially a difference-in-difference approach, it is also important to consider whether the performance of noncompliant (treatment) and compliant (control) firms was following similar trends before treatment, that is, whether the parallel trends assumption holds. Fig. 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) point toward the same conclusion. The divergence between low and high information cost firms seen in Fig. 3 shows that our main results are 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 single year.

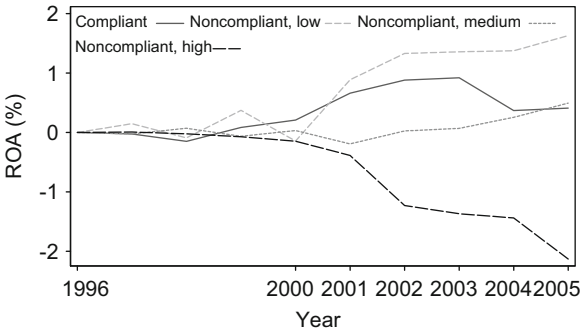

Fig. 3. Performance of noncompliant and compliant firms, 1996–2005. This figure presents the industry- and year-adjusted return on assets of noncompliant and compliant firms relative to 1996. Noncompliant firms are classified according to information cost index: low (bottom quartile), medium (second and third quartiles), or high (top quartile).

4. Evidence on outside directors and firm performance

4.1. Main results

This section presents the main findings concerning the effect of greater board independence on firm performance. Our baseline empirical model assumes that performance is determined according to:

$$V_{jt} = \beta I_{jt} + \lambda C_j + \gamma I_{jt} C_j + \cdots + r_j + s_t + e_{jt}, \quad (1)$$

where *j* indexes a firm, *t* indexes a year, *V* is a measure of performance, *I* is a variable indicating board independence, *C* represents the cost of information, *r* is a firm-specific performance effect, and *s* is a year-specific effect. Eq. (1) assumes that performance and independence vary over time, but information cost does not.[16] The marginal effect of outside directors on performance is $dV/dI = \beta + \gamma C$. We are interested in whether outside directors influence performance, that is, if $dV/dI = 0$ for some firms. We are also interested in whether the marginal effect depends on information cost as predicted by recent theory. This is tested by investigating the hypothesis $\partial^2 V/\partial I \partial C = 0$, which boils down to testing if $\gamma = 0$.

[16] We relax this assumption later and obtain similar results. Note, however, that less than 2% 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. The sample as a whole shows a modest increase in information cost according to our measures: the mean number of analysts fell from 16.3 in 2000 to 16.1 in 2005, the mean dispersion in analyst forecasts grew from 0.08% to 0.10%, and the mean forecast error grew from 0.16% to 0.20%.

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. Significance levels are indicated: *=10%, **=5%, ***=1%.

		Dependent variable					
	First stage (1)	ΔROA (2)	Δ log(Q) (3)	Stock return (4)	ΔROA (5)	Δ log(Q) (6)	Stock return (7)
Dummy=1 if firm did not comply with SOX in 2000	11.383***	…	…	…	…	…	…
	(1.021)						
Δ Independent directors (predicted values)	…	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 (predicted values) × Information cost index	…				−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

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

$$\Delta V_j = \beta \Delta I_j + \gamma C \Delta I_j + \cdots + \Delta s + \Delta e_j, \quad (2)$$

where $\Delta X \equiv X_{2005} - X_{2000}$. Eq. (2) removes firm-specific fixed effects, the time-specific effects are captured by the constant, 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 information 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 control for various factors previously found to be correlated with performance, including board size, leverage ratio, firm age, and firm size in 2000. We include these variables to control for initial conditions. Except as discussed below under robustness, we do not include these control variables as differences because they are likely to be driven by the same managerial factors that influence performance rather than independently driving performance. Standard errors are corrected to allow for clustering of errors 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 the board regulations in 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. (We sometimes refer to this as an "instrumental variables" approach.) Using compliance with SOX in 2000 allows us capture the 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 Fig. 1 shows that the immediate response in 2000 was not enormous). 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, but this only makes it harder to detect effects because it means our control group might actually include firms that have been "treated."[17]

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% during the sample period, an effect that is different from zero at better than the 1% level of statistical significance. The remaining columns report regressions of changes in firm performance on fitted changes in board composition. The performance variable is indicated at the top of each

[17] We should note that an alternative approach would be to estimate a panel regression with firm fixed effects over the entire 1996–2005 period. We explored such an approach (not reported) and found quantitatively similar results. This is not surprising because the sharp break between the performance of noncompliant and compliant firms does not take place before 2000 (Fig. 3). Our approach, which reduces the sample to one before-versus-after observation per firm, has the advantage of avoiding a possibly severe serial correlation problem that arises when using long time-series in differences-in-differences estimation (Bertrand, Duflo, and Mullainathan, 2004).

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 change in percentage of outsiders with the information cost index. Recall that the information cost index is based on 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. Consistent with recent theories, the effectiveness of outside directors depends on how costly it is for outsiders to acquire information about the firm.

Second, the estimates reveal that a change in board composition has a material impact on performance for certain firms. For firms in the lowest information cost quartile (with a mean information cost index of 0.23), a 10% increase in the percentage of outside directors (roughly comparable to the impact of the new regulations on noncompliant firms) is associated with 1.3% higher ROA, 8.1% higher *Q*, and 3.8% higher annual stock returns over the sample period. All of these effects are different from zero at the 5% level or better. One interpretation of this evidence is that before the new regulations took effect, management in low information cost firms was inefficiently restricting the representation of outsiders on their boards in order to reduce oversight.[18] For firms in the highest information cost quartile (with a mean information cost index of 0.74), a 10% increase in the percentage of outside directors is associated with 1.7% lower ROA, 15.8% lower *Q*, and 2.4% lower annual stock returns over the sample period. All three values are different from zero at the 5% 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 performance effect for the median information cost firm is small in magnitude and statistically distinguishable from zero only for *Q*. The magnitude of the ROA effect for high and low information cost firms is similar to the 1.4–2.0% effect that Dahya and McConnell (2007) find for United Kingdom firms that added independent directors in response to recommendations from the Cadbury Commission in the 1990s.

Table 3's evidence of a consistently 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 seem 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, could only capture the unconditional effect of outsiders, which in our sample is close to zero. Another possible reason we detect significant outsider effects may be due to our identification strategy that relies on 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.[19]

To shed more light on why our results differ from previous research, we re-estimated the main regressions in Table 3 without the first-stage regression. 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% increase in the percentage of independent directors is associated with a 0.4% increase in return on assets for low information cost firms, compared to a 1.3% 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

[18] As discussed above, the model predicts that within the group of low information cost firms, an increase in outsider representation will have no effect for firms with $C < C_\alpha$. Because α is unobservable and firm-specific, we cannot identify C_α, so we cannot partition the sample of low cost firms into those with $C < C_\alpha$ and those with $C > C_\alpha$. However, assuming that firms with the lowest values of C are more common in the group with $C < C_\alpha$, an increase in outsiders will have a smaller positive impact on performance for the *lowest* cost firms (because the lowest cost firms contain the highest proportion with $C < C_\alpha$). We explored this implication by examining separately those firms in the bottom decile (or quartile) of the low information cost group of firms. In unreported regressions, we found that outside directors improved performance less for these very-low-cost firms than for the rest of the low-cost firms, consistent with the model.

[19] 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.

Table 4
Regressions of performance on independent directors without predicted values.

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					
	ΔROA (2)	Δ log(Q) (3)	Stock return (4)	ΔROA (5)	Δ log(Q) (6)	Stock return (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 index	…	…	…	−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

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.

4.2. Robustness

We next report, in Table 5, the results of several robustness exercises. Each column of each panel reports 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 select coefficients.

The regressions in Panels A, B, and C use the individual information cost measures 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% level of significance in all nine cases. The basic patterns are not dependent on a specific information cost measure.

A second issue has to do with our assumption that information costs did not change over the sample period. This assumption is embedded in our empirical model by exclusion of a term for $\lambda\Delta C$ in Eq. (2), and by our normalization of the information cost variables to lie in [0,1]. The regressions in Panels D, E, and F add a term for $\lambda\Delta C$ to the models, and use values of the raw information cost variables that are not normalized to lie in [0,1]. We express the information cost variables as natural logs because the raw variables are right-tailed.[20] The interaction term remains negative and statistically significant for all three regressions in each panel. The change in the information cost variable itself is statistically insignificant in six of nine regressions. The coefficient on change in independent directors is negative simply because the information cost variables are typically negative. The implied marginal effects are qualitatively unchanged: for example, a 10% increase in board independence in Panel D is associated with 1.2% higher ROA for firms at the lowest information cost quartile and 1.4% lower ROA for firms at the highest information quartile; the comparable numbers for Panel E are 1.0% for low cost firms and −1.2% for high cost firms, and for Panel F are 1.1% for low cost firms and −1.2% for high cost firms.[21]

A third 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 G, we consider instead compliance with exchange regulations approved in 2003 that required a majority of outside directors on the board. Approximately 17% of firms were noncompliant according

[20] Specifically, we use the negative of the natural logarithm of number of analysts in Panel D (so that high values correspond to high information costs), the natural logarithm of the dispersion of analyst ROA forecasts in Panel E, and the natural logarithm of mean analyst forecast errors in Panel F.

[21] A related issue concerns the possibility that outside directors may adopt more transparent disclosure policies, and thereby reduce the information cost. See Vafeas (2000) for a discussion, but with negative results. By allowing information costs to change over time, the estimates in Panels D, E, and F partially address this issue, and by using beginning-of-period information cost as the conditioning variable on outsider effectiveness, the estimates in Table 3 would not be biased by such an effect.

Table 5
Alternative regressions of firm performance on board independence using predicted values of independent directors.

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–F, 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 G, 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 H, 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%.

	ΔROA	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 index	−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 index	−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 index	−0.393***	−3.170***	−0.054***
	(0.142)	(0.490)	(0.018)
Panel D: *Information cost measured by number of analysts* (*not normalized*)			
Δ Independent directors	−0.311***	−1.275**	−0.060**
	(0.089)	(0.544)	(0.017)
Δ Independent directors × Information cost index	−0.125***	−0.411**	−0.026***
	(0.033)	(0.195)	(0.006)
Δ Information cost	−2.276***	−5.507*	−0.468***
	(0.469)	(2.744)	(0.107)
Panel E: *Information cost measured by dispersion of analyst forecast* (*not normalized*)			
Δ Independent directors	−0.608**	−4.286***	−0.084**
	(0.255)	(1.197)	(0.038)
Δ Independent directors × Information cost index	−0.077**	−0.530***	−0.012**
	(0.032)	(0.145)	(0.004)
Δ Information cost	−0.146	−1.009	−0.041
	(0.492)	(3.046)	(0.079)
Panel F: *Information cost measured by analyst forecast error* (*not normalized*)			
Δ Independent directors	−0.487**	−3.015***	−0.055*
	(0.228)	(0.742)	(0.027)
Δ Independent directors × Information cost index	−0.065**	−0.377***	−0.009**
	(0.031)	(0.104)	(0.003)
Δ Information cost	−0.350	1.850	−0.014
	(0.339)	(1.948)	(0.057)
Panel G: *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 H: *Δ Board 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)

to both definitions, but 10% of firms were compliant with the audit committee requirement but not with the board majority requirement, and 19% were compliant with the board majority requirement but not 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 G 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 with the audit committee definition from 1999.[22]

A fourth 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% to 55% might matter more than a change from 85% to 95%). The regressions in Panel H 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, zero if the identity of the majority does not change, and −100 if it changes from a majority of outsiders to a majority of insiders.[23] 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% more likely at a noncompliant firm than a compliant firm, distinguishable from zero at better than the 1% level.

The estimates in Panel H 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 the 5% level or better. 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 effects are similar to our previous estimates: for firms in the lowest information cost quartile, a change from insider to outsider control (which happens with a roughly 23.4% probability at noncompliant firms) is associated with a 1.0% increase in ROA, a 6.7% increase in *Q*, and a 3.9% increase in annual stock return. All of these effects are different from zero at the 10% level or better. For firms in the highest information cost quartile, a shift from insider to outsider control is associated with a 1.3% decline in ROA, a 15.4% fall in *Q*, and 2.4% lower annual stock returns. These values are also different from zero at the 10% 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.[24]

5. Other determinants of effectiveness and spurious correlation

This section considers others factors that may be playing a role in outside director effectiveness. The goal is to expand our understanding of when outside directors are effective, and also to investigate if the effects we find are spurious, that is, if the information cost variable is a proxy for some other factor that actually drives the outside director-performance relation.

5.1. Director expertise

A body of empirical research argues that what matters for performance is not the number of outside directors per se, but their qualifications. For example, DeFond, Haan, and Hu (2005) argue that financial expertise is important, and Fich (2005) argues that business knowledge and experience are critical (see Yermack, 2006, for a survey). 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.[25] Between 2000 and 2005, both compliant and noncompliant firms added an average of 0.3 independent directors with academic expertise and 1.0 independent directors 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 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

[22] We focus on the audit committee as the compliance hurdle throughout the paper because that requirement came earlier than the board majority requirement, and had more time to influence behavior. The somewhat weaker results using the board majority requirement as an instrument lends support to the idea that the audit committee requirement had the largest impact during our sample period.

[23] See Brickley, Coles, and Terry (1994, Table 5) for a similar empirical approach in a study of board independence and poison pills.

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

[25] 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,'' ''chief operating officer (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.''

average. These numbers imply that roughly half of the independent directors added at noncompliant firms from 2000 to 2005 were qualified directors.

Table 6 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 the type of qualification that is controlled. One 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 statistically significant in every regression of every panel. Another interesting result is that the director qualifications variables are small in magnitude and can never be distinguished from zero at conventional levels of statistical significance. Our proxies for expertise may be crude, but if taken at face value, the irrelevance of expertise could mean that advising functions are less important than monitoring functions. In any case, Table 6 gives no reason to believe that the observed performance changes are driven by changes in director qualifications rather than changes in director independence.

5.2. Complexity and other information costs

Our information cost variables are intended to capture the cost for outsiders to become informed about the firm, a factor that has been stressed in the recent theoretical literature. Previous empirical studies have focused on

Table 6
Regressions of performance on board independence and director qualifications using predicted values of independent directors.

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 change in independent directors is a fitted value 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. 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. 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 index	−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 index	−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 index	−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 index	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 index	−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 index	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 index	0.060	0.276	0.003
	(0.060)	(0.231)	(0.006)

other information-related variables, with somewhat different motivations. In this section, we allow outsider effectiveness to depend on these additional variables. These augmented estimates, that are freer from endogeneity concerns than previous estimates, allow a broad comparison of the different information proxies that have been used in the literature. The results also provide pointers for the emerging theoretical literature by suggesting what type of information problems seem to be most important in determining board effectiveness.

- *Complexity/scope of operations*: Several papers (e.g., Boone, Field, Karpoff, and Raheja, 2007; Coles, Daniel, and Naveen, 2008) have investigated the role of firm "complexity" on board composition. Those studies argue that complex firms may have a greater demand for outside directors to advise the managers. We follow this literature by proxying for firm complexity with firm size, firm age, and number of segments, and estimate whether the effect of board independence depends on complexity.
- *Intangibility*: 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 assess than assets in place (Smith and Watts, 1992). Similarly, intangible assets are often thought to be difficult to evaluate (Harris and Raviv, 1991). To allow director effectiveness to depend on these hard-to-measure assets, we include the market-to-book ratio and a measure of intangible assets, calculated as one minus the value of plant, property, and equipment (PPE) as a fraction of assets.
- *Fundamental uncertainty*: A final variable is the volatility of stock returns, defined as the standard deviation of monthly returns in 2000. Stock return volatility is commonly used as a measure of fundamental uncertainty (e.g., Litvak, 2007; Boone, Field, Karpoff, and Raheja, 2007). To the extent that a firm's performance is fundamentally uncertain, monitoring may be difficult, and the effectiveness of outside directors may be limited.

The results are presented in Table 7. The control variables are the same as in Table 3, but we only report the coefficients of interest. All information variables are normalized based on percentile rankings to take values between zero and one, like our information cost index, to facilitate comparison of the coefficients.[26]

As can be seen, the analyst-based measure of information cost remains reliably correlated with director performance: all three interaction terms are negative and significant at the 5% level or better. Of the complexity variables, firm age is never statistically significant and firm size is only significant (and marginally so) in the stock return regression. The estimates suggest that outsider effectiveness may depend on number of segments: in the ROA and *Q* regressions, an increase in outside directors is associated with improved performance. This lends some support to the idea that diversified firms may benefit more from outside advice. The evidence on intangibility is also mixed. Outside directors appear to be less effective as the market-to-book ratio increases and as asset intangibility increases, but only the market-to-book coefficients can be distinguished from zero at conventional levels of statistical significance. The finding of consistent negative effects tends to reinforce the message that outsiders are less effective when it is difficult for them to understand the firm's business. The stock return volatility term is positive but significant in only one regression. Overall, the strongest determinants of outsider effectiveness appear to be the information cost index and the market-to-book ratio, both of which proxy for the cost of information.

5.3. Unmeasured SOX effects

Another possibility is that our information cost index is absorbing other regulatory effects stemming from SOX or other concurrent regulations. For example, the 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 performance differences associated with increased board independence in low and high information cost firms because SOX's *disclosure requirements* had a different performance impact on low and high information cost firms.[27] One problem with this story is that firms with high information cost should show the most improved performance when required to increase disclosure, creating a spurious effect that runs in the opposite direction of what we find (that is, biasing our results toward finding that outside directors help high information cost firms). Be that as it may, 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 level of the information cost index will capture any such effects that are conditional on information costs.

Table 8 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 are distinguishable from zero only for Tobin's *Q*. The coefficients associated with independent directors are robust to inclusion of information cost levels. In particular, the key interaction coefficient remains negative and statistically significant in every regression, and the magnitudes of the effects remain nontrivial. For example, an increase of 10% in the percentage of outside

[26] 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; Plant, property, and equipment=Data Item 8/Data Item 6.

[27] 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).

Table 7
Regressions with other information-related variables.

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 change in independent directors is a fitted value from a first-stage regression (unreported) 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. The information cost index combines information on analyst forecasts as described in Section 3. Firm size is the logarithm of the market value of equity. Firm age is years since the firm's first appearance on Compustat with valid assets. Asset intangibility is 1 − PPE. All regressions include industry fixed effects for the 48 Fama-French industries, and the same control variables as in Table 3 (board size, leverage ratio, firm age, and market value of equity). Significance levels are indicated: *=10%, **=5%, ***=1%.

	Δ ROA	Δ log(Q)	Stock return
Δ Independent directors	0.301	3.415***	0.087***
	(0.235)	(0.831)	(0.017)
Δ Independent directors × Information cost index	−0.629**	−4.663***	−0.119***
	(0.192)	(0.634)	(0.019)
Δ Independent directors × Firm size	0.356	1.839	0.053*
	(0.215)	(1.182)	(0.029)
Δ Independent directors × Firm age	−0.132	−0.443	−0.025
	(0.191)	(0.882)	(0.022)
Δ Independent directors × Number of segments	0.199**	1.781***	0.013
	(0.093)	(0.448)	(0.012)
Δ Independent directors × Market-to-book	−0.405**	−5.071***	−0.085***
	(0.176)	(0.880)	(0.023)
Δ Independent directors × Asset intangibility	−0.083	−0.587	−0.021
	(0.120)	(0.373)	(0.014)
Δ Independent directors × Stock return volatility	0.188	0.109	0.037*
	(0.113)	(0.555)	(0.018)
R^2	0.176	0.514	0.417
Observations	757	758	677

Table 8
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 index	−1.335	−31.970***	−0.460
	(2.390)	(9.895)	(0.379)
Δ Independent directors × Information cost index	−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

directors on the board is associated with 1.1% higher ROA in firms with an information cost in the lowest quartile (compared to 1.3% 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% 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.

5.4. Other issues

We explored several other possible confounding factors that we summarize here without reporting the full estimates. One possibility is that the information cost variable captures 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). We considered this possibility by estimating the model on a sample of only old economy firms, and by including a separate interaction term for the change in independent directors and new economy firms. The coefficient on the independence-information cost interaction term remained negative and significant in either approach, suggesting our information cost index is not proxying for new economy firms.

Another possibility is that the information cost variable proxies for overly aggressive accounting. Outside directors might inhibit aggressive accounting, leading to a decline in reported ROA (as well as Q and stock returns if the market underestimates the extent of the accounting problems). To assess this possibility, we estimated regressions with a variable that interacts 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.

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 (although it is not obvious why the impact of outside directors would be dependent on the risk factor). Of course, 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. To explore this issue, we re-estimated the stock return regressions using abnormal returns relative to the CRSP value-weighted index return, and abnormal returns relative to the return on a matched portfolio from a 5×5 size and book-to-market model. The estimates were not different in any important way from those in Table 3. We also estimated the stock return year-by-year to see if the results were 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. The interaction coefficient of interest was negative for all five years and all three returns measures (including raw returns), and statistically different from zero at the 10% level or better in 12 of 15 cases. The effect seemed to be weakest in the years immediately after passage of SOX, consistent with the idea that stock returns are forward-looking and incorporated the effect of SOX relatively quickly.

Table 9
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 column, the dependent variable is the percentage of independent directors. In the second column, the dependent variable is a dummy equal to one if a majority of directors are independent, and the regression is a logit. All regressions include year and industry fixed effects. Standard errors are clustered by firm. Significance levels are indicated: *=10%, **=5%, ***=1%.

	Dependent variable	
	Independent directors (%)	Majority of directors independent
Information cost index	−5.253***	−0.674***
	(1.559)	(0.209)
Market value of equity, log	0.382	0.062**
	(0.232)	(0.030)
Firm age	0.215***	0.026***
	(0.027)	(0.004)
Number of segments	0.839*	0.103
	(0.508)	(0.069)
Market-to-book	0.002**	0.001
	(0.001)	(0.001)
Asset intangibility	−1.159	−0.114
	(2.379)	(0.308)
Stock return volatility	2.603	0.703
	(4.495)	(0.564)
Leverage ratio	0.253	0.012
	(0.234)	(0.025)
R^2	0.211	…
Observations	11,245	11,239

6. 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. Ferreira, Ferreira, and Raposo (2008) report that firms with a high degree of information asymmetry, as measured by informativeness of their stock price, tend to have less independent boards, consistent with the predictions of recent theories and the findings of our paper. As a complement to their evidence, Table 9 reports regressions of board composition on our measure of information cost using the full panel of board composition data from IRRC (1996–2005). Each regression includes our information cost index and a set of variables that is common in the board composition literature (see e.g., Boone, Field, Karpoff, and Raheja, 2007; Linck, Netter, and Yang, 2008).[28] The dependent variable is the percentage of outsiders on the board in the first column and a dummy equal to one if

[28] We also attempted to include the probability of informed trading, as in Ferreira, Ferreira, and Raposo (2008), but data were available for only a small subset of our sample.

the board has a majority of independent directors in the second column. Both regressions include industry and year fixed effects.[29] Standard errors are clustered by firm because we have repeated firm observations in the panel.

The main result from Table 9 is that the coefficient on the information cost index is negative and significantly different from zero in both 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 1, the percentage of independent directors in firms with an information cost in the highest quartile is roughly 2.7% lower than the percentage in firms with an information cost in the lowest quartile. These findings lend additional support for the idea that information cost is important for understanding corporate boards.

7. 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 largely 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. Our main finding is that outside directors do appear to have a material effect on performance, but the direction of the effect depends on how costly it is for those directors to become informed about the firm. 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 suggest 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? Our emphasis on the conditional effectiveness of insiders and outsiders, and our attempt to drill down into the functions of directors, is consistent with an evolution in the literature away from the view that more outsiders are always better, and toward a more textured view that appreciates the strengths and weaknesses of both insiders and outsiders, depending on the firm's environment (e.g., see Coles, Daniel, and Naveen, 2008).

The results point to several conclusions. The finding that exogenous changes in the number of outsiders hurts some firms suggests that some firms keep the number of outside directors low for optimal reasons, and the one-size-fits-all approach of the new board regulations may not be ideal. At the same time, 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 evidence seems to imply that market forces alone are not enough to bring about value maximization in every case. It is beyond the scope of our paper to pinpoint the transaction costs that might be preventing market forces from bringing about efficiency, but the literature on the market for corporate control has identified several candidates, such as free rider problems among shareholders and asymmetric information.[30] 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. In some sense, our findings run against the popular view that boards are largely ceremonial (Mace, 1971). One explanation could be that boards are unimportant for everyday business, but can be critical for important decisions such as hiring and if necessary firing the CEO and approving mergers with other firms, and our estimates are picking up the consequences of those important, episodic decisions. Some existing evidence shows that outsider-dominated boards act differently on these issues than insider-dominated boards. For example, Borokhovich, Parrino, and Trapani (1996) find that outsider-dominated boards are more likely than insider-dominated boards to choose an outsider as a CEO, and several studies find a positive relation between announcement returns and board independence (Byrd and Hickman, 1992; Matsusaka, 1993; Cotter, Shivdasani, and Zenner, 1997). An interesting question for future research is whether board behavior on those decisions depends on the information environment.

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

[29] Year fixed effects are important because of the overall drift toward independent boards. We also estimated (but do not report) regressions that allow the effect of information to vary pre- and post-SOX, and found that information matters less after SOX. This is consistent with the idea that the one-size-fits-all post-SOX regulations are overriding firm-specific factors that would normally influence board composition. We should also note that board independence itself may influence the information cost, which could create a spurious connection between board structure and information conditions, although the magnitude of this effect is unknown.

[30] See Coles, Daniel, and Naveen (2008) for a careful discussion and attempt to address the issue of transaction costs that may prevent firms from fully adjusting the composition of their boards (insider vs. outsider mix) to the static value-maximizing configuration. Our finding of apparently inefficient boards in low information cost firms (where shareholders and others should be able to detect the inefficiency) seems to suggest that transaction costs are significant.

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. The estimates in Section 5 partly allay this concern by showing that the findings are robust to some of the more plausible alternative variables, 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 other unobservable changes in noncompliant firms.[31] The effect we are attributing to changes in independent directors could also include effects from other SOX-related changes. A related concern is that governance mechanisms are evolving during our sample period—firms are changing the use of stock options, the CEO and chair of the board positions are being split, and so on. We do not have a good hypothesis why those innovations would influence noncompliant more than compliant firms, and especially, why the effects of those innovations would vary with the cost of information, but the significant amount of parallel innovation in governance mechanisms other than board composition during our sample period would seem worth keeping in mind.

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[31] Black, Jang, and Kim (2006) describe a similar problem in their study of a policy experiment in Korea.

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