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The determinants of board structure ☆

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Abstract

Using a comprehensive sample of nearly 7,000 firms from 1990 to 2004, we examine the corporate board structure, trends, and determinants. Guided by recent theoretical work, we find that board structure across firms is consistent with the costs and benefits of the board's monitoring and advising roles. Our models explain as much as 45% of the observed variation in board structure. Further, small and large firms have dramatically different board structures. For example, board size fell in the 1990s for large firms, a trend that reversed at the time of mandated reforms, while board size was relatively flat for small and medium-sized firms.

JEL classification: G32; G34; K22

Keywords: Board composition; Board size; Board leadership; Duality; Endogeneity; SOX; Sarbanes-Oxley; Corporate governance

1. Introduction

Corporate board structure and its impact on firm behavior is one of the most debated issues in corporate finance today, yet there is relatively little research on the determinants of board structure. However, the literature is growing—see, for example, Boone, Field, Karpoff, and Raheja (2007), Coles, Daniel, and Naveen (2007), and Lehn, Patro, and Zhao (2004). We complement and extend recent work in several ways. First, we use the most comprehensive sample of any work in this area, composed of nearly 7,000 firms from 1990 to 2004. Our sample includes firms of all sizes, ages, and industries. While examining more specific samples is beneficial along some dimensions, the results may not be generalizable and may potentially miss important cross-sectional determinants of board structure due to the more limited variation in firm characteristics within the smaller samples. Second, we use recent theoretical work in this area to guide our empirical analysis.

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Finally, we examine our results with a variety of estimation methods, including several approaches that account for endogeneity, and find that our results are very robust.

Overall, we find that firms structure their boards in ways consistent with the costs and benefits of monitoring and advising by the board. Importantly, our models explain as much as 45% of the observed variation in board structure. Our evidence does not support the popular notion that smaller, more independent boards strictly dominate alternative board structures. For example, firms with high growth opportunities, high R&D expenditures, and high stock return volatility are associated with smaller and less independent boards, while large firms have larger and more independent boards. High managerial ownership is associated with smaller and less independent boards. Further, boards tend to be more independent if insiders have a greater opportunity to extract private benefits and when the CEO has greater influence over the board. We also find that the determinants of board structure differ between small and large firms. For example, outside director ownership is significantly related to board structure for medium and large firms, but is unrelated to board structure for small firms. In terms of board leadership, our results suggest that the CEO and Chairman of the Board (COB) posts are combined in large firms and when the CEO is older and has had a longer tenure.

Recent regulatory mandates appear to have had an immediate impact on board structure. While board size was falling in the 1990s, mainly for large firms, this trend was reversed after the implementation of the Sarbanes-Oxley Act (SOX) of 2002 and associated changes mandated by the stock exchanges. Further, in line with the fact that the new directives essentially mandated more independent boards, we find that board independence increased substantially from the pre- to post-SOX period.[1] While the economic determinants of board structure are generally similar in the post-SOX period as in the pre-SOX period, there are some differences. For example, the impact of ownership structure on board structure is weaker post-SOX than pre-SOX. One interpretation of this result is that SOX muted the importance of ownership structure in determining board structure. However, it is also consistent with the view that managers with substantial ownership stakes place higher value on outside directors in the post-SOX environment.

We structure our empirical analysis to test existing theoretical work. This leads to some important caveats. First, there is no general equilibrium theory of board structure. Further, individual models are not always consistent with each other, and explanatory variables can sometimes proxy for different things. Thus, individual results are often subject to alternative interpretations. In addition, the theoretical models generally only consider the relation examined under a specific set of circumstances, which may be problematic when many attributes are determined simultaneously (see, e.g., Coles, Lemmon, and Meschke, 2007). In reality, internal governance mechanisms such as board structure are endogenously determined within the broader system of corporate governance. We deal with this problem in several ways, including using simultaneous equations and dynamic panel estimation as robustness checks. Our results are robust to various estimation methods. Finally, we recognize that the theories we test are generally based on the idea that boards are structured to maximize shareholder wealth. We do not directly test alternative views in the paper, and recognize that certain individual findings are potentially consistent with alternative explanations. However, taken as a whole, our results are generally consistent with efficiency explanations of the determinants of board structure.

The rest of the paper is organized as follows. In Section 2, we motivate our research, review the literature, and develop our hypotheses. We describe our data and the sample in Section 3. In Section 4, we provide descriptive evidence on the development of corporate boards during 1990–2004, and empirically test the extent to which recent regulatory mandates affected board structure. In Section 5, we test our hypotheses regarding the determinants of board structure. We provide concluding remarks in Section 6.

2. Background, motivation, and development of hypotheses

State law has historically regulated firm governance, and has given broad deference to business transactions authorized by directors under the legal doctrine of the business judgment rule (Cox and Hazen, 2003, p. 185).

[1]While SOX does not specifically require majority-independent boards, it does mandate that the audit committee be composed entirely of independent directors. The new listing requirements of the NYSE and NASDAQ mandate majority-independent boards. The NYSE also requires entirely independent compensation and nominating/governance committees. The NASDAQ rules are similar, although more flexible, than the NYSE's.

Prior to SOX, the securities laws did not directly address board composition, board size, and director qualifications. In addition, courts have been reluctant to mandate board structure because doing so is difficult (Karmel, 1984). Fisch (1997) interprets this legal flexibility as evidence that it is efficient to allow firms to tailor board structure to the functions that are most important. Despite the absence of legal mandates, however, firms have long been encouraged to increase the independence of their boards. For example, Harold Williams, the SEC Chairman from 1977 to 1981, placed significant pressure on NYSE firms to have a majority of outside directors on their boards.

Scholars have suggested alternative explanations for the determinants of board structure. One possibility is that board structure develops as an efficient response to the firm's contracting environment. Alternatively, board structure does not matter or is the result of, rather than a solution to, agency problems. For example, some argue that boards serve at the pleasure of CEOs, and are ineffective in monitoring and advising (Mace, 1971; Lipton and Lorsch, 1992; Jensen, 1993; Bebchuck and Fried, 2005). The extent to which any of these alternatives explains board structure has policy implications. For example, if boards exacerbate agency problems, regulatory mandates could be beneficial to investors. Alternatively, if regulations force firms toward an inefficient board structure, such mandates could impose deadweight costs on firms and their stakeholders.

Our empirical tests are based on the premise that board structure develops as an efficient response to the firm's contracting environment. However, some of our findings are consistent with other explanations. For example, while a negative relation between managerial ownership and board independence is consistent with the hypothesis that these are substitute governing mechanisms, this relation is also consistent with the hypothesis that powerful managers structure their boards in self-serving ways provided managerial ownership proxies for managerial power. With this in mind, we conclude by examining whether our results, taken as a whole, are generally consistent with the hypothesis that firms structure their boards to mitigate agency conflicts specific to their contracting environment.

2.1. Related literature

Hermalin and Weisbach (1998), Adams and Ferreira (2007), Raheja (2005), and Harris and Raviv (2006) model the theoretical determinants of board structure, specifically the roles of insiders and outsiders. For example, Raheja (2005) argues that insiders are an important source of firm-specific information for the board, but that they can have distorted objectives due to private benefits and lack of independence from the CEO. Compared to insiders, outsiders provide more independent monitoring, but are less informed about the firm's constraints and opportunities. Thus, as the benefits (costs) of monitoring increase, boards will do more (less) monitoring leading to more (fewer) outsiders.

The above models, along with better access to data, have helped stimulate new empirical research. Lehn, Patro, and Zhao (2004) study 81 firms that survived from 1935 to 2000 and find that board size is positively related to firm size and negatively related to growth opportunities, while insider representation is negatively related to firm size and positively related to growth opportunities. Boone, Field, Karpoff, and Raheja (2007) track firms that went public from 1988 to 1992 through their first ten years of existence, and conclude that board structure reflects a firm's competitive environment and managerial team. Gillan, Hartzell, and Starks (2006) and Coles, Daniel, and Naveen (2007) provide complementary evidence on this topic, but their research questions differ from ours. Using more than 2,300 large companies from 1997 to 2000, Gillan, Hartzell, and Starks (2006) find that the strength of the external control market is related to the strength of the board's monitoring capability. Coles, Daniel, and Naveen (2007) study S&P 1500 firms from 1992 through 2001 and show that the market-to-book ratio increases with board size for complex firms (large, diversified, and levered firms) and with the percentage of insiders on the board for firms in which firm-specific knowledge is important.

2.2. Hypotheses

The board of directors has a broad range of responsibilities. The Business Roundtable suggests that the board of directors has five primary functions: (1) select, regularly evaluate, and, if necessary, replace the chief executive officers, and determine management compensation and review succession planning; (2) review and, where appropriate, approve the financial objectives, major strategies, and plans of the corporation; (3) provide

advice and counsel to top management; (4) select and recommend to shareholders an appropriate slate of candidates for the board of directors, and evaluate board processes and performance; and (5) review the adequacy of systems to comply with all applicable laws/regulations (The Business Roundtable, 1990).

For our purposes, and based on theoretical work, we classify the board's activities into two major functions: monitoring and advising (Adams and Ferreira, 2007; Raheja, 2005). Broadly speaking, the monitoring function requires directors to scrutinize management to guard against harmful behavior, ranging from shirking to fraud. The board's advising function involves helping management make good decisions about firm strategy and actions. A firm's optimal board structure is a function of the costs and benefits of monitoring and advising given the firm's characteristics, including its other governance mechanisms.

We test how firm characteristics are related to three measures of board structure—board size, board independence, and board leadership. Our tests are necessarily joint tests of the attributes that we hypothesize are important in determining board structure and the proxies we use to characterize those attributes. Mindful of the limitation of empirical proxies, we rely heavily on theory and established research in our choice of proxies. We define board size as the number of directors on the board, board independence as the proportion of the board composed of non-executive directors (outsiders), and board leadership as whether the CEO is also the COB (which is also referred to as combined leadership or CEO duality).

2.2.1. *Firm complexity and private benefits*

Both the monitoring and advising functions are expected to be related to firm complexity. Fama and Jensen (1983) suggest that corporate boards are "composed of experts." Outside directors, as the trade experts, bring valuable expertise and potentially important connections to the firm. Firms with disparate businesses and geographically dispersed operations or firms with complex operating and financial structures should benefit more from bringing in outsiders with a range of expertise, resulting in larger, more independent boards. Lehn, Patro, and Zhao (2004), Boone, Field, Karpoff, and Raheja (2007), and Coles, Daniel, and Naveen (2007) present similar arguments, which Boone, Field, Karpoff, and Raheja (2007) refer to as the *scope of operations hypothesis*. With respect to private benefits, Adams and Ferreira (2007) and Raheja (2005) show that monitoring optimally increases with the level of private benefits available to managers, leading to more independent boards.

Although monitoring costs naturally increase with a firm's complexity, the benefits from effective monitoring should outweigh the costs on balance (Fama and Jensen, 1983). Therefore, we predict that board size and independence increase in firm complexity and advising benefits, and that board independence increases in private benefits. To proxy for a firm's complexity and advising benefits, we use firm size, the proportion of debt in the capital structure, and the number of business segments (see, e.g., Fama and Jensen, 1983; Booth and Deli, 1999; Bushman, Chen, Engel, and Smith, 2004). Boone, Field, Karpoff, and Raheja (2007) also suggest that complexity increases with firm age. This is likely to be the case in their sample, which consists of IPO firms. However, it is not clear that complexity increases with firm age once a firm is "mature." We include firm age and the square of firm age in our analysis, which allows us to test whether the impact of age on board size is nonlinear. Following Jensen (1986), we proxy for private benefits using free cash flow.

2.2.2. *Costs of monitoring and advising*

Outside directors face information acquisition and processing costs in transforming their general expertise to the specific firm for which they serve as a director. Further, while adding directors adds incremental information, it also increases the costs related to free-rider problems and coordination costs as well as direct costs such as compensation. As Maug (1997) shows, it is not optimal for firms with high information asymmetry to invite monitoring from independent directors because it is costly for the firms to transfer firm-specific information to outsiders. Adams and Ferreira (2007) and Raheja (2005) model board structure and generally suggest that the number of outsiders decreases in the cost of monitoring.

The preceding discussion suggests that board size and independence decrease with the cost of monitoring and advising. Jensen (1993) argues that it is more costly for large boards to monitor growth firms. The same argument could be made for the cost of advising by outsiders. Additionally, Fama and Jensen (1983) note that firms with high stock return volatility are more likely to have specific information unknown to outsiders. Thus, to proxy for monitoring and advising costs, we use the market-to-book ratio (MTB), the level of R&D

spending, and the standard deviation of stock returns. MTB and R&D expenditures are standard measures in the literature to proxy for growth opportunities (see, e.g., Smith and Watts, 1992; Gaver and Gaver, 1993). Following Fama and Jensen (1983), we use the standard deviation of stock returns to proxy for information asymmetry. Since we expect the cost of monitoring and advising to increase in these characteristics, we expect them to be negatively related to board size and independence.

2.2.3. Ownership incentives

Raheja (2005) suggests that boards will be smaller when insiders' and shareholders' incentives are aligned. When such alignment exists, insiders are less likely to take inferior projects reducing the need for outside monitors, resulting in smaller, less independent boards. Raheja also notes that higher ownership by outside directors leads to more benefits of verification, which implies lower verification costs. In her model, the optimal board is large and majority independent when verification costs are low (Raheja, 2005, p. 296, Proposition 6). As verification costs increase, the number of outsiders optimally decreases, reducing coordination costs and partially offsetting the higher verification costs.

We proxy for insider incentive alignment with the percentage of shares held by the CEO, and for outsider incentive alignment with the percentage of shares held by outside directors. We expect board size and independence to be negatively related to CEO ownership and positively related to outside director ownership. This prediction essentially treats ownership structure as exogenous, which is unlikely to be the case. We deal with this concern more fully in Section 5.

2.2.4. CEO characteristics

Hermalin and Weisbach (1998) suggest that board independence decreases in the CEO's bargaining power, and that the CEO's bargaining power efficiently derives from his/her perceived ability. They predict that a firm will add more outsiders to the board following poor performance and that board independence will decline with CEO tenure. Further, they argue that as a CEO approaches retirement, the firm adds insiders to the board as part of the succession process.

In contrast, Raheja (2005) suggests that the number of outsiders increases as the CEO's influence increases. These seemingly different predictions arise from assumptions about what drives CEO bargaining power and influence. Hermalin and Weisbach (1998) argue that bargaining power derives from superior ability, which is consistent with the efficiency argument that good decision makers should have more decision-making power. In contrast, Raheja argues that when CEOs have strong influence it is more difficult for outsiders to overturn poor decisions. Thus, the board needs more outsiders to counterbalance CEO influence.

The above suggests that board independence decreases in the CEO's perceived ability and the imminence of the CEO's retirement, and increases in CEO influence. We proxy for the CEO's perceived ability using past performance and CEO tenure, as suggested by Hermalin and Weisbach (1998). We measure past performance using the average industry-adjusted return on assets over the two years preceding the proxy date. We use CEO age to proxy for the length of time to retirement, as well as an indicator variable for CEOs who are older than 60. We proxy for CEO influence using a dummy variable that equals one when the CEO is also the COB.[2]

2.2.5. Board leadership

Unlike board size and independence, there is limited theoretical work modeling the determinants of board leadership. However, there are several empirical papers that offer specific predictions regarding board leadership. Brickley, Coles, and Jarrell (1997) argue that CEOs are awarded the COB title as part of the promotion and succession process. Consistent with this incentive argument, Brickley, Coles, and Jarrell (1997) find that firms where the CEO is separate from the COB are usually transitioning to new CEOs—they later award successful CEOs the COB title. Brickley, Coles, and Linck (1999) also show that successful CEOs are more likely to remain on the board as the COB after they retire. Additionally, Brickley, Coles, and Linck

[2]In our empirical specification we use the lagged value of CEO duality instead of incorporating the contemporaneous value, since CEO duality and board independence can be determined simultaneously. We discuss other methods for dealing with endogeneity later in the paper.

(1999) note that CEOs have unparalleled firm-specific knowledge. This would be most important to an information-sensitive firm, since the CEO will likely have valuable firm-specific knowledge that is important for the success of the firm.

Thus, we predict that the probability that the CEO and COB posts are combined increases in the imminence of the CEO's retirement, the CEO's perceived ability, and information asymmetry. We also include CEO age to test the succession planning theory. To proxy for CEO ability, we use firm size, CEO tenure, and return on assets. To capture the value of the CEO's firm-specific information, we use the market-to-book ratio, R&D expenditures, and the standard deviation of stock returns (as in our board size and independence models). Fama and Jensen (1983) argue that specific information is detailed information that is costly to transfer. The capital structure literature has long argued that growth firms or firms with volatile stocks have more specific information unknown to outsiders (Harris and Raviv, 1991; Graham and Harvey, 2001). We expect all these characteristics to be positively related to the CEO/Chair duality dummy, which equals one if the CEO and COB positions are combined.

2.3. The Sarbanes–Oxley act of 2002

The models from which we derive the above hypotheses are generally based on value-maximizing behavior. Thus, evidence supporting the above hypotheses would suggest that, on average, firms choose board structure to maximize the effectiveness of the board given their specific contracting needs. However, various constraints can prevent boards from moving towards their optimum.[3] Regulations that force a firm away from its chosen board structure implicitly assume that firms are not at their optimum. If regulation is effective at "fixing" the problem of sub-optimal boards, then we would expect the economic relations between firm characteristics and board structure to be stronger post-SOX than they were pre-SOX. By "stronger" relations, we mean from an economic, as opposed to a statistical sense. For example, if CEO ownership leads to entrenchment and an entrenched CEO appoints more insiders to the board pre-SOX, then we would observe a negative relation between CEO ownership and board independence. Post-SOX, the negative statistical relation between CEO ownership and board independence would weaken as firms are "forced" to adopt more independent boards. While this is a statistically weaker relation post-SOX, it is a stronger relation in the sense that the board is moving toward better governance. Post-SOX board determinants that are more consistent with theoretical predictions than pre-SOX would be consistent with SOX "fixing" some governance problems, and vice versa.

By contrasts, if SOX drives firms away from their internal optimum, then we would expect these relations to weaken. Alternatively, SOX might have fundamentally changed the corporate governance environment, resulting in a regime shift. As firms move from the pre- to post-SOX contracting environment, the relations between board structure and firm characteristics can shift from one equilibrium to another. However, we would still expect the traditional relations to weaken under this scenario. Of course, it is also possible that the regulations have no effect, in which case we would observe no difference between the pre- and post-SOX periods. These issues are very difficult to disentangle empirically, and it is beyond the scope of this paper to comprehensively assess the impact of SOX on corporate boards.

3. Sample selection and data

We start with all firms in the Disclosure database between 1990 and 2004. From this population, we select all firms with information available on board size and composition for more than two years. We exclude firms with fewer than three board members to eliminate likely data entry errors. We then match this sample to the Center for Research in Security Prices (CRSP) and Compustat, and restrict the sample to unregulated US firms (excluding financial and utility companies) with annual financial data and monthly stock returns for the

[3]This situation would be one explanation for why Coles, Daniel, and Naveen (2007) are able to observe a correlation between board structure and firm value. If some firms are not at their optimum, possibly due to transaction costs, then we could detect a relation between performance and board structure—we would expect those with more optimal structures to perform better.

Table 1
Sample selection

This table reports the time series of the sample. We start with all firms in the Disclosure database from 1990 to 2004. We restrict the sample to those firms with information on board size and board composition for more than two years in Disclosure. Next, we match these firms to Compustat and CRSP. The table reports the final sample firms for each proxy year after excluding (1) foreign firms, (2) regulated firms (financial and utility firms or equivalently firms with the first two-digit SIC codes being 49 and 60–69), and (3) firms that are missing information on total assets or monthly stock returns.

Year	*N*	Percent
1990	2,590	4.8
1991	2,821	5.3
1992	3,031	5.7
1993	3,162	5.9
1994	3,648	6.8
1995	3,878	7.2
1996	3,725	7.0
1997	4,146	7.7
1998	4,235	7.9
1999	4,379	8.2
2000	4,201	7.8
2001	3,943	7.4
2002	3,464	6.5
2003	3,609	6.7
2004	2,770	5.2
Total	53,602	100.0
Total unique firms	6,931	

fiscal year immediately preceding the proxy statement dates. If Disclosure does not report a proxy date, we assume that the proxy month is four months after the fiscal-year-end month.[4] Table 1 reports the time series of the sample. The sample includes more than 53,000 firm-years representing almost 7,000 unique firms from 1990 through 2004.

Table 2 reports descriptive statistics for all sample firms on key firm, board, and ownership variables. All data are for, or as of, the year-end prior to the proxy date. The mean (median) value of total book assets is \$1.58 billion (\$127 million), and the mean (median) market value of equity is \$1.62 billion (\$106 million). The average firm in our sample is substantially smaller than the sample firms used by Lehn, Patro, and Zhao (2004), and substantially larger than those used by Boone, Field, Karpoff, and Raheja (2007), who report \$24 billion and \$150 million in mean total assets, respectively. Mean (median) MTB is 2.29 (1.47). Mean free cash flow (FCF) is negative, at −1.4% of total assets, but the median is 6.2%, suggesting some extreme values. Further analysis (not reported in the table) shows that the negative mean FCF is driven by small-firm outliers. For example, the value-weighted (by market value of equity) mean FCF is about 9%. The mean (median) number of business segments for our sample firms is 1.7 (1.0). The mean (median) firm age is 13 (8), which is similar to the mean (median) age for the CRSP universe of 11 (7). In contrast, Lehn, Patro, and Zhao (2004) report a mean firm age of 65 and Boone, Field, Karpoff, and Raheja (2007) report a mean age of five. Both the mean and median CEO age is 53, which is consistent with Faleye (2007) and Fee and Hadlock (2004); both studies report a mean CEO age of 55. We only have CEO tenure data for about 20% of our sample, generally the larger firms. For these firms, the average CEO has been on the job for seven years.

[4]For any given year, Disclosure provides proxy dates for more than 70% of the firms. To ascertain the accuracy of this information, we manually check the proxy statements for S&P 500 firms (excluding financial and utility firms) in 1994. We find that the proxy dates reported in the Disclosure database are actually the mailing dates of the proxy statements. More precisely, the reported proxy month is the proxy mailing month for 86% of the sample. In addition, the reported proxy month is within one month of this date for 97% of the sample. We also find that most firms hold annual meetings approximately five months after the fiscal-year-end month.

Table 2
Descriptive statistics

This table reports summary statistics on key firm, ownership, and board variables. The sample includes 6,931 firms covering 53,602 firm-years over the period 1990–2004. All data are for, or as of, the year-end prior to the proxy date. We obtain board and ownership information from Disclosure and financial data and stock returns from Compustat and CRSP, respectively. Panel A reports mean and median values of firm characteristics. *Assets* is the book value of total assets adjusted for inflation. *MVE* is the market value of equity adjusted for inflation. *MTB* is the market-to-book ratio of equity. *FCF* is free cash flow scaled by total assets, following Lehn and Poulsen (1989). *RETSTD* is the standard deviation of the monthly stock return over the fiscal year immediately proceeding the proxy date. *Performance* is the average annual industry-adjusted earnings before interest and taxes scaled by total assets over the two-year period preceding the proxy date. *Debt* is total long-term debt divided by total assets. *Segments* is the number of business segments. *FirmAge* is the number of years since the firm first appeared on CRSP. *CEO_Age* is the CEO's age and *CEO_Tenure* is the number of years the CEO has been CEO. Panel B reports shares owned by each group divided by total shares outstanding for the firm. *Aggregate Director_Own* represents the percent of firm's shares held by all non-executive directors and *Director_Own* represents the average amount held by each non-executive director. *Blockholder_Own* is the percent of firm's shares held by 5% blockholders. Panel C reports mean and median values of board characteristics. *Board Size* is the number of directors on the board, *%Insiders* is the proportion of the board composed of executive directors, *Insider-dominated* is a dummy variable that equals one if 50% or more of the board members are insiders (executive directors), and *CEO_Chair* indicates when the CEO is also the Chairman of the Board (COB).

Variable	*N*	Mean	Median
Panel A-Firm Characteristics			
Assets ($millions)	53,602	1,580.6	127.4
MVE ($millions)	53,474	1,623.7	105.5
MTB	53,473	2.29	1.47
FCF	49,174	−0.014	0.062
RETSTD	53,602	0.170	0.141
Performance	53,502	−0.020	0.011
Debt	52,225	0.438	0.409
Segments	53,360	1.7	1.0
FirmAge	53,602	12.9	8.0
CEO_Age	50,596	53.2	53.0
CEO_Tenure	11,318	7.1	5.0
Panel B—Ownership (*in percent*)			
Officers_Own	48,161	19.45	10.78
CEO_Own	31,591	6.07	0.97
Aggregate Director_Own	48,161	1.74	0.11
Director_Own	47,589	0.44	0.02
Institution_Own	48,113	34.16	29.53
Blockholder_Own	48,242	40.08	36.84
Panel C—Board structure			
Board Size	53,602	7.5	7.0
% Insiders	53,602	0.343	0.333
Insider-dominated	53,602	0.217	0.000
CEO_Chair	52,567	0.583	1.000

Panel B summarizes ownership characteristics. Results are comparable with those reported in other studies, albeit with some differences that are likely due to the large number of small firms in our sample. CEOs in our sample hold 6% of their firm's shares, on average (median = 1%), while outside directors as a whole hold on average just under 2%. This amounts to about 0.44% per outside director, on average (median = 0.02%).

Panel C reports summary statistics on board structure. Mean (median) board size is 7.5 (7), compared to the general observation of 11–12 for large firms (Farrell and Hersch, 2005; Yermack, 2004). The mean proportion of executive directors (insiders or officers) on the board is 34.3%, and 21.7% of the sample firms have an insider-dominated board. Finally, the CEO is also the COB in 58.3% of the sample firms. Our board characteristics are dramatically different from those in the Lehn, Patro, and Zhao (2004) and Boone, Field, Karpoff, and Raheja (2007) samples. The former has mean board size ranging from 11 to 13 in the 1990s, and a mean proportion of insiders ranging from 25.6% in 1990 to 16.2% in 2000. The latter study reports mean

Table 3
Board characteristics by firm size

The table reports summary statistics for board structure across small, medium, and large firms. Panel A includes all observations, and Panel B includes only sample observations from every third year (1992, 1995, 1998, 2001, and 2004). We form our size groups by ranking the sample firms into quintiles based on their market value of equity each year. We label the first quintile firms "small," quintiles two through four "medium," and quintile five "large." The mean (median) market value of equity for small, medium, and large firms is $9.6 ($8.1) million, $189.4 ($105.4) million, and $7.54 ($2.07) billion, respectively. We test the statistical significance of the differences in each board characteristic between (1) small and medium, (2) medium and large, and (3) large and small firms. All means are significantly different from each other in each of these comparisons at the 1% level (to save space, we do not report the statistics in the table). *Board Size* is the number of directors on the board, *%Insiders* is the proportion of the board composed of executive directors, *Insider-dominated* is a dummy variable that equals one if 50% or more of the board members are insiders (executive directors), and *CEO_Chair* indicates when the CEO is also the Chairman of the Board (COB).

Variable	Small firms			Medium firms			Large firms		
	N	Mean	Median	*N*	Mean	Median	*N*	Mean	Median
Panel A—Full sample (1990–2004)									
Board size	10,687	5.9	6.0	32,095	7.2	7.0	10,692	10.0	10.0
% Insiders	10,687	0.418	0.400	32,095	0.343	0.333	10,692	0.267	0.250
Insider dominated	10,687	0.360	0.000	32,095	0.212	0.000	10,692	0.090	0.000
CEO_Chair	10,361	0.514	1.000	31,540	0.564	1.000	10,542	0.710	1.000
Panel B—Includes only observations from every third year (1992, 1995, 1998, 2001, 2004)									
Board size	3,558	6.0	6.0	10,686	7.3	7.0	3,561	10.0	10.0
% Insiders	3,558	0.411	0.400	10,686	0.340	0.333	3,561	0.267	0.250
Insider dominated	3,558	0.340	0.000	10,686	0.201	0.000	3,561	0.087	0.000
CEO_Chair	3,447	0.513	1.000	10,532	0.562	1.000	3,518	0.705	1.000

board size of 6.2 in the IPO year and 7.5 ten years after the IPO. The mean proportion of insiders ranges from 38% in the IPO year to 26% ten years after the IPO.[5]

Table 3 reports summary statistics for board structure across small, medium, and large firms. We report differences across size groups because we are interested in the differences between small and large firms given the disproportionate attention focused on large firms, and the concerns about whether recent regulations disproportionately affect small firms. This also allows us to address the robustness of our results and the results reported in the existing research, which tends to examine specific samples of firms with less heterogeneity in size. We form our size groupings by ranking the sample firms into quintiles based on their market value of equity each year. We label the first quintile firms "small," quintiles two through four "medium," and quintile five "large." The mean (median) market value of equity across all years for small, medium, and large firms is $9.6 ($8.1) million, $189.4 ($105.4) million, and $7.54 ($2.07) billion, respectively. We include more firms in the middle category to highlight the differences between the largest and smallest firms. Results are qualitatively similar for other ranking methods.

Table 3 shows that board structure varies dramatically across our size groups. Indeed, *t*-tests suggest that the differences between (1) small and medium firms, (2) medium and large firms, and (3) small and large firms are statistically different from zero (p-value < 0.01) for each board characteristic (for brevity, the test statistics are not reported in the table). Small firms have the smallest boards with the most insiders and are least likely to have combined leadership. Results are similar when we include only observations from every third year (Panel B). Not reported in Table 3, we find that in 2000, prior to the recent rule changes, the proportion of

[5]In unreported analysis, we test whether mean board size, proportion of insiders, and CEO duality of the Lehn, Patro, and Zhao, and Boone, Field, Karpoff, and Raheja samples are statistically different from those of our sample. We assume firms with age greater than 60 years were part of the former sample and firms with age less than ten years were part of the latter sample (the sample averages we obtain for these subsamples are similar to those reported by Lehn, Patro, and Zhao, and Boone, Field, Karpoff, and Raheja, respectively). The differences in board characteristics between our proxy for the Lehn, Patro, and Zhao, and Boone, Field, Karpoff, and Raheja samples and the part of our sample that does not include those samples were significantly different from zero in all cases.

insider-dominated boards is 31% for small firms and 9% for large firms. This suggests that small firms are more likely to be affected by recent rule changes, which mandate essentially majority independent boards.

4. The trend in board structure from 1990 through 2004

There is ample anecdotal evidence that boards have undergone substantial changes due to forces like shareholder activism and technology advancement (see, e.g., Hamilton, 2000; "Board Trends 1970s to the 1990s: The More Things Change …," February 26, 1999, *Directors & Boards*). However, the literature lacks broad-sample evidence on the development of boards, and very little research examines post-SOX data.[6] Therefore, we provide descriptive evidence on the development of boards from 1990 to 2004 using our comprehensive dataset. We are particularly interested in the differences between small and large firms; thus, we separately report the trends by size groupings.

Fig. 1 shows the time trends of board independence, board size, and board leadership from 1990 to 2004. Panel A reports that large firms have fewer insiders on the board than do medium and small firms. All three groups show a downward trend in the percentage of insiders on the board, with small firms exhibiting the largest decrease. Small firms have the highest percentage of insiders on the board in 1990. This number decreases from about 46% in 1990 to about 34% in 2004. For large firms, this ratio drops from about 28% in 1990 to 24% in 2004. Panel B, which graphs the proportion of insider-dominated boards, shows a similar, albeit more pronounced, trend. Not surprisingly, given the mandates of SOX and the related rule changes by the NYSE and NASDAQ, few firms had insider-dominated boards by 2004. Both panels suggest that the trend toward independence pre-dated SOX; further, the most dramatic impact appears to be with small firms.[7]

Panel C shows the time trend in board size. Consistent with other studies, larger firms have larger boards. Further, the figure suggests a general decline in board size from 1990 to the late 1990s, although the trend appears most dramatic for the largest firms. We conjecture that large firms exhibit the biggest decline partially because they are subject to more intense scrutiny from institutional investors, who have been pushing for smaller boards. For example, Wu (2004) reports that CalPERS is more likely to publicly name firms that have more than 13 board members in their poor governance list. After about 1997, board size remains relatively flat for a couple of years, at which point it begins an upward trend. These increases in board size are significantly different from zero at the 1% level for medium and large firms, but are not statistically significant for small firms. One plausible explanation for the board size increase is that firms added independent directors in order to comply with the new independence requirements, as opposed to dropping insiders. It is also possible that the board's job became more complex in the wake of the new rules.

Fig. 1, Panel D, shows the time trend in board leadership. As with board size and independence, firm size appears to be an important determinant of whether a firm has a combined leadership structure. However, there does not appear to be a strong time trend in board CEO/COB duality. This suggests that calls for splitting the two titles have had relatively little effect, on average.

5. Determinants of board structure

5.1. Research design

Hermalin and Weisbach (1998) suggest that board structure is relatively persistent, raising concerns about the independence of the year-to-year firm-level observations in our dataset. In addition, board size, independence, and leadership are likely to be endogenously determined. Our research design uses several approaches to address these concerns. First, we estimate robust standard errors incorporating firm-level clustering, and only include observations from every third year (1992, 1995, 1998, 2001, and 2004) for our

[6]Chhaochharia and Grinstein (2004) have some post-SOX data in their sample. They examine changes in board structure using data from 1997, 2000, and 2003 for S&P 1500 firms. Linck, Netter, and Yang (2007) provide a comprehensive analysis of the impact of SOX on corporate boards.

[7]Linck, Netter, and Yang (2007) show that although some board changes—such as the increase in board independence—began before SOX, SOX appears to have accelerated the trends.

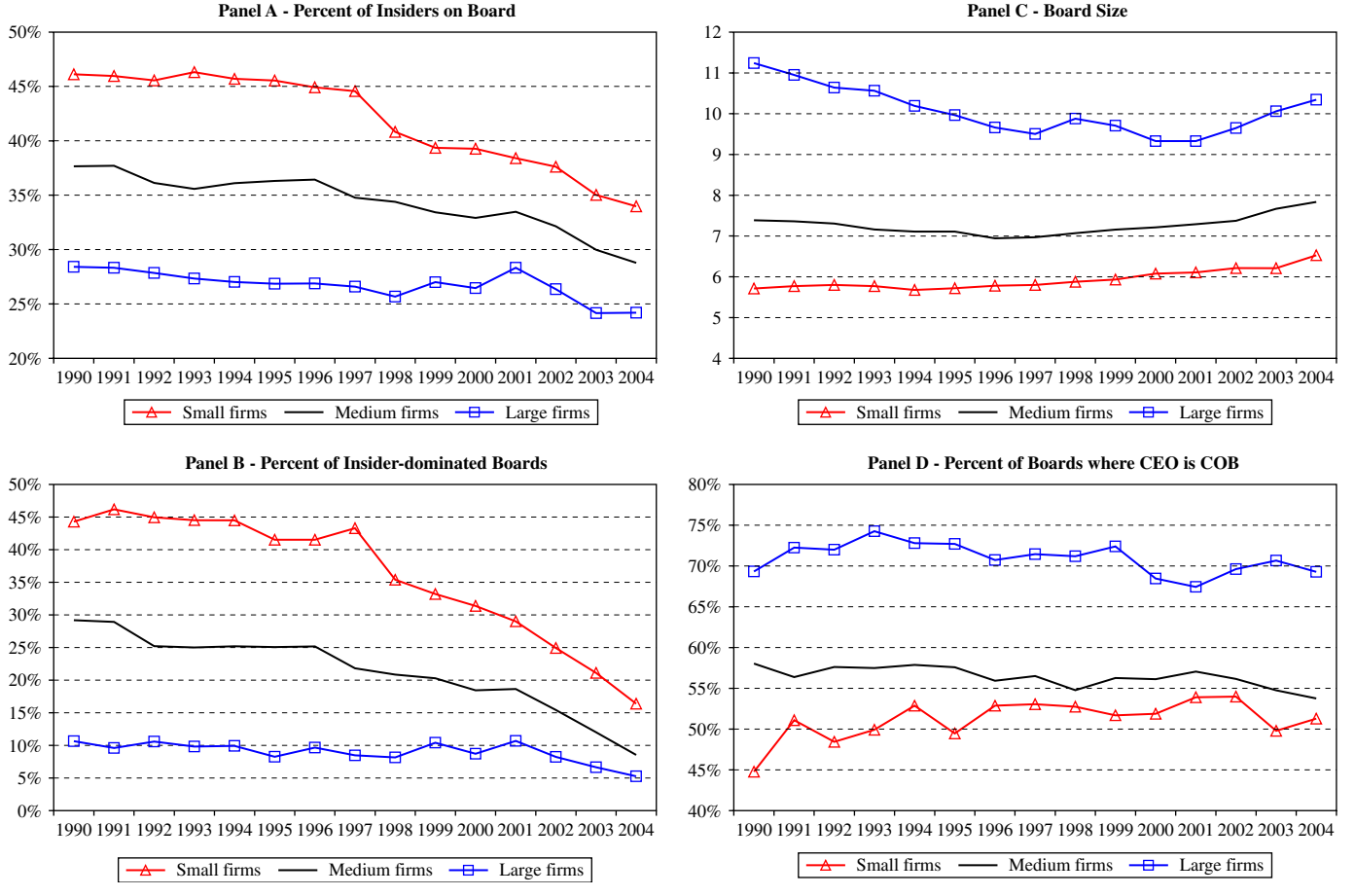

Fig. 1. Board Structure Trends: 1990–2004. The sample includes 6,931 unique firms covering 53,602 firm-years over the period 1990–2004. We form the size groups by ranking the firms into quintiles based on their market value of equity each year. We label the first quintile firms "small," quintiles two through four "medium," and quintile five "large." The mean (median) market value of equity for small, medium, and large firms is $9.6 ($8.1) million, $189.4 ($105.4) million, and $7.54 ($2.07) billion, respectively. Panel A reports the percent of insiders (executive directors) on the board, Panel B reports the percent of boards that are insider dominated (more than 50% board members are insiders), Panel C reports average board size, and Panel D reports the percentage of boards where the CEO is also the Chairman of the Board (COB).

statistical tests. (In unreported results, we estimate the same models including all available data (annual data from 1990 to 2004). The results are similar except that, as expected, the standard errors are generally smaller.) To reduce endogeneity problems, we include both industry and year fixed effects in our models, examine the robustness of our results after including lagged values of our dependent variables, and estimate our models in a simultaneous equations framework. Our OLS specification, while based on existing theory, implicitly assumes strict exogeneity. This assumption states that the errors are strictly independent of all past and future values of the independent variables (see Engle, Hendry, and Richard, 1983). While it might be reasonable to assume that errors and independent variables are independent within the same period, the same might not be true for all past and future values. For example, past board structure can affect current performance. Thus, we also estimate our models with a dynamic panel data estimation procedure that only assumes weak exogeneity (see Engle, Hendry, and Richard, 1983). Weak exogeneity allows the explanatory variables to be affected by past and current innovations in board structure; in other words, they are only assumed to be independent of all future innovations in board structure.This does not mean that the firm or market does not adjust for the firm's *expected* board structure. It simply means that it does not adjust for *unexpected* innovations to board structure.[8] Lastly, while some of our variables are subject to outlier concerns (e.g., MTB, free cash flow), we believe that our large sample mitigates these problems. However, for robustness, we replicate our results via an iteratively re-weighted least squares procedure (IRLS), the results of which do not alter our conclusions.[9]

5.2. Determinants of board structure

This section reports the results from tests of our hypotheses on the determinants of board structure. Our specifications are as follows.

$$\begin{aligned} BoardSize = {} & \alpha + \beta_1 LogMVE + \beta_2 Debt + \beta_3 LogSegments + \beta_4 FirmAge \\ & + \beta_5 FirmAge^2 + \beta_6 MTB + \beta_7 R\&D + \beta_8 RETSTD + \beta_9 CEO\_Own \\ & + \beta_{10} Director\_Own + \text{Industry Dummies} + \text{Year Dummies} + \varepsilon \end{aligned} \tag{1}$$

$$\begin{aligned} BoardIndep = {} & \alpha + \beta_1 LogMVE + \beta_2 Debt + \beta_3 LogSegments + \beta_4 FirmAge \\ & + \beta_5 FirmAge^2 + \beta_6 MTB + \beta_7 R\&D + \beta_8 RETSTD + \beta_9 CEO\_Own \\ & + \beta_{10} Director\_Own + \beta_{11} FCF + \beta_{12} Performance + \beta_{13} CEO\_Age \\ & + \beta_{14} lag(CEO\_Chair) + Industry\ \ Dummies + Year\ \ Dummies + \varepsilon \end{aligned} \tag{2}$$

$$\begin{aligned} BoardLeadership = {} & \alpha + \beta_1 LogMVE + \beta_2 MTB + \beta_3 R\&D + \beta_4 RETSTD \\ & + \beta_5 Performance + \beta_6 CEO\_Age + \beta_7 CEO\_Tenure \\ & + Industry\ \ Dummies + Year\ \ Dummies + \varepsilon \end{aligned} \tag{3}$$

where MVE = Market value of equity adjusted for inflation
$Debt$ = Long-term debt/Total assets
$Segments$ = Number of business segments
$FirmAge$ = Number of years since the firm was first listed on CRSP
MTB = Market value of equity/Book value of equity
$R\&D$ = R&D expenditures/Total assets (if missing, set to zero)
$RETSTD$ = Standard deviation of monthly stock returns over the 12 months in the preceding fiscal year.
CEO_Own = Percent of firm's shares held by the CEO
$Director\_Own$ = Average percent of firm's shares held by each non-executive director

[8] See Wintoki, Linck, and Netter (2007) for a detailed discussion of this methodology as it relates to corporate governance research.

[9] The ILRS procedure essentially deals with outliers by reducing the weight on observations that have larger residuals, iteratively performing weighted least squares estimations until it achieves "95% Gaussian efficiency" (Hamilton, 2003, p. 196).

FCF = Free cash flow = operating income before depreciation minus total income taxes, change in deferred taxes, interest expense, preferred dividends, and dividends on common stock/Total assets (from Lehn and Poulsen, 1989).
Performance = Average annual industry-adjusted return on assets over two years preceding the proxy statement date
CEO_Age = CEO's age
CEO_Tenure = Number of years that the CEO has served as CEO.

Table 4 reports the results from estimating Eqs. (1)–(3). Our regressions only include observations from years 1992, 1995, 1998, 2001, and 2004. Thus, lagged values refer to the value from three years earlier. In the board size regression, firm size, debt, the number of business segments, and firm age are all positive and significant. This is consistent with our hypotheses, which predict that board size and independence increase in firm complexity and advising benefits. The negative coefficient on the square of firm age suggests that the impact of age on board size increases at a decreasing rate. This is as predicted since complexity is unlikely to increase at the same rate for young firms as for mature firms. Our hypotheses also predict that board independence increases in the availability of private benefits. Consistent with this, we find that board independence increases in free cash flow, our proxy for the magnitude of private benefits.

We proxy for monitoring and advising costs using the market-to-book ratio (MTB), R&D expenditures, and the standard deviation of monthly returns, and predict that board size and independence decrease in these attributes. MTB and the standard deviation of stock returns are both negatively and significantly related to board size, and MTB is negatively and significantly related to board independence. R&D expenditures are not significantly related to board size and are positively related to board independence, which is inconsistent with our predictions. Overall, the results provide some, albeit not uniform, support for the hypothesis that board size and independence decrease in monitoring and advising costs.

We proxy for insider incentive alignment with the percentage of shares held by the CEO, and for outsider incentive alignment with the average percentage of shares held by each of the firm's outside directors. CEO ownership is significantly negative, consistent with the hypothesis that board size and independence decrease in insider incentive alignment. The coefficient on outside director ownership is negative, inconsistent with our hypothesis that board size and independence increase in outsider incentive alignment but consistent with the notion that fewer outside monitors are needed when each director has stronger incentives to monitor. In unreported results, we find that aggregate outside director ownership is positively related to board size and independence. However, this finding appears to be driven by the purely mechanical relation between the number of directors and aggregate ownership of those directors (we thank an anonymous referee for pointing this out).

Performance is negatively related to board independence, consistent with Hermalin and Weisbach's (1998) bargaining hypothesis, which suggests that firms add outsiders to the board following poor performance. Also, firms with older CEOs have more insiders on the board, consistent with the hypothesis that, as part of the succession planning process, firms add insiders to the board as the CEO approaches retirement. In unreported results, we replace CEO age with a dummy variable that equals one if the CEO is 60 or older to proxy for CEOs who are near retirement. As expected, this variable is negative and significant (p-value < 0.001).[10] We also find that board independence is higher when the CEO was also the COB in the prior period, and decreases in CEO ownership, consistent with the hypothesis that board independence increases in CEO influence and decreases in CEO incentive alignment.

We predict that firms are more likely to have a combined leadership structure when the CEO nears retirement and has higher perceived ability, and when information asymmetry is high. We define the board leadership dummy as one when the CEO is also the COB, and find that it is positively related to firm size, CEO

[10]We do not include CEO tenure in our reported results because we only have data on CEO tenure for a small portion of our sample. However, in unreported results, we estimate a model identical to the board independence model in Table 4 adding CEO tenure. The results are similar except that the coefficients of free cash flow and performance are no longer statistically significant. The reduced power is likely due to the reduced sample size as well as reduced cross-sectional variation since the firms for which we have CEO tenure are a non-random subset of our sample—they are disproportionately large firms.

Table 4
Determinants of board structure

The table reports results from regressing board size, board independence, and board leadership on various firm characteristics. The sample used in these regressions only includes observations from every third year (1992, 1995, 1998, 2001, and 2004). We estimate board size and independence regressions via OLS, and board leadership regressions via logistic regressions. *LogMVE* is the logarithm of market value of equity. *Debt* is total long-term debt over total assets. *LogSegments* is the logarithm of number of business segments. *FirmAge* is the number of years since the firm first appeared on CRSP. *MTB* is the market-to-book ratio of equity. *R&D* is R&D expenses over total assets. *RETSTD* is the standard deviation of the monthly stock return over the fiscal year immediately proceeding the proxy date. *CEO_Own* is the percent of shares held by the CEO. *Director_Own* is the average percent of firm's shares held by non-executive directors. *FCF* is free cash flow scaled by total assets, following Lehn and Poulsen (1989). *Performance* is the average annual industry-adjusted earnings before interest and taxes scaled by total assets over the two-year period preceding the proxy date. *CEO_Age* is the CEO's age. *CEO_Tenure* is the number of years the CEO has been CEO. *Lag(CEO_Chair)* is a dummy that equals one if the CEO is also the Chairman of the Board (COB) the previous period. The table reports the sign predicted by our hypotheses, the coefficient estimate, and the *p*-value based on robust standard errors that incorporate firm-level clustering.

Variable	Board size		Board independence		Board leadership	
	Prediction	Coeff (*p*-value)	Prediction	Coeff (*p*-value)	Prediction	Coeff (*p*-value)
LogMVE	(+)	0.524[a] (<0.001)	(+)	0.017[a] (<0.001)	(+)	0.241[a] (<0.001)
Debt	(+)	0.685[a] (<0.001)	(+)	0.025[a] (<0.001)		
LogSegments	(+)	0.287[a] (<0.001)	(+)	0.010[a] (0.006)		
FirmAge	(+)	0.053[a] (<0.001)	(+)	0.001[a] (0.001)		
FirmAge^2	(−)	−0.00028[a] (0.001)	(−)	−0.00001 (0.295)		
MTB	(−)	−0.083[a] (<0.001)	(−)	−0.004[a] (<0.001)	(+)	−0.038 (0.124)
R&D	(−)	−0.081 (0.354)	(−)	0.034[b] (0.039)	(+)	−0.885 (0.271)
RETSTD	(−)	−0.937[a] (<0.001)	(−)	−0.009 (0.623)	(+)	0.324 (0.642)
CEO_Own	(−)	−2.182[a] (<0.001)	(−)	−0.139[a] (<0.001)		
Director_Own	(+)	−3.940[a] (0.005)	(+)	−0.529[a] (<0.001)		
FCF			(+)	0.029[a] (0.009)		
Performance			(−)	−0.020[c] (0.083)	(+)	−0.051 (0.896)
CEO_Age			(−)	−0.001[a] (0.001)	(+)	0.066[a] (<0.001)
CEO_Tenure					(+)	0.066[a] (<0.001)
Lag(CEO_Chair)			(+)	0.013[a] (<0.001)		
Industry dummies		Yes		Yes		Yes
Year dummies		Yes		Yes		Yes
N		10,636		8,840		3,610
Model *p*-value		(<0.001)		(<0.001)		(<0.001)
R^2/Psuedo R^2		0.441		0.170		0.116

a, b and c denote significance at the 1%, 5%, and 10% level, respectively.

age, and CEO tenure. This is consistent with the notion that firms award high-ability CEOs the COB title, as well as with succession planning arguments. None of our proxies for information asymmetry are significantly related to the duality dummy; thus, our results do not support the hypothesis that a combined leadership structure is important for firms with high information asymmetry.

Overall, our models explain from 12% to 44% of the variation in board structure. This implies that models based on the tradeoffs between monitoring and advising costs and benefits explain a significant proportion of the variation in board structure.

5.3. Robustness checks

In this section, we perform a series of additional tests to deal with several economic and econometric concerns. These tests include principal components analysis, an examination of board determinants across firm size, and various techniques to control for endogeneity.

5.3.1. Principal components analysis and instrumental variables

Table 4 includes several variables to proxy for complexity and the costs of monitoring and advising. In this section, we combine these proxy variables using principal components analysis. We create two new proxy variables, COMPLEX and MONCOSTS. COMPLEX is the principal factor considering the information contained in debt, the log of the number of business segments, and the log of firm age. We include the log of firm age to account for the nonlinearity of firm age. This is preferable to using firm age and firm age squared in our factor analysis because our predicted coefficient on firm age is opposite to that of the other factors, and we are not concerned about specifically testing for nonlinearity here. MONCOSTS is the principal factor considering the information contained in MTB, R&D spending, and the standard deviation of monthly stock returns. Since these measures capture the commonality of the respective variables, they might be better proxies for the underlying information that we are trying to capture. In addition, replacing six explanatory variables with two makes our exposition of the results clearer. However, in all cases, we also estimate our models using the individual variables, with no effect on our conclusions.

In unreported analysis, we replicate Table 4 except that we include the principal factors COMPLEX and MONCOSTS in place of the specific variables used in Table 4. We also include lagged values of the other board attributes as instrumental variables to mitigate endogeneity concerns. The results are similar to those in Table 4: more complex firms have larger and more independent boards, while firms with higher monitoring and advising costs have smaller and less independent boards.

5.3.2. Board determinants for small, medium, and large firms

While our multivariate estimations include firm size as a control variable, which essentially controls for the level of board structure across firm size, it may be that the determinants of board structure vary across firm size. In Table 5, we estimate the determinants of board structure across our three size groups: small (firms in the 1st quintile), medium (firms in the 2nd–4th quintiles), and large (firms in the 5th quintile). For this analysis, we exclude our board leadership models because we only have CEO tenure (arguably the most important determinant of board leadership) for relatively large firms.

While the overall results are similar across each size grouping, there are some notable differences. Higher director ownership is associated with smaller and less independent boards for medium and large firms, but is not significantly related to board structure for small firms. In general, fewer factors appear to be important in explaining board structure for small firms than for medium and large firms. For example, CEO age and lagged board leadership are unrelated to board independence for small firms, but are strongly related to board independence for medium and large firms. In addition, monitoring costs are not significantly related to board independence for small or large firms, suggesting that the relation between monitoring costs and board independence is not particularly strong for all types of firms. Firm size, complexity, and CEO ownership appear to have similar effects across small, medium, and large firms in their relation to board independence. Overall, the models do reasonably well in explaining the variation in board structure. This is particularly true for large firms, where the models explain almost 21% of the variation in board independence and over 43% of the variation in board size.

5.3.3. Estimations that specifically account for endogeneity

To alleviate endogeneity and independence concerns, the above specifications include industry and year fixed effects and include observations from every third year only. As an additional robustness test, we estimate

Table 5
Determinants of board structure for small, medium, and large firms

The table reports results from regressing board size and board independence on various firm characteristics for small, medium, and large firms. We form our size groupings by ranking the sample firms into quintiles based on their market value of equity each year. We label the first quintile firms "small," quintiles two through four "medium," and quintile five "large." The mean (median) market value of equity for small, medium, and large firms is $9.6 ($8.1) million, $189.4 ($105.4) million, and $7.54 ($2.07) billion, respectively. The sample used in these models only includes observations from every third year (1992, 1995, 1998, 2001, and 2004). We estimate board size and independence regressions via OLS and include lagged values of the dependent variables as instrumental variables. *LogMVE* is the logarithm of market value of equity. Using principal components analysis, *COMPLEX* is the factor extracted from debt, the log of the number of business segments, and the log of firm age, while *MONCOSTS* is the factor extracted from the market-to-book ratio, R&D spending, and the standard deviation of monthly stock returns. *Debt* is total long-term debt over total assets. *Firm age* is the number of years since the firm first appeared on CRSP. *R&D* is R&D expenses over total assets. *CEO_Own* is the percent of shares held by the CEO. *Director_Own* is the average percent of firm's shares held by non-executive directors. *FCF* is free cash flow scaled by total assets, following Lehn and Poulsen (1989). *Performance* is the average annual industry-adjusted earnings before interest and taxes scaled by total assets over the two-year period preceding the proxy date. *CEO_Age* is the CEO's age. *Lag(CEO_Chair)* is a dummy that equals one if the CEO is also the Chairman of the Board (COB) in the previous period. *Lag(Board Indep)* is the percent of non-executive directors on the board in the previous period. *Lag(Board Size)* is the lagged number of directors on the board. The table reports the sign predicted by our hypotheses, the coefficient estimate, and the *p*-value based on robust standard errors that incorporate firm-level clustering.

Variable		Board size				Board independence		
		Small	Medium	Large		Small	Medium	Large
LogMVE	(+)	0.421[a]	0.379[a]	0.861[a]	(+)	0.015[a]	0.017[a]	0.008[b]
		(<0.001)	(<0.001)	(<0.001)		(0.009)	(<0.001)	(0.022)
COMPLEX	(+)	0.349[a]	0.421[a]	0.521[a]	(+)	0.010[c]	0.013[a]	0.016[a]
		(<0.001)	(<0.001)	(<0.001)		(0.085)	(<0.001)	(<0.001)
MONCOSTS	(−)	−0.105[a]	−0.233[a]	−0.787[a]	(−)	0.000	−0.011[a]	−0.005
		(0.001)	(<0.001)	(<0.001)		(0.937)	(0.002)	(0.466)
CEO_Own	(−)	−1.414[a]	−2.394[a]	−4.674[a]	(−)	−0.063[c]	−0.149[a]	−0.370[a]
		(<0.001)	(<0.001)	(<0.001)		(0.067)	(<0.001)	(<0.001)
Director_Own	(+)	−2.353	−5.179[a]	−16.789[a]	(+)	−0.121	−0.711[a]	−1.331[a]
		(0.245)	(0.003)	(0.001)		(0.612)	(<0.001)	(0.001)
FCF					(+)	0.003	−0.015	−0.002
						(0.790)	(0.312)	(0.850)
Performance					(−)	0.009	−0.013	0.024
						(0.479)	(0.469)	(0.476)
CEO_Age					(−)	0.000	−0.001[b]	−0.001[b]
						(0.358)	(0.016)	(0.035)
Lag(CEO_Chair)		−0.077	−0.037	0.088	(+)	0.006	0.011[a]	0.022[a]
		(0.377)	(0.480)	(0.435)		(0.452)	(0.006)	(0.001)
Lag(Board Indep)		0.720[a]	0.815[a]	0.142				
		(0.001)	(<0.001)	(0.714)				
Lag(Board Size)						0.004[c]	0.007[a]	0.004[a]
						(0.063)	(<0.001)	(0.003)
Industry dummies		Yes	Yes	Yes		Yes	Yes	Yes
Year dummies		Yes	Yes	Yes		Yes	Yes	Yes
N		1,852	6,157	2,287		1,543	5,126	2,036
Model *p*-value			(<0.001)	(<0.001)		(<0.001)	(<0.001)	(<0.001)
R^2/Psuedo R^2		0.156	0.206	0.432		0.073	0.119	0.208

a, b and c denote significance at the 1%, 5%, and 10% level, respectively.

our models with a dynamic panel data estimation procedure that only assumes weak exogeneity (see Engle, Hendry, and Richard, 1983). We also estimate our models jointly in a simultaneous equations framework, estimate models with firm fixed effects, and estimate models in which we limit the data to one observation per firm (i.e., one year). As expected, we lose power in some of these tests, mainly in our board independence regressions. However, when we use our principal component factors for complexity and monitoring costs or add additional data (i.e., by not dropping every third year), our important explanatory variables remain statistically significant with the predicted signs.

In summary, our overall conclusions are not altered by these robustness tests (results available from the authors upon request).

5.4. Impact of SOX and related rule changes on board structure and its determinants

In Section 4 we document several time trends in board structure, showing that board structure has changed since the scandals early in the decade and the resulting rule changes. In this section, we examine whether the rule changes result in a detectible change in the relation between board structure and its determinants. We restrict our analysis to the years 1998, 2001, and 2004, and include only those firms that existed in all three periods. We do this to balance the amount of pre- and post-SOX data, and to ensure that the results are not driven by changes in sample composition.

While it is beyond the scope of this paper to fully examine the impact of SOX on corporate boards, we do test whether boards change significantly post-SOX to help form a basis for our SOX-related objective, which is to understand whether SOX affected the determinants of board structure. Table 6, Panel A, reports summary statistics across size groups for those sample firms that existed in 1998, 2001, and 2004. As expected, results are similar to those reported in Table 3 for the broader sample. Small firms have smaller, less independent boards and are less likely to combine the CEO and COB positions relative to medium and large firms. Significantly more small firms (23.8%) have insider-dominated boards, compared to only 6.2% of large firms.

Panel B tests changes in board structure from 2001 to 2004. Given the emphasis on independent directors by SOX and the new NYSE and NASDAQ rules, it is not surprising that the proportion of insiders on the board decreases significantly from 2001 to 2004. The impact is largest for small firms, which initially have the highest proportion of insiders on the board. Board size increases over this time period for medium and large firms, but

Table 6
Board Structure for 1998, 2001, and 2004 by firm size

The table reports summary statistics for board structure across small, medium, and large firms for the subsample of firms that existed in 1998, 2001, and 2004. We form our size groupings by ranking the sample firms into quintiles based on their market value of equity each year. We label the first quintile firms "small," quintiles two through four "medium," and quintile five "large." The mean (median) market value of equity for small, medium, and large firms is $9.6 ($8.1) million, $189.4 ($105.4) million, and $7.54 ($2.07) billion, respectively. We test the statistical significance of the differences between (1) small and medium, (2) medium and large, and (3) large and small firms. *Board Size* is the number of directors on the board, *%Insiders* is the proportion of the board composed of executive directors, *Insider-dominated* is a dummy variable that equals one if 50% or more of the board members are insiders (executive directors), and *CEO_Chair* indicates when the CEO is also the Chairman of the Board (COB). Panel A reports mean and median board characteristics for each size category. All means are significantly different from each other in each of these comparisons at the 1% level (to save space, we do not report the statistics in the table). Panel B reports the mean changes in board characteristics from 2001 to 2004 and associated *p*-values.

Variable	Small firms			Medium firms			Large firms		
	N	Mean	Median	*N*	Mean	Median	*N*	Mean	Median
Panel A—Board Structure—1998, 2001 and 2004									
Board size	1,001	6.4	6.0	3,006	7.8	7.0	1,001	10.6	10.0
% Insiders	1,001	0.367	0.333	3,006	0.312	0.286	1,001	0.241	0.222
Insider dominated	1,001	0.238	0.000	3,006	0.142	0.000	1,001	0.062	0.000
CEO_chair	1,001	0.553	1.000	3,006	0.576	1.000	1,001	0.732	1.000
		Mean			Mean			Mean	
	N	Change	*p*-Value	*N*	Change	*p*-Value	*N*	Change	*p*-Value
Panel B-Board Structure Changes from 2001 to 2004									
Board size	333	0.060	(0.47)	1,001	0.426	(<0.01)	333	0.465	(<0.01)
% Insiders	333	−0.035	(<0.01)	1,001	−0.027	(<0.01)	333	−0.015	(0.04)
Insider dominated	333	−0.093	(<0.01)	1,001	−0.071	(<0.01)	333	−0.030	(0.08)
CEO_chair	333	−0.027	(0.25)	1,001	−0.041	(<0.01)	333	−0.030	(0.25)

Table 7
Determinants of board structure—pre- and post-SOX

The table reports results from regressing board size, board independence, and board leadership on various firm characteristics. We estimate board size and independence regressions via OLS and board leadership regressions via logistic regressions. *LogMVE* is the logarithm of market value of equity. Using principal components analysis, *COMPLEX* is the factor extracted from debt, the log of the number of business segments, and the log of firm age, while *MONCOSTS* is the factor extracted from the market-to-book ratio, R&D spending, and the standard deviation of monthly stock returns. *Debt* is total long-term debt over total assets. *Firm age* is the number of years since the firm first appeared on CRSP. *R&D* is R&D expenses over total assets. *CEO_Own* is the percent of shares held by the CEO. *Director_Own* is the average percent of firm's shares held by non-executive directors. *FCF* is free cash flow scaled by total assets, following Lehn and Poulsen (1989). *Performance* is the average annual industry-adjusted earnings before interest and taxes scaled by total assets over the two-year period preceding the proxy date. *CEO_Age* is the CEO's age. *POSTSOX* equals one if the sample year is after 2001. *Lag(CEO_Chair)* is a dummy that equals one if the CEO is also the Chairman of the Board (COB) the previous period. *Lag(Board Indep)* is the percent of non-executive directors on the board in the previous period. *Lag(Board Size)* is the number of directors on the board in the previous period. The table reports the sign predicted by our hypotheses and the coefficient estimates.

Variable	Board size			Board independence			Board leadership		
		(1)	(2)		(3)	(4)		(5)	(6)
LogMVE	(+)	0.597[a]	0.573[a]	(+)	0.017[a]	0.013[a]	(+)	0.267[a]	0.236[a]
COMPLEX	(+)	0.532[a]	0.511[a]	(+)	0.014[a]	0.012[b]			
MONCOSTS	(−)	−0.334[a]	−0.325[a]	(−)	−0.028[a]	−0.025[b]	(+)	−0.438[c]	−0.394
CEO_Own	(−)	−3.093[a]	−2.773[a]	(−)	−0.212[a]	−0.229[a]			
Director_Own	(+)	−2.056	−2.392	(+)	−1.141[a]	−1.156[a]			
FCF				(+)	−0.031	−0.035			
Performance				(−)	−0.021	−0.013	(+)	0.361	0.569
CEO_Age				(−)	0.000	−0.001	(+)	0.065[a]	0.065[a]
CEO_Tenure							(+)	0.031	0.030
POSTSOX		−0.029	−0.045		0.008	0.008		−1.791	−1.689
COMPLEX*POSTSOX		−0.067	−0.071		0.003	0.002			
MONCOSTS*POSTSOX		0.067	0.056		0.015	0.015		0.073	0.073
CEO_Own*POSTSOX		1.407[b]	1.155[c]		0.195[b]	0.204[b]			
Director_Own*POSTSOX		−8.173	−7.461		0.389	0.475			
FCF*POSTSOX					0.042	0.047			
PERFORMANCE*POSTSOX									
CEO_AGE*POSTSOX								0.019	0.016
CEO_Tenure*POSTSOX								0.062[b]	0.067[b]
Lag(CEO_Chair)			−0.009	(+)		0.023[a]			
Lag(Board Indep)			1.319[a]						2.046[a]
Lag(Board size)						0.005[a]			−0.003
Industry dummies		Yes	Yes		Yes	Yes		Yes	Yes
N		2,077	2,060		1,576	1,564		1,072	1,072
Model *p*-value		(<0.001)	(<0.001)		(<0.001)	(<0.001)		(<0.001)	(<0.001)
R^2/Psuedo R^2		0.457	0.459		0.207	0.220		0.148	0.158

a, b, and c denote significance at the 1%, 5%, and 10% level, respectively, based on robust standard errors that incorporate firm-level clustering. Data are from the years 1998, 2001, and 2004 only.

is statistically unchanged for small firms. These results are consistent with the notion that the board's tasks have become more complex; thus, boards require more members. Our findings also support the notion that larger firms that face more imminent compliance deadlines adjust boards more quickly than smaller firms.[11]

In Table 7 we test whether the determinants of board structure are significantly different in the post-SOX period than in the pre-SOX period. We define a POSTSOX dummy variable as one if the observation is from 2004 and zero otherwise, and interact this dummy variable with each of our hypothesized determinants. We include only observations from 1998 and 2004 to include a similar amount of timeI in both the pre- and

[11]For example, Section 404 of SOX became effective for fiscal years ending after November 15, 2004 for accelerated filers (larger firms). However, the SEC made exceptions for smaller firms. Originally, companies with market capitalization of less than $75 million had until July 2005 to implement Section 404. This deadline has since been delayed to early 2008.

post-SOX periods. Thus, the models include industry, but not year, fixed effects. For each attribute, we estimate two models, one with and the other without lagged values of the other board attributes.

The table shows that the effect of ownership on board structure is significantly lower in the post-SOX period. In both the board size and independence regressions, the coefficient on CEO ownership is negative and significant, and the coefficient on its interaction term with the POSTSOX dummy is positive and significant, suggesting that the influence of CEO ownership is not as great in 2004 as in 1998. We can reject the hypothesis that the sum of the coefficients on CEO ownership and its interaction term with the POSTSOX dummy equals zero in the board size regressions (p-value <0.01, statistic not reported in the table). This suggests that higher CEO ownership is associated with smaller boards in both periods, but that the relation is weaker post-SOX compared to pre-SOX. We cannot reject the hypothesis that CEO ownership and its post-SOX interacted term is zero, suggesting that higher CEO ownership is associated with lower board independence in the pre-SOX period, but not post-SOX. The only other significant interaction term is the impact of CEO tenure on board leadership, which suggests that the positive relation between CEO tenure and board leadership is stronger post-SOX.

In sum, it appears that board structure changed post-SOX, primarily in the form of greater board independence. We also find some evidence that the impact of ownership structure on board structure is weaker post-SOX. Overall, the models explain from 15% to 46% of the variation in board structure.

6. Conclusion

This paper examines the development and determinants of board structure using a sample of almost 7,000 firms from 1990 to 2004. The sample includes firms of all sizes, ages, and industries, which allows us to generalize our results more than is possible in papers with more restrictive sample selection criteria. For example, we find pronounced differences in the determinants of board structure between small and large firms. Further, given that our sample spans the adoption of the Sarbanes-Oxley Act in 2002, our findings contribute to the current debate on how SOX and contemporaneous rule changes by the NYSE and NASDAQ affect corporate governance.

Consistent with anecdotal evidence, we find that corporate boards become smaller and more independent in the 1990s, although these trends do not apply equally to all firms. Small firms show a more dramatic increase in board independence, while large firms see a more dramatic decrease in board size. Further, there is evidence that the passage of SOX had a significant impact on boards, accelerating the movement towards more independent boards but reversing the trend towards smaller boards. The average increase in board size is both statistically and economically significant from the pre- to the post-SOX periods.

Our empirical results are generally consistent with the hypothesis that firms choose board structures based on the costs and benefits of monitoring and advising. Broadly speaking, monitoring guards against harmful behavior, and advising provides input on strategy. Firms with high growth opportunities, high R&D expenditures, and high stock return volatility are associated with smaller and less independent boards, while large firms tend to have larger and more independent boards. High managerial ownership is associated with smaller and less independent boards, consistent with the hypothesis that managerial ownership and board monitoring are substitute governing mechanisms. However, if managerial ownership proxies for managerial power, then this result is also consistent with the alternative view that powerful managers structure their boards in ways that are more advantageous to themselves. We also find that firms have more independent boards when insiders have more opportunity to extract private benefits and when the CEO has greater influence over the board.

We structure our empirical analysis to test existing theoretical work. For tractability, the models only illustrate what happens under a certain set of circumstances, which can be problematic when many attributes are determined simultaneously. For example, internal governance mechanisms such as board structure are endogenously determined within the broader system of corporate governance. Thus, empirical tests based on existing theories are imperfect. We handle this problem in several ways, including simultaneous equations estimations, fixed-effects models, and other procedures that deal with endogeneity issues. Taken as a whole, our results are generally consistent with efficiency explanations of the determinants of board structure. In fact, our models explain as much as 45% of the observed variation in board structure.

Overall, our results show strong relations between board structure and firm characteristics, suggesting that any regulatory framework that imposes uniform requirements on board structure could be ill-conceived. Further, the strong associations between board structure and firm size and ownership suggest that policy makers and researchers pay special attention to the effect of mandated reforms on small firms and firms with higher managerial ownership.

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