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公司績效與董事會雙重角色：公司特性、政策法規及 CEO 與董事的社會網絡連結*

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摘要

本研究探討公司特性、政策法規，以及 CEO 與董事間的網絡連結強度如何影響董事建議和監督的雙重角色，從而影響公司的治理。研究結果發現具有較高外部不確定性和依賴性的公司，其外部董事建議的有效性較為顯著。而當公司較依賴產業、公司特有的專精知識技術，或者較依賴短期高獲利的創新時，則會增加內部董事建議的有效性。再者，當公司有較高的監督成本（例如：營收不穩定）時，則會降低外部董事監督的有效性。檢查沙賓法案(Sarbanes–Oxley Act)與相關證交所掛牌準則的施行對於企業經營績效所帶來的影響，其結果更加支持我們的論點。研究結果顯示全面性地強制要求過半的獨立董事，此種法規對於需要有較高比率的內部董事以追求競爭優勢的公司而言，有負面的效果。而這些相關的法律條文，亦忽略了 CEO 與董事之社會網絡連結，會改變董事對公司管理階層監督職責的履行。

關鍵詞：董事會組成、公司績效、沙賓法案、社會網絡連結

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Corporate Performance and the Dual Roles of Boards: Firm Characteristics, Governance Regulations, and CEO–Director Relationships*

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Abstract

This study examines how firm characteristics, governance regulations, and CEO–director social ties affect the dual roles of directors as advisors and monitors and, in turn, influence corporate governance. We find that the effectiveness of outside directors as advisors is particularly significant in firms with more external uncertainty and dependence, whereas inside directors' advising effectiveness increases when firms rely more heavily on firm-specific expertise or on short-lived innovation profits. The effectiveness of outside directors as monitors diminishes in firms with high monitoring costs such as firms with less persistent earnings. Firm performance after the implementation of the Sarbanes–Oxley Act of 2002 and related exchange rules further supports our findings. We document that the regulations, which mandate uniformly high levels of outside director monitoring on all firms, are detrimental to firms that have a greater need for inside directors to pursue competitive advantage. Such regulations also neglect social links between CEO and directors, which may influence directors' responsibility in monitoring firms.

Keywords: *Board composition, Firm performance, Sarbanes–Oxley Act, Social ties*.

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1. INTRODUCTION

Recent literature suggests that corporate boards fill roles beyond monitoring managerial behavior (e.g., Adams and Ferreira 2007; Andrés and Vallelado 2008; Linck, Netter, and Yang 2008; Pathan and Skully 2010). Because the monitoring function within a board is mainly provided by independent outside directors, if the board only fulfilled the monitoring function, greater numbers of independent outside directors would improve firm performance. However, the literature shows that boards constructed by a balance of inside and outside directors are better equipped to create higher firm performance than excessively independent boards because the balanced boards are able to combine the monitoring function of outside directors with an advisory function, which requires both outside and inside directors. Therefore, boards fulfill at least dual roles as both monitor and advisor. Outside directors play the dual roles, while inside directors primarily play an advisory role where their advisory capabilities complement those of outside directors.

Yet board structure especially in the balance of inside and outside directors that yields the highest firm performance remains a matter of debate, and, therefore, we investigate the balance, an efficient board composition, from a view of the boards' dual roles. Specifically, although results on a relation between board size and firm performance are widely accepted (Yermack 1996), results on a relation between board composition and firm performance are still inconclusive (Cotter, Shivdasani, and Zenner 1997; Rosenstein and Wyatt 1997; Klein 1998; Bhagat and Black 2002). Accordingly, we explore how the board composition, the trade-off between outside and inside directors, affects firm performance. To achieve the monitoring function, the literature recommends increasing the number of outside directors relative to inside directors. However, only a few studies focus on directors' advisory role, and the corresponding results are mixed. Hence, the question remains: In which scenarios do more outside directors improve performance, and in which scenarios do more inside directors improve performance?

We construct two primary hypotheses. First, we hypothesize that outside directors serve dual monitoring and advisory roles, which is particularly significant in diversified leveraged firms. These firms with a higher proportion of outside directors exhibit higher performance because, in addition to the monitoring function, these firms require the most outside knowledge, information, and resources from outside directors due to higher environmental uncertainty, external resource dependency, and debt ratios. Second, we hypothesize that inside directors primarily serve an advisory role, which is particularly significant in R&D-intensive firms. These firms with a higher proportion of inside directors exhibit higher performance because the firms can take advantage of firm-specific expertise and information of inside directors.

Our results add to the literature in several ways. First, we provide unique insight into the construction of performance-enhancing board composition, which relates to the board's dual roles. Further, we discuss the impact of mandated requirements concerning board composition implemented following the Sarbanes–Oxley Act of 2002 (SOX) and related exchange listing rules. We find that the uniform regulations for all firms, regardless of their characteristics, are detrimental. Moreover, we argue that external CEO–director ties among different boards affect the ability of directors to perform their fiduciary duty as monitors. Certain types of ties undermine corporate governance, and the regulations have not yet addressed these matters to rectify the defects.

Accordingly, our results have several policy implications. First, uniform regulations, which apply to all firms, for a majority of independent directors may force firms toward an inefficient board structure, and hence different types of firms should have different thresholds of independence for boards. Second, board independence should be required for true independence because firms may circumvent the regulations by hiring directors who satisfy the statutory requirements for independence but have strong social connections to the CEO. In addition to the current statutory requirements, we suggest that the requirements should further take into account the CEO-director ties which influence the monitoring role of directors.

The remainder of this paper is organized as follows. In Section 2, we review the literature and construct empirical hypotheses. Among them, we discuss the roles of outside directors and inside directors, explore the impact of SOX, and investigate the influence of external directorship ties. In Section 3, we discuss our data set and regression models. In Section 4, we provide our results and execute robustness tests. Section 5 offers our conclusions.

2. LITERATURE REVIEW AND HYPOTHESES

2.1 Roles of Outside Directors

Prior studies of the relation between outside directors and firm performance mainly focus on the monitoring role based on agency theory. That is, outside directors are responsible for monitoring top managers by means of supervising strategy implementation, evaluating and rewarding managers, planning managers' succession, and so on. These activities reduce managers' discretionary power and control managers' adversarial behavior to mitigate agency costs and thus improve firm performance (Fama 1980; Hermalin and Weisbach 1991; John and Senbet 1998; Hillman and Dalziel 2003; Lin, Yeh, and Yang 2014).

In contrast with agency studies, which describe the role of outside directors exclusively as monitors, we further adopt an advisory basis to investigate the relation between outside directors and firm performance based on the following argument: Outside directors as advisors are valuable to firms not only via providing advice and counsel obtained from their knowledge, expertise, and experience but also via providing outside information and resources obtained from their external links to other organizations.

For example, on the one hand, Agrawal and Knoeber (2001) document that outside directors with politics experience are more important on the boards of firms for which costs incurred from sales to government, exports, and lobbying are higher. The experience aids diminishing the costs and thus benefits firms. According to Booth and Deli (1999) and Güner, Malmendier, and Tate (2008), commercial bankers with financial expertise as outside directors enhance firms' access to external financing. Kim and Lim (2010) find a consistent positive relation between firm valuation and the diversity of outside directors' academic majors.

On the other hand, outside directors are also beneficial to firms through their external links, which aid strategic decisions and reduce environmental uncertainty. One type of the outsiders' external links is from their external directorships. Carpenter and Westphal (2001) state that outside directors who serve on different boards participate in decision-making processes and then witness the consequences of those decisions on multiple boards. Therefore, what outside directors learn from one board may be effectively applied to another board. Peng (2004) also argues that the links facilitates firms' outside information acquisition, borrowing, and alliance formation.

In addition, the scope of operations hypothesis of Boone, Field, Karpoff, and Raheja (2007) show that the proportion of outside directors increases with the number of business segments. This result also reflects the diversified firms' self-selection for higher firm performance. The reason is that the efficient board composition varies with firms' needs based on their characteristics. Diversified firms have greater advisory needs due to higher environmental uncertainty. Outside directors bring valuable outside knowledge and external connections to the firms to lower the uncertainty (Linck et al. 2008).

The similar argument may be applied to leveraged firms. Coles, Daniel, and Naveen (2008) argued that these firms depend on external resources to a greater extent and thus have greater advisory needs for outside directors. Further, according to Agrawal and Knoeber (1996), uses of debt and outside directors are two important monitoring mechanisms to control agency problems. A firm that employs one mechanism more has lower demand for the other. Booth, Cornett and Tehranian (2002) and Belkhir (2009) present a similar view. Hence, a firm with higher leverage ratio, inducing monitoring by lenders, would have lower monitoring demand from outside directors. Therefore, demand in leveraged firms for outside directors is more consistent with advisory needs than the monitoring scheme.

In our framework, we acknowledge that outside directors serve a monitoring role, as supported by agency theory, and posit that they also serve an alternative advisory role. The dual roles of outside directors are particularly strong in diversified leveraged firms because, in addition to a monitoring requirement, these firms have greater advisory needs from outside directors for external knowledge, experience, information, and resources to enhance firm performance. Stated in their alternative form:

Hypothesis 1: For diversified leveraged firms, there is a positive association between the proportion of outside directors and firm performance.

Furthermore, while some studies argue that outside directors with multiple appointments can generate benefits in terms of networks and enhancement of resource accessibility (Harris and Shimizu 2004; Pietra, Grambovas, Raonic, and Riccaboni 2008), others claim that firms with busy boards, those in which outside directors hold too many directorships, may diminish the effectiveness of outside directors as corporate monitors (Core, Holthausen, and Larcker 1999; Shivdasani and Yermack 1999; Fich and Shivdasani 2006). For example, Harris and Shimizu (2004) find that multiple board directorships are important sources of knowledge and information to enhance acquisition performance. Pietra et al. (2008) argue that large companies with more persistent earnings and lower earnings growth tend to appoint directors with wide spread network of corporate, social, and political links. These appointments also have positive signal effects to capital markets. On the other hand, Core et al. (1999) find that multiple directorships are correlated with excessive compensation of CEOs. Fich and Shivdasani (2006) show that independent but busy boards display CEO turnover-performance sensitivities indistinguishable from those of inside-dominated boards. However, Ferris, Jagannathan, and Pritchard (2003) find no evidence that multiple directors lower the firm performance, shirk their responsibilities, or make their firms more vulnerable to securities fraud litigation. Therefore, it is open to question whether the busyness hypothesis holds. Even though the busyness hypothesis, which claims that the multiple appointments may harm the monitoring role of outside directors, holds, it is compatible with our theory for the advisory role of outside directors. We argue that the advisory role is more dominant than monitoring role as a determinant of corporate performance in diversified leverage firms. The advice effect of outside directors from their external links can be partly detected by the number of their external directorships. This argument forms the following hypothesis:

Hypothesis 2: For diversified leveraged firms, there is a positive association between the number of external directorships of outside directors and firm performance.

2.2 Roles of Inside Directors

Relative to outside directors, inside directors play a less significant role as monitors due to their dependence on the current management. Specifically, inside directors[1] may be current or former employees (managers) of the firm or associated with the management as a result of business dealings, family relationships, and so on. The top managers, therefore, may exert undue influence over them, which creates a disincentive for inside directors to monitor (Hillman and Dalziel 2003; Valenti 2008).

However, as advisors, inside directors are particularly important (but receive less attention in the literature) in firms that require strong professional expertise or high technological knowledge such as in R&D-intensive firms. The explanation is that inside directors have firm-specific expertise and experience to make pertinent decisions in their professional field (Fama and Jensen 1983) and outside directors can also learn the expertise and business practices through their communication with inside directors (Carpenter and Westphal 2001). Information acquired from fellow inside directors is particularly influential because these directors are more informed regarding the firms' constraints, opportunities (Linck et al. 2008), and investment project quality (Raheja 2005), and top managers are more likely to share information with them (Adams and Ferreira 2007).

Further, outside directors have higher advisory and monitoring costs in R&D-intensive firms than the other types of firms. First, the advisory costs are those costs incurred from outside directors who need to face information acquisition and processing costs in transforming their general knowledge to the specific expertise of the firms for which they serve as directors (Maug 1997; Linck et al. 2008; Duchin, Matsusaka, and Ozbas 2010).

Second, the monitoring costs increases in R&D-intensive firms due to high project verification costs (Raheja 2005). R&D-intensive firms with their streams of short-lived innovations benefit more from inside directors. On the one hand, the innovations involve high industry- or firm-specific expertise, and need fast intra-firm communication and integration, which inside directors are more capable of facilitating than outside directors. On the other hand, according to Balkin, Markman, and Gomez-Mejia (2000), emphasis on innovations causes less persistence earnings. This characteristic makes it difficult for

[1] In this paper, directors that do not fit the definition for independent outside directors are classified as inside directors.

outside directors, who evaluate and reward managers mainly on the basis of financial outcome (Baysinger and Hoskisson 1990), to achieve their monitoring function (Boone et al. 2007). Hence, although outside directors have higher monitoring incentives, they have less monitoring ability in these firms. In addition, the less persistence earnings expose managers to a higher likelihood of job termination and negative reputations in the managerial labor market (Balkin et al. 2000), which disciplines managers to make efforts for their prospective employers (Agrawal and Knoeber 1996). Consequently, R&D-intensive firms' monitoring mechanisms appear to rely more on the external market force and less on the use of outside directors on the boards internal to the firms. This cause also weakens outside directors' monitoring role in these firms.

In our framework, we posit that inside directors primarily serve as an advisory role and that this role is amplified within R&D-intensive firms because the specific expertise base is critical to decision-making in these firms. Inside directors not only have the firm-specific expertise but also transmit the expertise and participate in inside information sharing, which improves the overall decision-making ability of the board to enhance firm performance. Stated in their alternative form:

Hypothesis 3: For R&D-intensive firms, there is an inverse (positive) association between the proportion of outside (inside) directors and firm performance.

Further, we use annual stock return volatility, the standard deviation of stock returns over the year, to measure earnings persistence. We argue that the firms with high volatility (i.e., low earnings persistence), having high monitoring costs of outside directors, benefit more from inside directors. Outside directors have less ability to judge the managers' performance and to evaluate the firms' growth potential.[2] The argument is formalized in the following hypothesis:

Hypothesis 4: For firms with high stock volatility, there is an inverse (positive) association between the proportion of outside (inside) directors and firm performance.

Finally, we explore a special role of inside directors, related to a firm's leadership structure–CEO duality versus non-CEO duality. Although the CEO duality structure, in which CEO is also the chairman of the board, may restrain a board's ability to monitor the CEO and thus create higher agency costs (Jensen 1993), it reduces information sharing

2 The aforementioned environmental uncertainty means that firms operate in multiple segments and need outside knowledge for a greater number of industries. Outside directors provide valuable external advice and links to the firm, which lowers uncertainty. By contrast, firms with high stock volatility cause different uncertainty about the firms' prospects and performance. The uncertainty increases the monitoring costs of outside directors. The reason for firms with high R&D expenses is similar. In addition to the advisory benefits of inside directors, R&D-intensive firms have high growth opportunities, which are more costly for outside directors to monitor or verify managers' performance.

costs (between the board and the top management) and promotes efficient decision process and implementation (Dahya and Travlos 2000). Current empirical evidence provides no consensus on the duality-performance relationship. Some prior studies suggest that combining roles is preferable (Donaldson and Davis 1991; Lin 2005), others (Rechner and Dalton 1989; Baliga, Moyer, and Rao 1996; Abdullah 2004) find no significant relationship between CEO duality and company financial performance, still others (Brickley, Coles, and Jarrell 1997; Kiel and Nicholson 2003; Faleye 2007; Lam and Lee 2008) argue that both duality and separation perspectives have related benefits and costs, and thus the better leadership structure is contingent upon firms' circumstances. Elsayed (2007) finds that impact of CEO duality on corporate performance varies across industries. We argue that the impact may vary across firms with different characteristics. On the basis of our aforementioned theory, we argue that for R&D-intensive firms, which have higher monitoring costs and need rapid communication and integration, the CEO duality structure is more effective to improve performance. The argument gives rise to the following hypothesis:

Hypothesis 5: For R&D-intensive firms, the CEO duality structure exhibits better performance relative to the non-CEO duality structure.

2.3 Effects of SOX and External Directorship Ties

Generally, firms have self-selection effects for board structure to meet their unique needs and pursue better performance. However, various constraints may prevent boards from moving toward their optimum such as regulation requirements (Linck et al. 2008). That is one of the reasons why we can compare boards that deviate from their optimum with boards that have more optimal structure to observe the relation between firm performance and board structure.

Figure 1 shows that between 1996 and 2010 board composition evolved toward a more independent structure, which may be, in part, in response to changing requirements between 1999 and 2003. The Sarbanes–Oxley Act of 2002 (SOX) and modified exchange listing rules of 2003 formally required stricter definition of independence and a majority of independent directors on corporate boards (for details see Linck, Netter, and Yang 2009). In addition, before the passage of these regulations, regulatory reforms[3] had begun a few years earlier in 1999 (Duchin et al. 2010). During this period, the reforms and the developing trend of the regulations toward increasing the participation of outside directors also influenced the transition of board composition.

[3] For example, in 1999 major exchanges, the NYSE and NASDAQ, began requiring that corporate audit committees consist entirely of independent directors. Although the requirement did not specifically require firms to have a majority of independent directors yet, it revealed that regulations aim at increasing the representation of outside directors.

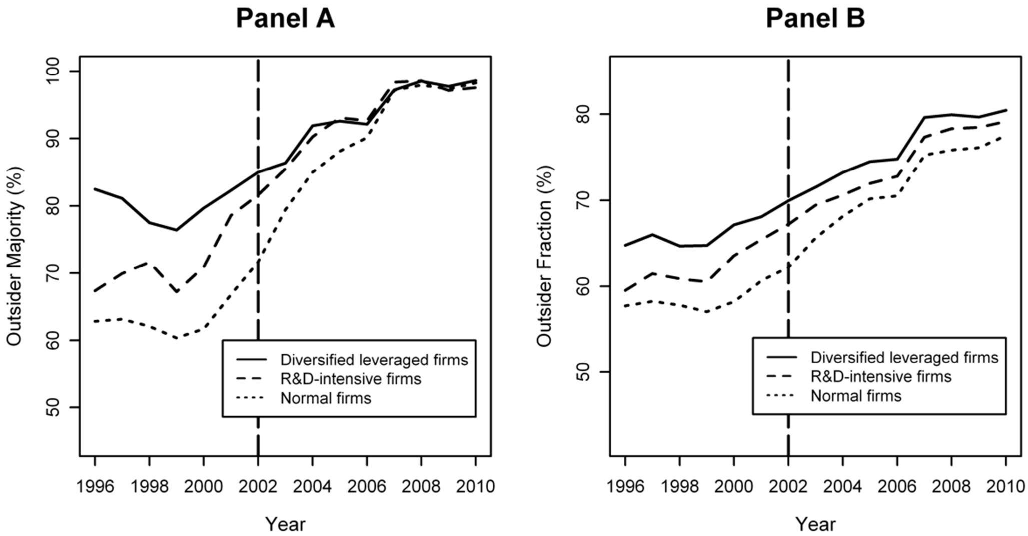

Figure 1　Board Composition Trends, 1996-2010

Notes: This figure describes the evolution of board composition for three types of firms (diversified leveraged, R&D-intensive, and normal) over the period between 1996 and 2010. The period experiences numerous changes in requirements of outside directors from some reform acts, beginning in 1999, to the passage of the Sarbanes–Oxley Act (SOX), which became law in 2002, to the new exchange rules, approved by the Securities and Exchange Commission in 2003. Panel A describes evolvement of the average percentage of outsider majority boards (more than 50% board members are outside directors) and Panel B shows evolvement of the average percentage of outside directors on boards.

Although the regulations appear to enhance corporate governance, they may be detrimental to certain firms (Wintoki 2007)—particularly R&D-intensive and high stock volatility firms according to our aforementioned argument. In contrast with diversified leveraged firms, in which performance is positively related to greater board independence, and normal firms, in which performance may be less sensitive to more or less independence, R&D-intensive firms—given their dependence on inside directors and due to the high monitoring costs of outside directors—may suffer from more independent boards. This conjecture leads to the following hypothesis:

Hypothesis 6: Compared to the pre-SOX period, R&D-intensive firms exhibit lower performance in the post-SOX period.

Analogically, we apply the conjecture to the high stock volatility firms, leading to our hypothesis:

Hypothesis 7: Compared to the pre-SOX period, firms with high stock volatility exhibit lower performance in the post-SOX period.

To date, although regulations have included some provisions on board structure to strengthen the board’s functions, they have not considered external directorship ties of the CEO and directors that may influence the internal board’s roles. Accordingly, we explore the effects of the external directorship ties. In contrast with prior studies (Hwang and Kim

2009; Krishnan, Raman, Yang, and Yu 2011; Fracassi and Tate 2012), we argue that some ties between the CEO and directors across different boards in firms may enhance managerial influence and hence weaken the monitoring intensity of directors, whereas other ties may enhance the monitoring effectiveness. Therefore, we posit that firms with more CEO–director ties do not necessarily underperform.

We consider CEO–director external directorship ties of two different types: *Familiar Influence* and *Reciprocal CEO Interlocks*. First, *Familiar Influence* is a variable defined as the number of current external directorships on the same boards outside the firm for its CEO and directors. We use this variable as a proxy to measure the level of familiarity between the CEO and directors through boards. These CEO–director ties may undermine the monitoring role of directors, thus reducing firm performance. The rationale is that when the CEO and the firm's directors work together on many boards, they become familiar with each other. Thus, the CEO has more opportunities to exert undue influence on the directors. The argument gives rise to the following hypothesis:

Hypothesis 8: The level of familiarity between a CEO and directors is negatively associated with firm performance.

Second, we consider a variable, *Reciprocal CEO Interlocks*, to measure the density of reciprocal interlocks between a CEO and directors. For example, the CEO of firm *i* serves as directors of firms *j* and *k*, and the CEOs of firms *j* and *k* serve as directors of firm *i.* In this case, we regard firm *i* as having two interlocks. Accordingly, the variable is defined as the number of interlocks in the firm. Such interlocks may arise because they are in the interests of the companies' shareholders. We argue that directors may monitor the CEO more stringently when they are monitored by the CEO in other firms in which the CEO and directors interchange their managerial and monitoring roles. Hence, our final hypothesis is as follows:

Hypothesis 9: The density of reciprocal interlocks between a CEO and directors is positively associated with firm performance.

Note that we further consider two variables to control the effects of separate external directorship ties of the directors and the CEO when we explore the related hypotheses. *Links of directors* is defined as the aggregate number of external directorships held by the directors in a board, and *Links of CEO* is defined as the number of external directorships held by the CEO.

3. DATA AND MODELS

3.1 Data

We obtain our sample from RiskMetrics, COMPUSTAT, and Center for Research in Security Prices (CRSP) over the period 1996 to 2010. We start with all firms on the RiskMetrics database for board structure variables and exclude utility and financial firms from the sample as they are different types of firms and are regulated. We then match this sample to COMPUSTAT and CRSP to obtain firm performance, firm characteristic, and CEO characteristic variables. CRSP provides information on *Annual stock return*, and Compustat Fundamentals Annual tape provides information on other performance variables. Among firm characteristic variables, *Stock volatility* and *Firm age* are obtained from CRSP, and *Business segments* are calculated from Compustat Segments tape. The other variables (such as *R&D intensity*, *Leverage*, and *Firm size*) come from the Compustat Fundamentals Annual tape. CEO characteristic variables (such as *CEO tenure* and *CEO ownership*) are obtained from Compustat Execucomp tape.

Table 1 reports descriptive statistics for all firms on board, performance, firm, and CEO variables. The sample consists of 15,426 firm-year observations. The results are compatible with those in prior studies. In Panel A, the median *Board size* is 9 directors. The median composition of the board, which is measured by *Outsider fraction*, is 71.43%, where *Outsider fraction* is calculated by the number of independent outside directors divided by *Board size*. The values are similar to those in Brick and Chidambaran (2010) and Duchin et al. (2010).

In Panel B of Table 1, the proxy variables for firm performance are measured by market-to-book ratio of assets, *Return on assets* (*ROA*), and *Annual stock return*. Among them, the market-to-book ratio is calculated by the book value of total assets minus the book value of common equity plus the market value of common equity, all divided by the book value of total assets. This proxy, or its extensions, is an estimate of Tobin's Q and is commonly used in empirical studies for firm performance in corporate governance issues (e.g., Yermack 1996; Andrés and Vallelado 2008; Dahya, Dimitrov, and McConnell 2008).

Panels C and D of Table 1 provide statistics on firm and CEO characteristics. The mean value of *Business segments*, which measures the level of diversification, is 2.6290, where 60.69% firm-year observations have more than one business segment. The mean value of *R&D intensity*, measured by the ratio of R&D expense to total assets, is 0.0296, where 46.06% firms have nonzero R&D expense. The mean of *Leverage*, the ratio of total debt to total assets, is 0.2227. In CEO characteristics, the mean *CEO age* and *CEO tenure* are 55.7 years old and 7.6 years, respectively; 58.29% of firms apply the CEO duality structure in which the CEO is also the chairman of the board. These values are close to those in Linck et al. (2008).

Table 1 Descriptive Statistics

Variables	Mean	Median	SD	Q_1	Q_3	Min	Max
Panel A—Board characteristics							
Board size	9.1770	9.0000	2.4886	7.0000	11.0000	3.0000	39.0000
Inside directors	1.7601	1.0000	1.0901	1.0000	2.0000	0.0000	30.0000
Gray directors	1.0950	1.0000	1.2983	0.0000	2.0000	0.0000	13.0000
Outside directors	6.3218	6.0000	2.3662	5.0000	8.0000	2.0000	28.0000
Outsider fraction	0.6859	0.7143	0.1692	0.5714	0.8182	0.2000	1.0000
Outside director ownership	0.0132	0.0032	0.0436	0.0011	0.0086	0.0000	0.2128
Outsider directorships in other firms	5.6877	4.0000	5.5547	1.0000	9.0000	0.0000	40.0000
Insider directorships in other firms	1.3343	1.0000	2.1399	0.0000	2.0000	0.0000	32.0000
Panel B—Performance variables							
Tobin's Q	1.9969	1.5242	1.6863	1.1848	2.2167	0.4006	8.0981
ROA	0.1358	0.1306	0.1059	0.0856	0.1852	-0.1572	0.9651
Annual stock return	0.1628	0.1653	0.4284	-0.0631	0.3854	-0.6803	3.2896
Panel C—Firm characteristics							
Business segments	2.6290	2.0000	1.6822	1.0000	4.0000	1.0000	10.0000
R&D intensity	0.0296	0.0000	0.0577	0.0000	0.0369	0.0000	0.2397
Leverage	0.2227	0.2112	0.1850	0.0550	0.3402	0.0000	0.7552
Firm size	7.3037	7.2008	1.4918	6.2991	8.2506	4.0517	12.1059
Firm age	24.9249	19.0000	19.0371	10.5833	34.0833	0.2500	85.0000
Stock volatility	0.0278	0.0244	0.0139	0.0182	0.0338	0.0051	0.1936
Intangible assets	0.7187	0.7879	0.2421	0.5837	0.9048	0.1133	0.9848
Free cash flow	0.0882	0.0841	0.0911	0.0427	0.1320	-0.1573	0.8278
Panel D—CEO characteristics							
CEO tenure	7.5884	5.3333	7.3064	2.5833	9.9167	0.0833	34.9167
CEO age	55.7034	56.0000	7.4090	51.0000	60.0000	32.0000	76.0000
CEO ownership	0.0228	0.0033	0.0583	0.0010	0.0126	0.0000	0.2944
CEO duality	0.5829	1.0000	0.4931	0.0000	1.0000	0.0000	1.0000

Notes: The table reports descriptive statistics, mean, median, standard deviation, 1st quartile, 3rd quartile, minimum, and maximum, for board, performance, firm, and CEO variables in Panels A to D, respectively. The data set consists of 15,426 firm-year observations over the time period 1996–2010 from RiskMetrics, COMPUSTAT, and CRSP. For board characteristics, *Board size* is the number of board's members. *Inside directors*, *Gray directors*, and *Outside directors* are the numbers of inside directors, affiliated outside directors, and independent outside directors defined and classified by RiskMetrics, respectively. *Outsider fraction* is the proportion of *Outside directors* to *Board size*. *Outside director ownership* represents the percentage of the firm's shares owned by outside directors. *Outsider (Insider) directorships in other firms* is the number of external directorships held by outside directors (inside and gray directors). For performance variables, *Tobin's Q* is the ratio of market value of assets to book value of assets. *ROA* is the return on assets, measured as operating income over total assets. *Annual stock return* inclusive of dividends is obtained from the CRSP stock file. The return is the change in the price over the year plus any dividends paid, divided by the original price of the stock. For firm characteristics, *Business segments* represents the number of business segments. *R&D intensity* is the ratio of R&D expenditure to total assets. *Leverage* is the ratio of total debt to total assets. *Firm size* is measured as the log of sales ($million). *Firm age* is the number of years since the firm first lists in CRSP. *Stock volatility* is the standard deviation of stock returns over the year. *Intangible assets* is 1 minus the ratio of net property, plant, and equipment to total assets. *Free cash flow* is defined as the ratio of operating cash flow less preferred and common equity dividend payments to total assets. For CEO characteristics, *CEO tenure* is the number of years the CEO has been the CEO. *CEO age* is the CEO's age. *CEO ownership* represents the percentage of the firm's shares held by the CEO. *CEO duality*, a dummy variable, indicates when the CEO is also the chairman of the board in the firm.

3.2 Model Specifications

In this section, we conduct regression analyses to test our hypotheses. The models' specifications are

$$
\begin{aligned}
Tobin's\ Q_{i,t} = {} & \alpha + \beta_1 Outsider\ fraction_{i,t} + \beta_2 Outsider\ fraction_{i,t} \times D\&L_{i,t} \\
& + \beta_3 Outsider\ fraction_{i,t} \times R\&D_{i,t} + \eta_1 CEO\ duality_{i,t} \\
& + \eta_2 CEO\ duality_{i,t} \times D\&L_{i,t} + \eta_3 CEO\ duality_{i,t} \times R\&D_{i,t} + \kappa_1 Board\ size_{i,t} \\
& + \kappa_2 Outside\ director\ ownership_{i,t} + \kappa_3 Firm\ size_{i,t} + \kappa_4 Firm\ age_{i,t} \\
& + \kappa_5 Leverage_{i,t} + \kappa_6 Stock\ volatility_{i,t} + \kappa_7 Intangilbe\ assets_{i,t} \\
& + \kappa_8 Free\ cash\ flow_{i,t} + \kappa_9 CEO\ tenure_{i,t} + \kappa_{10} CEO\ age_{i,t} \\
& + \kappa_{11} CEO\ ownership_{i,t} + \kappa_{12} D\&L_{i,t} + \kappa_{13} R\&D_{i,t} \\
& + Industry\ dummies_{i,t} + Year\ dummies_{i,t} + \varepsilon_{i,t}.,
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
Tobin's\ Q_{i,t} = {} & \alpha + \gamma_1 Links\ of\ Outsiders_{i,t} + \gamma_2 Links\ of\ Outsiders_{i,t} \times D\&L_{i,t} \\
& + \gamma_3 Links\ of\ Outsiders_{i,t} \times R\&D_{i,t} + \eta_1 CEO\ duality_{i,t} \\
& + \eta_2 CEO\ duality_{i,t} \times D\&L_{i,t} + \eta_3 CEO\ duality_{i,t} \times R\&D_{i,t} \\
& + \kappa_1 Board\ size_{i,t} + \kappa_2 Outside\ director\ ownership_{i,t} + \kappa_3 Firm\ size_{i,t} \\
& + \kappa_4 Firm\ age_{i,t} + \kappa_5 Leverage_{i,t} + \kappa_6 Stock\ volatility_{i,t} \\
& + \kappa_7 Intangilbe\ assets_{i,t} + \kappa_8 Free\ cash\ flow_{i,t} + \kappa_9 CEO\ tenure_{i,t} \\
& + \kappa_{10} CEO\ age_{i,t} + \kappa_{11} CEO\ ownership_{i,t} + \kappa_{12} D\&L_{i,t} \\
& + \kappa_{13} R\&D_{i,t} + Industry\ dummies_{i,t} + Year\ dummies_{i,t} + \varepsilon_{i,t}., and
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
Tobin's\ Q_{i,t} = {} & \alpha + \beta_1 Outsider\ fraction_{i,t} + \delta Outsider\ fraction_{i,t} \times HV_{i,t} \\
& + \eta_1 CEO\ duality_{i,t} + \eta_2 CEO\ duality_{i,t} \times D\&L_{i,t} + \eta_3 CEO\ duality_{i,t} \times R\&D_{i,t} \\
& + \kappa_1 Board\ size_{i,t} + \kappa_2 Outside\ director\ ownership_{i,t} \\
& + \kappa_3 Firm\ size_{i,t} + \kappa_4 Firm\ age_{i,t} + \kappa_5 Leverage_{i,t} + \kappa_6 Stock\ volatility_{i,t} \\
& + \kappa_7 Intangilbe\ assets_{i,t} + \kappa_8 Free\ cash\ flow_{i,t} + \kappa_9 CEO\ tenure_{i,t} + \kappa_{10} CEO\ age_{i,t} \\
& + \kappa_{11} CEO\ ownership_{i,t} + \kappa_{12} D\&L_{i,t} + \kappa_{13} R\&D_{i,t} \\
& + \kappa_{14} HV_{i,t} + Industry\ dummies_{i,t} + Year\ dummies_{i,t} + \varepsilon_{i,t}.,
\end{aligned}
\tag{3}
$$

where the dependent variable, *Tobin's Q*, is a proxy for firm performance. The explanatory variables include Outsider fraction, Links of outsiders, Board size, Outside director ownership[4], Firm size, Firm age, Leverage, Stock volatility, Intangible assets, Free cash flow, CEO tenure, CEO age, and CEO ownership. Links of outsiders is defined as the number of external directorships held by outside directors relative to the number of external directorships held by inside directors. As defined, this variable controls the effect of the external directorships held by inside directors when we investigate the relation between performance and the external links of outside directors.

4 We include *Outside director ownership* as a control because ownership is a way to incentivize leadership of outside directors. Higher equity ownership may lead to more strategic involvement (Chatterjee 2009) or stronger supervision (Lin, Liao, and Chang 2011). We use the variable to control for the effect that directors are increasingly required to hold stakes in the companies they oversee from 1994.

The main dummy explanatory variables are *D&L*, *R&D*, *HV*, and *CEO duality*, which indicate diversified leveraged firms, R&D-intensive firms, firms with high stock volatility and firms with CEO duality structure, respectively. *D&L* equals one if the firm's both levels of diversification and leverage are greater than the medians, and zero otherwise. *R&D* (*HV*) equals one if the firm's R&D intensity (stock volatility) is greater than the 75th percentile value, and zero otherwise. *CEO duality* equals one if the firm's CEO is also the chairman of the board, and zero otherwise. Further, all specifications consider industry and year fixed effects. The rationale is that firms in the same industry and time period face similar market environment, and the effects, therefore, control for the underlying economic conditions that affect performance.

Equation 1 tests Hypotheses 1 and 3; Equations 2 and 3 test Hypotheses 2 and 4, respectively. In Equations 1 to 3, the main explanatory variables are entered separately to avoid multicollinearity problems between proxy variables (*Outsider fraction* versus *Links of outsiders*; *R&D* versus *HV*). The *CEO duality* variable, which is used to examine Hypothesis 5, has less multicollinearity issues, and thus this variable is included together with the other variables in Equations 1 to 3.

For Hypotheses 6 and 7 (8 and 9), we adopt *Post-SOX*-related variables (*Familiar Influence* and *Reciprocal CEO Interlocks*) into our regression analyses to capture the impact of SOX (CEO–director ties) on performance for each type of firms. The dependent variables are performance measures. Among explanatory variables, *Post-SOX* is a dummy variable, indicating the period after 2002 (*Familiar Influence* and *Reciprocal CEO Interlocks*, representing two different types of CEO–director external directorship ties); Other control variables, including board, firm, and CEO variables, are the same with those in Equations 1 and 3.

4. RESULTS AND ANALYSES

4.1 The Influence of Board Structure on Firm Performance

We begin by examining relations between board composition and firm performance for diversified leveraged firms (Hypothesis 1) and R&D-intensive firms (Hypothesis 3). We first divide firms into three types: diversified leveraged firms, R&D-intensive firms, and normal firms (i.e., all other firms) to explore related issues. In terms of normal firms, due to the absence of theories regarding the relative strength of the monitor effect and the two advice effects from outside and inside directors, we do not take a prior stand on which is more likely to dominate.

In Equation 1, the main explanatory variables are *Outsider fraction*, *Outsider fraction* × *D&L*, and *Outsider fraction* × *R&D*; the corresponding coefficients are β_1, β_2, and β_3. β_1

captures the effect of *Outsider fraction* for normal firms; $\beta_1+\beta_2$ and $\beta_1+\beta_3$ (β_2 and β_3) are the total (incremental) effects of *Outsider fraction* for diversified leveraged firms and R&D-intensive firms, respectively. $\beta_2 > 0$ ($\beta_3 < 0$) denotes a positive incremental outsider (insider) fraction effect for diversified leveraged firms (R&D-intensive firms) relative to normal firms; $\beta_1+\beta_2 > 0$ ($\beta_1+\beta_3 < 0$) denotes that a higher fraction of outside (inside) directors enhances firm performance for diversified leveraged firms (R&D-intensive firms).

Model 1 of Table 2 provides the regression results for Equation 1. The results show that diversified leveraged firms (R&D-intensive firms) have a significant positive incremental outsider (insider) fraction effect and that *Tobin's Q* increases as the *Outsider fraction* increases (decreases). The findings support Hypothesis 1 ($\beta_2 > 0$ and $\beta_1+\beta_2 > 0$, p-value < 0.01) and Hypothesis 3 ($\beta_3 < 0$ and $\beta_1+\beta_3<0$, p-value < 0.01).

Hence, the results are consistent with the concept that the advice effects exist and have two directions: an outsider advice effect and an insider advice effect, which are amplified within diversified leveraged firms and R&D-intensive firms, respectively. Diversified leveraged firms' monitor effect and outsider advice effect have the same directional needs for more outside directors. Conversely, R&D-intensive firms' monitor effect and insider advice effect have opposite directional needs. However, the insider advice effect dominates the monitor effect; therefore, the results suggest stronger needs for inside directors.

Our results are predicated on controlling for firm types. Otherwise, the outsider and insider advice effects for different types of firms would confound and offset each other. The subsequent findings of the relation between firm performance and outsider fraction would be uncorrelated (traditional view) or inconclusive between (in some sample sets, weakly positive; in some other sample sets, weakly negative). Therefore, by taking firm types—and, therefore, unique advice effects—into account, the results help explain the internal relations between firm performance and outsider fraction.

In addition, the results of Hypothesis 2 support the advisory role of outside directors through their external links. Model 2 of Table 2 provides regression results for Equation 2 that examines Hypothesis 2. For diversified leveraged firms, *Tobin's Q* increases as the number of external directorships held by outside directors relative to inside directors increases ($\gamma_1+\gamma_2 > 0$, p-value < 0.01). The results imply that the firms benefit from the links of outside directors.[5]

5 The results are almost the same as those in which we consider both the number of external directorships of outside and inside directors in the model specification to observe the relation between performance and external directorships of outside directors.

Table 2　Regression Analyses for the Influence of Board Structure on Firm Performance

Independent variables		Prediction	Baseline Model	Model 1	Model 2	Model 3	Full Model
			Dependent variable: *Tobin's Q*				
Intercept	α		3.0751***	2.5634***	2.6841***	2.6293***	2.6225***
			(0.1543)	(0.1605)	(0.1514)	(0.1551)	(0.1680)
Outsider fraction	β_1		-0.2810**	-0.0961		0.0570	0.1420
			(0.0848)	(0.1040)		(0.0931)	(0.1219)
Outsider fraction × D&L	β_2	(+)		0.6393***			0.6017***
				(0.1670)			(0.1898)
Outsider fraction × R&D	β_3	(–)		-1.6974***			-1.8493***
				(0.1699)			(0.1965)
Links of outsiders	γ_1				0.0055*		0.0089**
					(0.0035)		(0.0038)
Links of outsiders × D&L	γ_2	(+)			0.0095**		0.0223***
					(0.0049)		(0.0064)
Links of outsiders × R&D	γ_3				-0.0120**		-0.0003
					(0.0056)		(0.0055)
Outsider fraction × HV	δ	(–)				-1.5583***	-1.4696***
						(0.1588)	(0.1586)
CEO duality	η_1		0.0992**	0.0523*	0.0350	0.0626**	0.0502*
			(0.0269)	(0.0349)	(0.0350)	(0.0346)	(0.0345)
CEO duality × D&L	η_2			-0.0594	-0.0539	-0.0453	-0.0577
				(0.0565)	(0.0567)	(0.0558)	(0.0558)
CEO duality × R&D	η_3	(+)		0.2076***	0.1921***	0.1819***	0.2031***
				(0.0565)	(0.0567)	(0.0559)	(0.0558)
Board size	κ_1		-0.0216***	-0.0152***	-0.0206***	-0.0164***	-0.0175***
			(0.0062)	(0.0061)	(0.0062)	(0.0061)	(0.0062)
Outside director ownership	κ_2		0.0497	0.0302	-0.0360	0.1384	0.1099
			(0.2802)	(0.2759)	(0.2761)	(0.2733)	(0.2723)
Firm size	κ_3		-0.0724***	-0.0487***	-0.0559***	-0.0741***	-0.0862***
			(0.0110)	(0.0109)	(0.0112)	(0.0109)	(0.0111)
Firm age	κ_4		0.0014**	0.0011*	0.0008	0.0019***	0.0014**
			(0.0007)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Leverage	κ_5		-0.7374***	-0.3452***	-0.3797***	-0.3419***	-0.3138***
			(0.0736)	(0.0789)	(0.0792)	(0.0781)	(0.0779)
Stock volatility	κ_6		0.0387***	0.0369***	0.0376***	0.0260***	0.0258***
			(0.0014)	(0.0014)	(0.0014)	(0.0015)	(0.0015)

Table 2 Regression Analyses for the Influence of Board Structure on Firm Performance (Continued)

Independent variables		Prediction	Baseline Model	Model 1	Model 2	Model 3	Full Model
			Dependent variable: *Tobin's Q*				
Intangible assets	κ_7		0.4833***	0.4461***	0.4218***	0.3552***	0.3786***
			(0.0669)	(0.0662)	(0.0664)	(0.0656)	(0.0654)
Free cash flow	κ_8		4.2816***	4.2911***	4.2680***	4.0363***	4.0948***
			(0.1431)	(0.1409)	(0.1417)	(0.1401)	(0.1397)
CEO tenure	κ_9		0.0037**	0.0033**	0.0041**	0.0020	0.0029*
			(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
CEO age	κ_{10}		-0.0166***	-0.0142***	-0.0145***	-0.0133***	-0.0122***
			(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
CEO ownership	κ_{11}		0.3392*	0.3851**	0.6320***	0.5925***	0.4515**
			(0.2332)	(0.2306)	(0.2281)	(0.2281)	(0.2279)
D&L	κ_{12}			-0.6337***	-0.2267***	-0.1853***	-0.6130***
				(0.1244)	(0.0524)	(0.0471)	(0.1293)
R&D	κ_{13}			1.7475***	0.6088***	0.5540***	1.7254***
				(0.1267)	(0.0555)	(0.0500)	(0.1329)
HV	κ_{14}					1.6234***	1.5554***
						(0.1134)	(0.1133)
Industry dummies			Yes	Yes	Yes	Yes	Yes
Year dummies			Yes	Yes	Yes	Yes	Yes
Adjusted R^2			0.2190	0.2437	0.2374	0.2572	0.2637
Number of observations			15,426	15,426	15,426	15,426	15,426
Model *p*-value			<0.001	<0.001	<0.001	<0.001	<0.001
F-test							
Hypothesis 1: $\beta_1+\beta_2$		(+)	--	0.5432***			0.7437***
Hypothesis 2: $\gamma_1+\gamma_2$		(+)	--		0.015***		0.0312***
Hypothesis 3: $\beta_1+\beta_3$		(−)	--	-1.7935***			-1.7073***
Hypothesis 4: $\beta_1+\delta$		(−)	--			-1.5013***	-1.3276***
Hypothesis 5: $\eta_1+\eta_3$		(+)	--	0.2599***	0.2271***	0.2445***	0.2533***
Joint Hypothesis Test: *Wald* χ^2			--	164.2616***	34.0526***	128.7732***	223.0888***

Notes: This table reports the estimation of the relations between board structure and firm performance. The dependent variable is firm performance, measured as *Tobin's Q*. The main explanatory variables used to test Hypotheses 1 to 5 are *Outsider fraction* × *D&L*, *Links of outsiders* × *D&L*, *Outsider fraction* × *R&D*, *Outsider fraction* × *HV*, *CEO duality* × *R&D*, respectively. The column of prediction shows the directions predicted by our hypotheses. Standard errors for the corresponding coefficient estimates are presented in parentheses. ***, **, and * denote significance levels for one-tailed tests at the 1%, 5%, and 10%, respectively. Joint hypothesis tests compute asymptotic Chi-squared statistics for carrying out the Wald-test-based comparisons between unrestricted and restricted models.

As to the monitoring effect, Hypotheses 4 and 5 investigate relations between board structure and firm performance when firms have high monitoring costs, which diminish the monitoring role of outside directors. In Hypothesis 4, we examine the relation for firms with high stock volatility. The regression results for Equation 3 in Model 3 of Table 2 suggest that high stock volatility firms benefit more from inside directors due to high monitoring costs of outside directors.[6] *Tobin's Q* increases as *Outsider fraction* decreases ($\beta_1 + \delta < 0$, *p*-value < 0.01). Hypothesis 5 examines the relation for R&D-intensive firms. In addition to higher monitoring costs, the firms face higher information sharing costs which can be alleviated by CEO duality. The results show that *Tobin's Q* is higher for R&D-intensive firms when their boards have CEO duality ($\eta_1 + \eta_3 > 0$, *p*-value < 0.01 in Models 1 to 3).

In addition, Table 2 presents the results of Baseline and Full Models. Comparing the results of Full Model (or Models 1 to 3) with those of Baseline in Table 2, one can find that the advisory and monitoring effects of boards for different types of firms would confound or offset each other without controlling for interaction terms between firm types and governance variables. The inference of Full Model, using all factors, is the same as that of Models 1 to 3, using three sets of factors for possible multicollinear concerns, separately. The results suggest that multicollinearity is not severe in our study. Moreover, joint tests of our hypotheses are presented in the last row of Table 2, as indicated by the *Wald* χ^2. The joint tests are significant, indicating that firm characteristics affect the dual roles of directors as advisors and monitors and thereby influence corporate performance. That is, the optimal board structure depends on the characteristics of the firm.

Furthermore, according to the results of Hypotheses 3 and 5 (Model 1 of Table 2), R&D-intensive firms with more inside directors and the CEO duality structure exhibit higher performance. The results suggest that a firm with higher monitoring and information sharing costs is more suitable to employ a more friendly board, either with less independence or the CEO duality structure, or both.

Finally, we use *ROA* and *Annual stock return*, measuring a firm's accounting performance and market-based performance, as alternative measures of firm performance. Table 3 shows similar results as those obtained by using *Tobin's Q* as the measure of performance. For the results of *ROA*, all coefficients used to test Hypotheses 1 to 5 are significant and are in the expected directions. For the results of *Annual stock return*, all coefficients used to test Hypotheses 1 to 4 are in the expected directions. The coefficients for Hypotheses 3 and 4 are significant and the other coefficients become insignificant. The reason of the reduced significance could be from the defect of the proxy measure because stock returns may be biased by market sentiment (Demsetz and Villalonga, 2001). In general, the results, however, present additional evidence to our hypotheses.

[6] Our results are robust to using earnings or stock volatilities as proxy variables of monitoring costs of outside directors.

Table 3 The Influence of Board Structure on Alternative Measures of Firm Performance

			Dependent variables					
			ROA			*Annual stock return*		
Independent variables		Prediction	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	α		0.1421***	0.1332***	0.1533***	0.2061***	0.1989***	0.1749***
			(0.0089)	(0.0075)	(0.0077)	(0.0470)	(0.0442)	(0.0406)
Outsider fraction	β_1		-0.0146***		-0.0141***	-0.0056		0.0108
			(0.0055)		(0.0044)	(0.0306)		(0.0244)
Outsider fraction × D&L	β_2	(+)	0.0139*			0.0348		
			(0.0088)			(0.0487)		
Outsider fraction × R&D	β_3	(−)	-0.0133*			-0.0891**		
			(0.0085)			(0.0470)		
Links of outsiders	γ_1			-0.0007***			-0.0009	
				(0.0002)			(0.0011)	
Links of outsiders × D&L	γ_2	(+)		0.0005**			0.0003	
				(0.0002)			(0.0015)	
Links of outsiders × R&D	γ_3			0.0002			-0.0009	
				(0.0003)			(0.0015)	
Outsider fraction × HV	δ	(−)			-0.0292***			-0.1522***
					(0.0075)			(0.0416)
CEO duality	η_1		-0.0026*	-0.0022*	-0.0019	-0.0049	0.0044	0.0015
			(0.0019)	(0.0016)	(0.0016)	(0.0104)	(0.0103)	(0.0091)
CEO duality × D&L	η_2		-0.0004	-0.0005	-0.0003	-0.0062	-0.0051	-0.0088
			(0.0030)	(0.0027)	(0.0026)	(0.0168)	(0.0168)	(0.0146)
CEO duality × R&D	η_3	(+)	0.0102***	0.0109***	0.0109***	-0.0129	-0.0142	-0.0186
			(0.0028)	(0.0027)	(0.0026)	(0.0157)	(0.0157)	(0.0146)
Board size	κ_1		-0.0024***	-0.0021***	-0.0023***	-0.0040**	-0.0038**	-0.0030**
			(0.0003)	(0.0003)	(0.0003)	(0.0019)	(0.0019)	(0.0016)
Other control variables			YES	YES	YES	YES	YES	YES
Adjusted R^2			0.5684	0.5729	0.5791	0.2147	0.2146	0.2100
Number of observations			15,426	15,426	15,426	15,426	15,426	15,426

Notes: This table reports robustness tests of the relations between board structure and firm performance for alternative measures of firm performance. Firm performance is measured by *ROA* and *Annual stock return*. The main explanatory variables used to test Hypotheses 1 to 5 are *Outsider fraction × D&L*, *Outsider fraction × R&D*, *Links of outsiders × D&L*, *Outsider fraction × HV*, *CEO duality × R&D*, respectively. *Other control variables*, including all other firm and CEO characteristic variables, are the same as those in Equations 1 to 3. The column of prediction shows the directions predicted by our hypotheses. Standard errors for the corresponding coefficient estimates are presented in parentheses. ***, **, and * denote significance levels for one-tailed tests at the 1%, 5%, and 10%, respectively.

4.2 The Impact of SOX and External Ties on Firm Performance

Table 4 provides regression analyses for Hypotheses 6 and 7. In the analyses, we adopt *Post-SOX*-related variables to capture the impact of SOX on performance for each type of firm. The results of Models 1 and 2 for *Tobin's Q*, *ROA*, and *Annual stock return* indicate that SOX has significant negative effects for both R&D-intensive firms and high stock volatility firms ($\varphi_1+\varphi_3 < 0$ and $\varphi_1+\varphi_4 < 0$, p-value < 0.01). The negative effect is more prominent for R&D-intensive firms in magnitude and significance.

Consequently, SOX and the exchange rules, which impose a uniform restriction for independence on boards for all firms despite the heterogeneous needs among different types of firms, restrain certain firms from obtaining higher performance. Particularly, R&D-intensive firms with progressively independent boards significantly underperform post-SOX. The firms suffer from overmonitoring and inefficient advisory problems due to a higher percentage of outside directors as compelled by law.

Further, we find evidence that SOX may be relatively beneficial for diversified leveraged firms in the post-SOX period ($\varphi_2 > 0$). However, the results are slightly weaker with respect to firms' accounting performance, *ROA* (p-value = 0.1022).

Table 5 reports the results of the effects of external directorship ties on performance. The results support Hypotheses 8 and 9 across different performance measures and model specifications ($\tau_1 < 0$ and $\tau_2 > 0$). Further, we find that directors' external directorships generally enable firms to access beneficial information and resources and then exhibit higher performance ($\tau_3 > 0$), where diversified leveraged firms benefit more from outside directors' external links ($\gamma_2 > 0$). However, firms whose CEOs with more external directorships appear to be distracted from their main work exhibit lower performance ($\tau_4 < 0$). Collectively, the results suggest that firms with more external directorship ties form their CEOs and directors do not necessarily underperform or outperform, and external directorship ties of the CEOs and directors should be considered separately and jointly.

4.3 Robustness Tests

In this section, we perform robustness checks for several concerns. These concerns include the problems of error term dependence, nonlinearity, endogeneity, and the hidden bias resulting from omitted variables.

4.3.1 Error term dependence and nonlinearity

The results show similar support for Hypotheses 1 to 5. Among them, for the problem of error term dependence in panel data, we employ the approaches of Fama and MacBeth (1973), White (1980), and Petersen (2009) to consider a probability of misestimating standard errors due to error term dependence within firm and time clusters. We reestimate the standard errors of coefficients because under- and over-estimation of standard errors

Table 4 The Impact of SOX on Performance for Different Types of Firms

			Dependent variables					
			Tobin's Q		*ROA*		*Annual stock return*	
Independent variables		Prediction	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intercept			2.7237***	2.7513***	0.1319***	0.1361***	0.1445***	0.1320***
			(0.1510)	(0.1462)	(0.0085)	(0.0083)	(0.0488)	(0.0473)
POST-SOX	φ_1		-0.1212***	-0.0954***	-0.0160***	-0.0177***	-0.0397***	-0.0235**
			(0.0373)	(0.0315)	(0.0020)	(0.0017)	(0.0122)	(0.0102)
POST-SOX × *D&L*	φ_2		0.1341**		0.0041†		0.0809***	
			(0.0595)		(0.0032)		(0.0196)	
POST-SOX × *R&D*	φ_3	(–)	-0.8659***		-0.0188***		-0.1373***	
			(0.0628)		(0.0032)		(0.0193)	
POST-SOX × *HV*	φ_4	(–)		-0.5494***		-0.0004		-0.1139***
				(0.0598)		(0.0032)		(0.0193)
D&L			-0.5968***		-0.0185***		-0.0171	
			(0.1241)		(0.0065)		(0.0395)	
R&D			1.7589***		-0.0051		0.0650**	
			(0.1268)		(0.0064)		(0.0387)	
HV				1.6187***		0.0403***		0.1739***
				(0.1139)		(0.0060)		(0.0367)
Other control variables			YES	YES	YES	YES	YES	YES
Adjusted R^2			0.2544	0.2599	0.5701	0.5742	0.2201	0.2189
Number of observations			15,426	15,426	15,426	15,426	15,426	15,426
Model *p*-value			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
F-test								
$\varphi_1+\varphi_2$			0.0129		-0.0119***		0.0412***	
$\varphi_1+\varphi_3$		(–)	-0.9871***		-0.0348***		-0.1770***	
$\varphi_1+\varphi_4$		(–)		-0.6448***		-0.0181***		-0.1374***

Notes: This table reports the changes of performance between pre- and post-SOX periods for different types of firms. The dependent variables are performance measures, *Tobin's Q*, *ROA*, and *Annual stock return*. Among explanatory variables, *POST-SOX* is a dummy variable that indicates the period after 2002; *Other control variables*, including board, firm, and CEO variables in Models 1 and 2 are the same with those in Equations 1 and 3. φ_1 represents the effect of SOX for normal firms and non-high stock volatility firms in Models 1 and 2, respectively. $\varphi_1+\varphi_2$, $\varphi_1+\varphi_3$, and $\varphi_1+\varphi_4$ (φ_2, φ_3, and φ_4) represent the total (incremental) effects of SOX for diversified leveraged, R&D-intensive, and high stock volatility firms, respectively. The corresponding explanatory variables of Hypotheses 6 (7) are *POST-SOX* and *POST-SOX* × *R&D* (*POST-SOX* × *HV*); the corresponding coefficients are $\varphi_1+\varphi_3$ and $\varphi_1+\varphi_4$. The results, in which the performance is measured by *Tobin's Q* (*ROA* and *Annual stock return*), provide main results (alternative robustness tests) for Hypotheses 6 and 7. Standard errors for the corresponding coefficient estimates are presented in parentheses. ***, **, *, and † denote significance levels for one-tailed tests at the 1%, 5%, 10%, and 15%, respectively.

Table 5　The Effects of External Directorship Ties on Performance

Independent variables		Prediction	*Tobin's Q* Model 1	*Tobin's Q* Model 2	*Tobin's Q* Model 3	*ROA* Model 1	*ROA* Model 2	*ROA* Model 3	*Annual stock return* Model 1	*Annual stock return* Model 2	*Annual stock return* Model 3
Intercept	α		2.7706***	2.7791***	2.7682***	0.1283***	0.1273***	0.1273***	0.1481***	0.1479***	0.1468***
			(0.1556)	(0.1557)	(0.1557)	(0.0077)	(0.0077)	(0.0077)	(0.0403)	(0.0404)	(0.0404)
Familiar Influence	τ_1	(–)	-0.0616***		-0.0744***	-0.0020**		-0.0012	-0.0086*		-0.0089*
			(0.0251)		(0.0263)	(0.0012)		(0.0012)	(0.0065)		(0.0068)
Reciprocal CEO Interlocks	τ_2	(+)	0.1258***		0.1261***	0.0051**		0.0057***	0.0173*		0.0180*
			(0.0484)		(0.0486)	(0.0023)		(0.0023)	(0.0125)		(0.0126)
Links of Directors	τ_3			0.0156***	0.0168***		0.0000	0.0000		0.0015*	0.0017*
				(0.0039)	(0.0040)		(0.0002)	(0.0002)		(0.0010)	(0.0010)
Links of CEO	τ_4			-0.0329**	-0.0282**		-0.0018***	-0.0020***		-0.0053*	-0.0049†
				(0.0154)	(0.0160)		(0.0007)	(0.0008)		(0.0040)	(0.0042)
Links of outsiders	γ_1		0.0074**	-0.0023	-0.0025	-0.0010***	-0.0010***	-0.0010***	-0.0017**	-0.0027***	-0.0027***
			(0.0036)	(0.0043)	(0.0043)	(0.0002)	(0.0002)	(0.0002)	(0.0009)	(0.0011)	(0.0011)
Links of outsiders × D&L	γ_2	(+)	0.0093**	0.0094**	0.0094**	0.0006***	0.0006***	0.0006***	0.0004	0.0004	0.0004
			(0.0047)	(0.0047)	(0.0047)	(0.0002)	(0.0002)	(0.0002)	(0.0012)	(0.0012)	(0.0012)
Links of outsiders × R&D	γ_3		-0.0031	-0.0023	-0.0026	0.0005**	0.0005**	0.0005**	-0.0007	-0.0006	-0.0006
			(0.0053)	(0.0053)	(0.0053)	(0.0003)	(0.0003)	(0.0003)	(0.0014)	(0.0014)	(0.0014)
CEO duality	η_1		0.0365†	0.0339	0.0349	-0.0018†	-0.0016	-0.0015	0.0022	0.0021	0.0023
			(0.0350)	(0.0350)	(0.0350)	(0.0016)	(0.0016)	(0.0016)	(0.0091)	(0.0091)	(0.0091)
CEO duality × D&L	η_2		-0.0551	-0.0531	-0.0537	-0.0007	-0.0006	-0.0006	-0.0092	-0.0088	-0.0089
			(0.0568)	(0.0568)	(0.0568)	(0.0027)	(0.0027)	(0.0027)	(0.0147)	(0.0147)	(0.0147)
CEO duality × R&D	η_3		0.1851***	0.1861***	0.1830***	0.0103***	0.0104***	0.0102***	-0.0193*	-0.0192*	-0.0196*
			(0.0568)	(0.0568)	(0.0568)	(0.0027)	(0.0027)	(0.0027)	(0.0147)	(0.0147)	(0.0147)
Board size	κ_1		-0.0233***	-0.0278***	-0.0275***	-0.0019***	-0.0019***	-0.0019***	-0.0022*	-0.0026*	-0.0026*
			(0.0064)	(0.0065)	(0.0065)	(0.0003)	(0.0003)	(0.0003)	(0.0017)	(0.0017)	(0.0017)
Other control variables			YES	YES	YES	YES	YES	YES	YES	YES	YES
Adjusted R^2			0.2377	0.2381	0.2386	0.5734	0.5735	0.5736	0.2068	0.2068	0.2068
Number of observations			15,426	15,426	15,426	15,426	15,426	15,426	15,426	15,426	15,426

Notes: This table provides the effects of external directorship ties of the CEO and directors on performance. Firm performance is measured by *Tobin's Q*, *ROA*, and *Annual stock return*. The main explanatory variables used to test Hypotheses 8 to 9 regarding joint CEO–director ties are *Familiar Influence* and *Reciprocal CEO Interlocks*. The explanatory variables regarding separate external directorship ties of the directors and the CEO are *Links of directors* and *Links of CEO*. *Other control variables*, including all other firm and CEO characteristic variables, are the same as those in Equation 2. The column of prediction shows the directions predicted by our hypotheses. Standard errors for the corresponding coefficient estimates are presented in parentheses. ***, **, *, and † denote significance levels for one-tailed tests at the 1%, 5%, 10%, and 15%.

lead to biases for and against rejecting the null hypothesis, respectively. False spurious significant results are particularly problematic because they cause incorrect inference. However, panel data sets, which have a probability of misestimating standard errors due to error term dependence within firm and time clusters, are commonly used in the literature. For this reason, Petersen (2009) adjusts the standard error estimates for possible error term dependence. Specifically, he argues that Fama and MacBeth (1973) and White (1980), the two main remedial approaches in the literature, are still affected by different extents of error term dependence within the firm cluster and are, therefore, biased. He corrects these biases and considers the dependence effects within both firm and time clusters. For completeness, we report test results from all the three approaches in Table 6. As Table 6 shows, the coefficients of all our main explanatory variables, β_2, β_3, γ_2, δ, and η_3, in Hypotheses 1 to 5 are stably significant for all three tests. Accordingly, even when considering the error term dependence, our results are robust.

For nonlinearity in the models, we consider quadratic forms to capture additional curvature effects. Figure 2 presents a graphic illustration of the nonlinear patterns. The figure allows a more intuitive observation of the empirical evidence. We find that performance of R&D-intensive firms has high sensitivity to board composition (Panel A) and board leadership structure (Panel D). Namely, the choice of board structure severely affects R&D-intensive firms' performance.

4.3.2 Endogeneity problem

In our regressions of firm performance, we use board composition and CEO ownership as independent explanatory variables while prior literature indicates that these variables, in turn, are determined by firm performance. Therefore, we address possible endogeneity concerns by adopting a simultaneous equation approach (three-stage least squares, 3SLS). This approach allows firm performance, board composition, and CEO ownership to be endogenously determined. The consideration is similar to Bhagat and Black (2002). Table 7 provides the results.[7]

We find that the relations between firm performance and board structure (Table 7, columns 1 in Systems 1 and 2) are generally consistent with our hypotheses.[8] The inferences of 3SLS and OLS models in Tables 6 and 2 for the effects of board structure on

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7 The literature commonly shows that firm size and age have direct effects on *Tobin's Q*, and therefore these variables should be included in Table 7, columns 1 of Systems 1 and 2. Actually, we include the variables when we implement the simultaneous equation approach. During parameter optimization, the process shows that the variables can be nearly explained by linear combinations of the other variables. Hence, the output neglects the coefficients; the effects, however, are taken into account in the estimation of the systems.

8 We further control for potential endogenous relations among performance, board, and firm variables by estimating simultaneous equations in *Tobin's Q*, *Outsider fraction*, *CEO duality*, *D&L*, *R&D*, and *HV*. The results are robust and consistently indicate the effects of board structure on firm performance. The corresponding coefficients are significant and with the expected sign.

Table 6　Correcting Error Term Dependence

Dependent variable: *Tobin's Q*			Approaches								
			White			Petersen			Fama–MacBeth		
Independent variables		Prediction	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	α		2.5634***	2.6841***	2.6293***	2.5634***	2.6841***	2.6293***	2.6346***	2.4769***	2.4831***
			(0.1784)	(0.1769)	(0.1801)	(0.3252)	(0.3251)	(0.3422)	(0.9725)	(0.9319)	(1.0847)
Outsider fraction	β_1		-0.0961		0.0570	-0.0961		0.0570	-0.3267***		-0.0404
			(0.0966)		(0.0757)	(0.1468)		(0.1212)	(0.3527)		(0.3001)
Outsider fraction × D&L	β_2	(+)	0.6393***			0.6393***			0.5665***		
			(0.1301)			(0.2051)			(0.4259)		
Outsider fraction × R&D	β_3	(–)	-1.6974***			-1.6974***			-0.4091†		
			(0.4355)			(0.7268)			(1.4087)		
Links of outsiders	γ_1			0.0055**			0.0055†			0.0026**	
				(0.0029)			(0.0045)			(0.0047)	
Links of outsiders × D&L	γ_2	(+)		0.0095***			0.0095**			0.0090***	
				(0.0033)			(0.0048)			(0.0079)	
Links of outsiders × R&D	γ_3			-0.0120*			-0.0120†			0.0003	
				(0.0082)			(0.0111)			(0.0269)	
Outsider fraction × HV	δ	(–)			-1.5583***			-1.5583***			-0.8903***
					(0.3677)			(0.4760)			(0.7350)
CEO duality	η_1		0.0523**	0.0350†	0.0626**	0.0523†	0.0350	0.0626*	0.0769***	0.0565**	0.0716***
			(0.0285)	(0.0276)	(0.0294)	(0.0447)	(0.0435)	(0.0452)	(0.1020)	(0.0916)	(0.1015)
CEO duality × D&L	η_2		-0.0594**	-0.0539*	-0.0453*	-0.0594†	-0.0539	-0.0453	-0.0321†	-0.0170	-0.0031
			(0.0348)	(0.0348)	(0.0343)	(0.0554)	(0.0544)	(0.0520)	(0.1094)	(0.1041)	(0.1071)
CEO duality × R&D	η_3	(+)	0.2076***	0.1921***	0.1819**	0.2076*	0.1921*	0.1819*	0.0586	0.0403	0.0567
			(0.0816)	(0.0808)	(0.0785)	(0.1364)	(0.1350)	(0.1318)	(0.3315)	(0.2973)	(0.3114)
Board size	κ_1		-0.0152***	-0.0206***	-0.0164***	-0.0152**	-0.0206**	-0.0164**	-0.0112**	-0.0140***	-0.0119**
			(0.0052)	(0.0053)	(0.0053)	(0.0090)	(0.0092)	(0.0088)	(0.0190)	(0.0179)	(0.0179)
Other control variables			YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations			15,426	15,426	15,426	15,426	15,426	15,426	15,426	15,426	15,426

Notes: This table provides robustness tests for correcting error term dependence problem in panel data. The estimated coefficients and corresponding standard error estimates for White (1980), Petersen (2009), and Fama–MacBeth (1973) approaches are presented in order. The estimated coefficients in White and Petersen approaches are both ordinary least squares coefficients. Petersen standard error estimates are adjusted by considering both error term dependence effects within firm and time clusters. The column of prediction shows the directions predicted by our hypotheses. ***, **, *, and † denote significance levels at the 1%, 5%, 10%, and 15%, respectively.

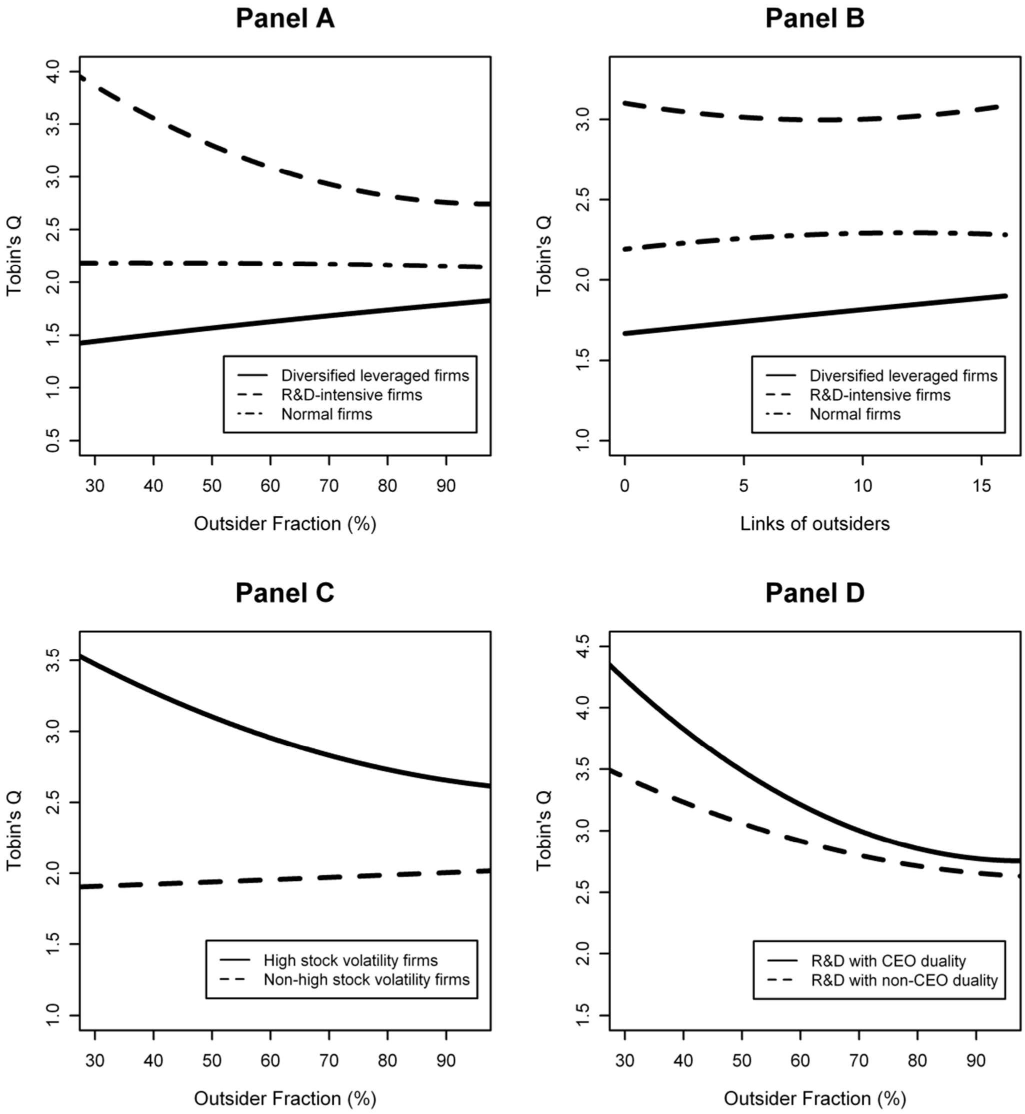

Figure 2 Board Structure and Firm Performance

Notes: This figure presents estimated relations between board structure and firm performance for different types of firms. Panels A and C depict relations between board composition and firm performance. Panel A is for diversified leveraged, R&D-intensive, and normal firms. Panel C is for high stock volatility firms and non-high stock volatility firms. Panel B depicts relations between external links of outside directors and firm performance for diversified leveraged, R&D-intensive, and normal firms. In Panel D, we further consider interactions between board leadership structure, board composition, and firm type to depict relations in R&D-intensive firms. Board composition, external links of outside directors, and firm performance are measured as *Outsider fraction*, *Links of outsiders*, and *Tobin's Q*, respectively. Except for the main variables, the control variables are held at means of their own firm type.

Table 7　Controlling for Endogeneity

Independent variables		Prediction	System 1			System 2		
			Tobin's Q	*Outsider fraction*	*CEO ownership*	*Tobin's Q*	*Outsider fraction*	*CEO ownership*
Intercept			1.4725***	-1.1596***	0.0373***	1.2435***	-1.1724***	0.0389***
			(0.4048)	(0.1560)	(0.0039)	(0.3978)	(0.1559)	(0.0039)
Tobin's Q				0.4852***	0.0065***		0.4969***	0.0062***
				(0.0431)	(0.0007)		(0.0434)	(0.0007)
Outsider fraction	β_1		1.2032**			1.6110***		
			(0.6919)			(0.6801)		
Outsider fraction × *D&L*	β_2	(+)	2.6506***					
			(0.0521)					
Outsider fraction × *R&D*	β_3	(−)	-0.6547***					
			(0.0530)					
Outsider fraction × *HV*	δ	(−)				-0.0749*		
						(0.0555)		
Board size			-0.0358***	0.0297***		-0.0421***	0.0317***	
			(0.0060)	(0.0040)		(0.0059)	(0.0040)	
CEO duality	η_1		-0.0020			-0.0187		
			(0.0529)			(0.0522)		
CEO duality × *D&L*	η_2		-0.3683***			-0.2906***		
			(0.0197)			(0.0219)		
CEO duality × *R&D*	η_3	(+)	0.1027***			0.0932***		
			(0.0197)			(0.0220)		
CEO ownership			4.5483***	9.8137***		4.5105***	10.0523***	
			(1.2075)	(0.9725)		(1.1863)	(0.9724)	
Outside director ownership			-0.1993	0.1666*	-0.0026	-0.0721	0.1433*	-0.0029
			(0.3399)	(0.1017)	(0.0099)	(0.3339)	(0.1016)	(0.0099)
CEO tenure				-0.0320***	0.0028***		-0.0328***	0.0028***
				(0.0027)	(0.0001)		(0.0027)	(0.0001)

Dependent variables: System 1 and System 2.

Table 7 Controlling for Endogeneity (Continued)

		Dependent variables					
		System 1			System 2		
Independent variables	Prediction	*Tobin's Q*	*Outsider fraction*	*CEO ownership*	*Tobin's Q*	*Outsider fraction*	*CEO ownership*
Firm size			0.0564***	-0.0042***		0.0518***	-0.0044***
			(0.0053)	(0.0003)		(0.0053)	(0.0003)
Firm age			0.0010***	-0.0001***		0.0014***	-0.0001***
			(0.0002)	(0.0000)		(0.0002)	(0.0000)
Stock volatility		0.0390***	-0.0214***		0.0268***	-0.0209***	
		(0.0014)	(0.0018)		(0.0016)	(0.0019)	
Intangible assets		0.1955***	-0.1334***		0.1387**	-0.1350***	
		(0.0665)	(0.0260)		(0.0655)	(0.0261)	
Leverage			0.2331***			0.2466***	
			(0.0456)			(0.0457)	
Free cash flow			-0.9875***			-1.0879***	
			(0.1886)			(0.1898)	
D&L		-2.0772***	0.2029***		-0.2433***	0.2046***	
		(0.0494)	(0.0153)		(0.0341)	(0.0153)	
R&D		1.0403***	-0.2795***		0.5642***	-0.2852***	
		(0.0566)	(0.0245)		(0.0430)	(0.0248)	
HV					0.6660***	-0.0363***	
					(0.0497)	(0.0103)	
Industry dummies		YES	YES	YES	YES	YES	YES
Year dummies		YES	YES	YES	YES	YES	YES
Number of observations		15,426	15,426	15,426	15,426	15,426	15,426

Notes: This table reports estimation results of systems of simultaneous equations. The results control for endogenous relations among firm performance, board composition, and CEO ownership for each system. The main explanatory variables used to test our hypotheses are *Outsider fraction* × *D&L*, *Outsider fraction* × *R&D*, *Outsider fraction* × *HV*, *CEO duality* × *R&D*, respectively. The column of prediction shows the directions predicted by our hypotheses. Standard errors for the corresponding coefficient estimates are presented in parentheses. ***, **, and * denote significance levels for one-tailed tests at the 1%, 5%, and 10%, respectively.

firm performance are similar, which suggests that endogeneity are not seriously skewing our results.[9] Furthermore, the Sarbanes–Oxley Act of 2002 (SOX) and related rules as exogenous shocks for board composition also alleviate the endogeneity problem.

As to relations between board composition and its determinants (Table 7, columns 2 in Systems 1 and 2), diversified leveraged firms (R&D-intensive firms and high stock volatility firms) tend to have a higher percentage of outside (inside) directors (the coefficients of *D&L*, *R&D*, and *HV* are significant; p-value < 0.01). The results suggest that the firms self-select the board composition that meets their unique needs even if it is not always optimal. Finally, relations between *CEO ownership* and its determinants (columns 3 in Systems 1 and 2) indicate that ownership is negatively related to *Firm size* and positively related to *Tobin's Q* and *CEO tenure*. These results are consistent with other current studies.

4.3.3 SOX impact controlling for effects of omitted and endogenous variables

To analyze the policy effect and avoid that such effect is contaminated by potential biases resulting from omitted or endogenous variables, we employ both propensity score-matching methods (PSM) and simultaneous equation models (SEM) to alleviate the potential biases. Among them, SEM permits sources of endogenous relations among firm performance, board composition, and CEO ownership. PSM builds experimental and control groups to approximate randomization by balancing the groups on potential confounding variables. The approach can effectively reduce the bias caused by omitted variables. Furthermore, for each type of firms, the effect of the policy is estimated from the difference in the outcomes for the treated and comparison firms. The corresponding coefficient is a difference-in-differences estimator. Table 8 presents the results.

The results of Table 8 not only provide support for Hypotheses 6 and 7 but also have policy implications. Without controlling for the potential biases, the results of Table 4 indicate that SOX appears to be detrimental to most firms ($\varphi_1 < 0$), in particular for R&D-intensive and high stock volatility firms ($\varphi_3 < 0$ and $\varphi_1+\varphi_3 < 0$; $\varphi_4 < 0$ and $\varphi_1+\varphi_4 < 0$). The benefits to diversified leveraged firms ($\varphi_1+\varphi_2 > 0$) are ambiguous. The policy seems to have no clear positive impact. However, controlling for the biases, the results of Table 8 show that SOX are beneficial to most firms ($\varphi_1 > 0$; $\varphi_2 > 0$ and $\varphi_1+\varphi_2 > 0$) and are only detrimental to R&D-intensive and high stock volatility firms. It suggests that policy has an overall positive impact and policy makers may only need to adjust the policy for certain industries. Hence, when evaluating policy one should take into account the potential biases and then can give objective opinions.

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[9] We estimate the relations between board structure and firm performance using two-stage least squares (2SLS) to control for potential endogeneity, and three-stage least squares (3SLS) to control for potential endogeneity and cross-correlation among the equations. Generally, 3SLS is more efficient than 2SLS. All the results of 3SLS and 2SLS estimates are consistent with the expectations. To save space, we only report the results of 3SLS estimates.

Table 8 The Impact of SOX Controlling for Effects of Omitted and Endogenous Variables

			Dependent variables					
			System 1			System 2		
Independent variables		Prediction	*Tobin's Q*	*Outsider fraction*	*CEO ownership*	*Tobin's Q*	*Outsider fraction*	*CEO ownership*
Intercept			3.0738***	0.5346***	0.0363***	3.3023***	0.7140***	0.0376***
			(0.2018)	(0.1249)	(0.0028)	(0.1680)	(0.0221)	(0.0027)
Tobin's Q				0.0140†	0.0033†		0.0277**	0.0029†
				(0.0134)	(0.0028)		(0.0149)	(0.0027)
POST-SOX	φ_1	(+)	0.1132**			0.0693*		
			(0.0599)			(0.0552)		
POST-SOX × D&L	φ_2	(+)	0.0586**					
			(0.0314)					
POST-SOX × R&D	φ_3	(–)	-0.8654***					
			(0.0649)					
POST-SOX × HV	φ_4	(–)				-0.5694***		
						(0.0615)		
Outsider fraction			-1.7271***			-1.4918***		
			(0.3873)			(0.3819)		
Board size			-0.0291***	0.0030***		-0.0368***	0.0030***	
			(0.0055)	(0.0005)		(0.0055)	(0.0005)	
CEO duality			0.0237			-0.0008		
			(0.0354)			(0.0348)		
CEO ownership			0.5673	-0.6561		6.8340	-5.4299***	
			(1.2075)	(3.4316)		(1.1863)	(0.3911)	
Outside director ownership			0.4776*	0.2190***	0.0120	0.7493***	0.2722***	0.0106
			(0.2971)	(0.0494)	(0.0107)	(0.3015)	(0.0589)	(0.0107)
CEO tenure				0.0479***	-0.0008		0.0374***	-0.0020
				(0.0076)	(0.0028)		(0.0146)	(0.0027)

Table 8　The Impact of SOX Controlling for Effects of Omitted and Endogenous Variables (Continued)

		Dependent variables					
		System 1			System 2		
Independent variables	Prediction	*Tobin's Q*	*Outsider fraction*	*CEO ownership*	*Tobin's Q*	*Outsider fraction*	*CEO ownership*
Firm size			0.0147	0.0047^{**}		0.0362^{***}	0.0045^{**}
			(0.0175)	(0.0028)		(0.0148)	(0.0027)
Firm age			0.0681^{***}	-0.0019		0.0672^{***}	-0.0001
			(0.0097)	(0.0028)		(0.0148)	(0.0027)
Stock volatility		0.0371^{***}	-0.0001		0.0251^{***}	-0.0003	
		(0.0014)	(0.0018)		(0.0016)	(0.0019)	
Intangible assets		0.3016^{***}	0.0092^{*}		0.1752^{***}	0.0082^{*}	
		(0.0674)	(0.0064)		(0.0668)	(0.0064)	
Other control variables		YES	YES	YES	YES	YES	YES
Number of observations		9,588	9,588	9,588	7,714	7,714	7,714
Hypothesis tests		Coefficients	*p*-value	Type	Coefficients	*p*-value	Type
$\varphi_1+\varphi_2$	(+)	0.1718^{***}	<0.01	*Wald*			
$\varphi_1+\varphi_3$	(–)	-0.7522^{***}	<0.01	*Wald*			
$\varphi_1+\varphi_4$	(–)				-0.5001^{***}	<0.01	*Wald*

Notes: This table reports the impact of SOX controlling for effects of omitted-variable and endogeneity concerns. The analyses employ both propensity score-matching methods (PSM) and simultaneous equation models (SEM) to alleviate potential bias resulting from omitted or endogenous variables. Matches are found using nearest-neighbor non-replacement matching approach. Endogenous relations allow firm performance, board composition, and CEO ownership to be endogenously determined. The dependent variables are *Tobin's Q*, *Outsider fraction*, and *CEO ownership*. Among explanatory variables, *POST-SOX* is a dummy variable that indicates the period after 2002; *Other control variables*, including board, firm, and CEO variables, in Systems 1 and 2 are the same with those in Equations 1 and 3. φ_1 represents the effect of SOX for normal firms and non-high stock volatility firms in Systems 1 and 2, respectively. $\varphi_1+\varphi_2$, $\varphi_1+\varphi_3$, and $\varphi_1+\varphi_4$ (φ_2, φ_3, and φ_4) represent the total (incremental) effects of SOX for diversified leveraged, R&D-intensive, and high stock volatility firms, respectively. The corresponding explanatory variables of Hypotheses 6 (7) are *POST-SOX* and *POST-SOX* × *R&D* (*POST-SOX* × *HV*); the corresponding coefficients are $\varphi_1+\varphi_3$ and $\varphi_1+\varphi_4$. Standard errors for the corresponding coefficient estimates are presented in parentheses. ***, **, *, and † denote significance levels for one-tailed tests at the 1%, 5%, 10%, and 15%, respectively.

5. CONCLUDING REMARKS

We examine whether different dual roles of outside and inside directors exist and, if so, how these roles affect firms differently, depending on the type of firms. Outside directors provide external advice and links. Hence, diversified leveraged firms appear to benefit more from outside directors because these firms have higher environmental uncertainty and more external resource dependency. Inside directors provide firm- or industry-specific advice. This effect appears to benefit R&D-intensive firms because these firms depend on short-lived innovations and thus need professional expertise and fast integration. For these firms, CEO duality structure further facilitates communication and execution that enhances firm performance. As to monitoring effects, although outside directors provide better monitoring incentive, they have less monitoring ability than inside directors, especially among certain classes of firms such as high stock volatility and R&D-intensive firms in which monitoring costs are high. Too high of a percentage of outside directors diminishes firm value.

Our findings regarding the implementation of SOX and related exchange listing rules further supports our argument. Namely, regulations imposing unvaried constraints on board structure to have a majority of independent directors are harmful to the firms that have more needs for inside directors. Such findings provide reference for government bodies when legislating. Further, although external directorship ties of directors increase performance by facilitating information and resource transfer, we need to also consider the effect of the joint CEO–director directorship ties which reduce performance due to undermining corporate governance. The restrictions of such CEO–director ties may be another consideration for ongoing legislation.

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