Three essays on corporate finance

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Introduction

The dissertation comprises three essays on corporate finance.

In essay one we examine whether corporate boards serve as a substitute or as a complement to external governance, using private firms as a setting for lack of external governance force. Supporting the substitution view that lack of external governance, such as hostile takeovers and stock market monitoring, makes private firms rely more on board monitoring, we find that compared to public firms, private firms have a smaller board, a higher proportion of outside directors, and a lower likelihood of CEO-chairman duality. We further find that private firms' CEO turnover-performance sensitivity, going-public likelihood, and IPO value increase with the proportion of outside directors.

Essay two examines the impact of board expertise on IPO underpricing using detailed biographical data on directors sitting on the boards of IPO firms over the period 2002 to 2008. We find that IPO firms whose boards have a higher proportion of directors with experience in investment banking, venture capital, and public firms (as directors or CEOs), or as lawyers, realize smaller underpricing. Directors' investment banking and public firm expertise also help lower underwriting fees and enhance firm value as measured by ratio of market capitalization on the first trading date to pre-IPO sales. These results are more pronounced when the directors have served on the boards of the IPO firms longer. We also find that board expertise has a stronger mitigating effect on IPO underpricing when firms have more advisory needs such as when they are large, when they have high leverage, or when their IPOs are not backed by venture capitalists. Overall these results suggest that board expertise plays an important role in helping reduce IPO underpricing and increase shareholder value.

Essay three focuses on corporate diversification, documenting a worsening effect over time. Diversified firms not only demonstrate a diversification discount; the discount also becomes larger over time after diversification. At a given point of time, mature diversified firms with larger diversification age are likely to perform worse than juvenile diversified firms. CEO incentives and information asymmetry partly explain the diversification time effect, but this time effect still holds after taking into consideration R&D expenditure, number of segments, firm age, CEO and board characteristics, other unobserved firm characteristics and self-selection bias. In addition, the time effect is not driven by poor corporate governance in mature diversified firms. However, mature diversified firms perform better and show a diversification premium during a financial crisis, which sheds some light on why firms choose to stay diversified.

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Essay One:

Does Board Monitoring Substitute for External Corporate Governance? Evidence from Private Firms

Abstract

We examine whether corporate boards serve as a substitute or as a complement to external governance, using private firms as a setting for lack of external governance force. Supporting the substitution view that lack of external governance, such as hostile takeovers and stock market monitoring, makes private firms rely more on board monitoring, we find that compared to public firms, private firms have a smaller board, a higher proportion of outside directors, and a lower likelihood of CEO-chairman duality. We further find that private firms' CEO turnover-performance sensitivity, going-public likelihood, and IPO value increase with the proportion of outside directors.

Keywords: Private firms, Public firms, Board size, Outside director, CEO-chairman duality, Monitoring role, Advisory role, External governance

JEL Classification: G32, G34, L22

1. Introduction

There has been much debate about whether corporate boards, an important internal governance mechanism, serve as a substitute or as a complement to external governance mechanisms. On the one hand, Fama (1980) and Fama and Jensen (1983) argue that board structure is determined by the effectiveness of external governance mechanisms (e.g., hostile takeovers and stock market monitoring) and thus, firms facing weaker external governance need to have more powerful boards to take greater responsibility in monitoring managerial discretion (substitution view). Shivdasani (1993), Gillan, Hartzell, and Starks (2007), and Ferreira, Ferreira, and Raposo (2011) find evidence supporting this view.

On the other hand, Cremers and Nair (2005) and Acharya, Myers, and Rajan (2011) argue that the internal governance mechanism is reinforced by the effective function of external governance mechanisms, leading to a complementary relation between the two (complementary view). Consistent with this view, Brickley and James (1987), Hadlock and Lumer (1997), and Mikkelsen and Partch (1997) find that the effectiveness of board oversight is enhanced by an active external takeover market.¹

This mixed evidence on the relation between monitoring and external governance systems suggests that the issue regarding whether boards of directors serve as a substitute or as a

¹ However, some studies find no significant relation between internal and external governance mechanism. For example, Denis and Kruse (2000) find that, after the level of takeover activity declines in the late 1980s, the frequency of internally precipitated forced CEO turnover and corporate restructuring activities in poorly performing firms are not significantly changed. Similarly, Huson, Parrino, and Starks (2001) find that the changes in the intensity of the takeover market are not associated with the changes in the sensitivity of CEO turnover to firm performance.

complement to external governance still remains an important empirical question. Moreover, given the importance of internal corporate governance in limiting managerial conflicts and its effect on firm performance, better understanding of this issue can shed further light on how firms design and implement their internal governance structures, which provides new insights into their value enhancement.

In this paper we examine the debate over the relation between board monitoring and external governance systems by using privately held firms as an experimental setting and comparing their board structure with that of public firms. In addressing the issue regarding whether the internal governance mechanism serves as a substitute or as a complement to the external governance mechanism, previous studies focus entirely on public firms, particularly on S&P 1500 firms. However, the degree of external governance scrutiny, such as takeover threats, stock market regulations, liquidity of stock trading and informativeness of stock prices, and attention from analysts and financial media, tends to be similar among these firms, making it difficult to draw a meaningful inference from the comparative analysis.² This problem is less severe when private firms are compared with public firms with similar characteristics because of the large variation in external governance mechanisms between these two types of firms: unlike public firms, private firms' stocks are not listed on the stock exchanges and thus, they do not face stock market monitoring.³ This large variation in external governance allows us to examine the debate about

²As suggested by Cremers and Ferrell (2013), Dittmar, Mahrt-Smith, and Servaes (2003), and Gao, Harford, and Li (2013), significant variation in governance is required for the meaningful analysis of whether governance matters.

³ Private firms can differ from public firms in several aspects, such as capital structure (Brav, 2009), dividend policy (Michaely and Roberts, 2012), investment intensity (Asker, Farre-Mensa, and Ljungqvist, 2012), and ownership

the substitutability (complementarity) of corporate governance in a more compelling and powerful way than prior studies that exclusively focus only on public firms.⁴ Moreover, using private firms enables us to perform rich empirical tests that are not possible in the analysis of public firms, such as the change in board structure around IPO events and the role of outside directors in IPOs.

We expect the influence of external governance to be much weaker in private firms than in public firms because private firms face little threat of hostile takeover or stock market monitoring due to no public trading of their shares. First, while poorly performing public firms are likely to become targets of hostile takeover, which helps curb managerial agency problems, private firms do not face the threat of hostile takeover because their stocks are not publicly traded. Second, unlike private firms, public firms' stock prices are continuously evaluated by outside investors, serving as an objective third-party assessment on managerial performance and playing an important role to discipline the managers (Holmstrom and Tirole, 1993; Ferreira, Ferreira, and Raposo, 2011). Third, public firm managers are constantly monitored by stock market regulators (e.g., Securities Exchange Commission), financial analysts, and the media, further constraining managers from rent-seeking behavior. In contrast, private firm managers

structure and CEO compensation (Gao and Li, 2013). In our regression analyses, we include a number of firm-specific variables to control for these differences, so that we can draw a meaningful inference for the relation between the difference in board structure between public and private firms and external governance mechanisms. Moreover, as discussed in Section 3, our sample private firms are more comparable to typical public firms than average private firms used in the previous studies. We also perform an instrumental variables approach to mitigate the concern that unobservable omitted variables affect our results.

⁴In addition, studying the board structure of private firms is of great interest to financial economists since there is lack of evidence on their board structure and its effectiveness due to data unavailability.

face little monitoring from these forces due to their private nature.

Previous studies show that smaller boards, outsider-dominated boards, and boards without CEO-chairman duality are more powerful in monitoring management than other types of boards (e.g., Yermack, 1996; Weisbach, 1988; Shivdasani and Yermack, 1999). Thus, the lack of external governance in private firms suggest that under the substitution (complementary) view, private firms have a more (less) powerful board than their public counterparts as measured by board size, the proportion of outside directors on the board, and CEO-chairman duality.

Using a large sample of 7,563 private and 23,790 public firm-year observations (4,099 matching private and public firm pairs) from 1999 to 2008, we find evidence supporting the substitution view—private firms have fewer directors but proportionally more outside directors than public firms, after controlling for various firm and CEO characteristics. Moreover, compared to public firm CEOs, private firm CEOs are less likely to take the position of chairman of the board.

To address the potential endogeneity of firms being publicly listed, we perform several additional tests. First, to take into account the possibility that some unobservable firm characteristics drive our results, we examine within-firm variation in listing status. Using a sample of more than 300 IPO firms, we find that there is a significant change in board structure as firms transition from private to public status: after being listed on stock exchanges, firms increase their board size, decrease the proportion of outside directors, and are more likely to appoint their CEO as chairman of the board. Second, we apply a two-stage least squares (2SLS) regression approach using industry average IPO underpricing as an instrumental variable. We

find that the differences in board size, the fraction of outside directors, and CEO-chairman duality between public and private firms remain statistically and economically significant, even after correcting for endogeneity bias. Third, we use a propensity score matching approach to control for observable firm and CEO characteristics that may affect both a firm's listing status and board structure decisions. We find that compared to matching public firms, private firms have a smaller board, a higher proportion of outside directors, and a lower frequency of CEO-chairman duality.

To provide supporting evidence that outside directors in private firms indeed take greater responsibility in advising and monitoring managers, we perform several tests. First, we examine the association between a firm's advisory and monitoring needs and outside director representation on the board, and find that this association is stronger in private firms than in public firms. Next, we examine private firms' CEO turnover-performance sensitivity, going-public likelihood, and IPO valuation, and find that the sensitivity of CEO turnover to operating performance in private firms, the likelihood of firms going public, and IPO value increase with the proportion of outside directors on the board. These results suggest that outside directors in private firms perform important value-enhancing monitoring and advisory functions for shareholders.

Our study contributes to the literature on corporate governance by showing that board effectiveness serves as a substitute to external governance. Unlike previous studies that focus entirely on public firms, our study includes both private and public firms in the analysis, allowing us to explore a greater variation in external governance than using only public firms.

This helps us better understand how a firm structures its internal governance mechanism in response to the external governance environment.

Moreover, our study uses Capital IQ database, a new private firm database that provides detailed information on directors for a large sample of private U.S. firms. Compared to prior studies that examine private firms from various other databases, private firms in our database are much more representative of typical public firms in terms of size, industry coverage, accounting performance, and level of disclosure. We use this database to provide evidence on the difference in board structures between public and private firms and examine the monitoring and advisory roles performed by outside directors in private firms. To the best of our knowledge, our paper is the first to examine differences in board structures between public and private firms in the U.S., and whether outside directors in private firms perform monitoring and advisory functions.

The paper is organized as follows. In Section 2, we review the literature and develop our main empirical predictions. In Section 3, we describe the data and sample characteristics. Section 4 presents results from the tests of our main hypotheses. In particular, we examine differences in board size, the proportion of outside directors on the board, and CEO-chairman duality between private and public firms and provide results from various cross-sectional regressions. In Section 5, we present results from controlling for endogeneity bias of being publicly listed. In Section 6, we examine the monitoring and advisory roles performed by outside directors in private firms, using CEO turnover and IPOs as the events for our experiments. Finally, we present a summary and concluding remarks in Section 7.

2. Prior Literature and Testable Prediction

Several papers provide evidence supporting the substitution view. For example, using a sample of 1,158 public firms, Shivdasani (1993) finds that firms with ineffective boards are more likely to become hostile takeover targets. Similarly, Gillan, Hartzell, and Starks (2007) analyze a sample of S&P 1500 public firms and find that firms with more anti-takeover provisions have more powerful boards. These studies suggest that the market for corporate control substitutes for board monitoring. Using S&P 1500 firms, Ferreira, Ferreira, and Raposo (2011) further show a negative association between stock price informativeness and board independence, interpreting this result as evidence that stock market monitoring substitutes for board monitoring.

On the other hand, other papers find results that support the complementary view. Brickley and James (1987) examine the board structure in the banking industry and find that the number and proportion of outside directors on the board are greater when there is an active market for corporate control. Using a sample of 240 public firms during the 1983–1988 period and a sample of 231 public firms during the 1933–1941 period, respectively, Mikkelsen and Partch (1997) and Hadlock and Lumer (1997) show that boards are more likely to fire underperforming CEOs during the active takeover period. Hadlock and Lumer (1997) interpret their finding as evidence that the takeover market complements board effectiveness. Cremers and Nair (2005) and Acharya, Myers, and Rajan (2011) further show that the internal governance mechanism by blockholders and subordinates is complementary to the external governance mechanism.

While these studies help us understand the substitutability and complementarity of corporate governance, their analyses are based on either a small sample of public firms, or on a sample of

very large public firms (e.g., S&P 1500 firms), within which the variation in the external governance mechanism is likely to be small (Gao, Harford, and Li, 2013). Moreover, they typically focus on only one aspect (usually takeover markets) of a firm's multi-faceted external governance environment and thus, fail to fully capture the strength of the overall external governance. For example, Armstrong, Balakrishnan, and Cholen (2012) find that firms' stock price informativeness increases following the passage of anti-takeover provisions; Lang, Lins, and Miller (2004) find that analysts tend to play more active monitoring roles when the country-level legal protection for shareholders is poor. These studies do not consider the possibility that the weakness of one dimension of external governance is associated with the strength of another dimension of external governance and thus, do not necessarily provide the inference for the overall external governance. Our paper, which considers both private and public firms in the analysis, mitigates this concern since our argument (that private firms have weaker external governance than public firms) is not based on some particular aspect of external governance, but on fairly comprehensive (if not all) dimensions of external governance, including hostile takeover, stock price informativeness, analyst and media monitoring, and stock market regulation.

To examine whether boards of directors serve as a substitute or as a complement to external governance, we focus on three measures of board effectiveness, board size, the proportion of outside directors, and CEO-chairman duality. Jensen (1993) argues that a larger board is less efficient due to poorer communication and greater coordination problems. Supporting this argument, Yermack (1996) documents an inverse relation between firms' market valuation and

board size, although others show that board size is shaped by a broad combination of firm-specific and managerial characteristics (Boone, Field, Karpoff, and Raheja, 2007; Coles, Daniel, and Naveen, 2008; Lehn, Patro, and Zhao, 2009).

In addition, previous studies show that outside directors on the board play an instrumental role in internal governance⁵. For example, Fama (1980), Hermalin and Weisbach (1998), and Monks and Minow (2000) argue that outside directors play an important role in monitoring managerial behavior. Supporting this argument, Brickley and James (1987), Weisbach (1988), and Byrd and Hickman (1992), for example, show that outside directors protect the interests of shareholders when agency problems exist between managers and shareholders. This result suggests that boards with a higher proportion of outside directors are more efficient in disciplining poorly performing managers than those with a lower proportion of outside directors.

Finkelstein and D'Aveni (1994) show that powerful boards are less likely to favor CEO-chairman duality when performance is poor. Shivdasani and Yermack (1999) find that compared to a CEO who is not chairman of the board, a chairman CEO is more powerful and has more discretion with respect to important firm decisions, such as director appointments. Goyal

⁵ Prior literature also indicates outside directors may not effectively monitor and control agency problems. For example, Jensen (1993) argues that information problems severely hinder the ability of board members to contribute effectively to the monitoring and evaluation of the CEO. A recent study by Duchin, Matsusaka and Ozbas (2010) also argues the effectiveness of outside directors depends on the cost of acquiring information about the firm. Although the effectiveness outside directors' monitoring role is inconclusive, sizable studies in literature still agrees that outside directors protect the interest of shareholders when there are agency problems (Brickley and James, 1987; Weisbach, 1988; Byrd and Hickman, 1992). In addition, Hermalin and Weisbach (1998) argue that board structure depends on the balance of power between the CEO and outside directors. In their model, a board's independence is determined by a bargaining game between the shareholders and the CEO. Therefore, outside directors are considered to represent the shareholder's interest in the board-setting process, even if the effectiveness of outside directors' monitoring is not clear.

and Park (2002) further show that a chairman CEO is less likely to be fired for poor firm performance. These studies suggest that CEO-chairman duality gives more power to the CEO and may hinder the board's ability to monitor management.

Taken together, these studies on board structures suggest that a smaller board, a higher proportion of outside directors on the board, and a board in which a CEO is not its chairman are more effective and powerful than other types of board structures. Since the substitution view argues that lack of external governance in private firms makes them structure their boards more effectively and powerfully, it predicts that compared to public firms, they are more likely to have a smaller board, a higher proportion of outside directors on the board, and a lower likelihood of the CEO being chairman of the board. In contrast, the complementary view, which posits that the internal governance mechanism is reinforced by the external governance mechanism, predicts that stronger external governance environments from the stock market force public firms to possess a more effective and powerful board, characterized by a smaller board size, a higher proportion of outside directors on the board, and a lower likelihood of the CEO being chairman of the board.

3. Sample and Summary Statistics

3.1. Sample

Our primary data source for private and public firms is the Capital IQ (CIQ) database. CIQ is an affiliate of S&P and provides financial and director data beginning in the late 1990s on private U.S. firms that file their financial statements to the SEC. Private firms are required to file their

financial statements to the SEC if: 1) they have outstanding public debt; or 2) the value of their total assets is greater than \$10 million and the number of their shareholders is more than 500. The majority of these private firms are subject to similar disclosure requirements as public firms, ensuring that data on financial statements and directors are of similar quality to those reported by public firms in our sample. Thus, any differences that we document in our paper are not due to reporting differences between the two types of firms.⁶ These SEC filing requirements also ensure that our sample consists of larger and more economically important private firms than other private firms used in previous studies, and is more comparable to typical public firms than average private firms. In addition, the coverage of CIQ for private firms is comparable to the coverage of Compustat and ExecuComp for public firms.⁷ It is also worth noting that private firms used in our study are not typical private firms managed by owners but a sample of private firms run by professional managers. Thus, managerial agency problems in our sample of private firms are likely to be nontrivial compared with public firms, making board monitoring important for these firms.

⁶ The differences in information asymmetry between public and private firms could influence the differences in their board composition (Fama and Jensen, 1983; Jensen, 1993). In general, compared to public firms, private firms are not subject to the same level of accounting information scrutiny by regulatory agencies and capital market participants, suggesting that private firms face greater information asymmetry and enjoy considerable latitude in setting accounting policy (Ball and Shivakumar, 2005; Burgstahler, Hail, and Leuz, 2006; De Franco, Gaviglio, Jin, and Richardson, 2011). However, given the high level of disclosure requirements for our sample of private firms, it is unlikely that any major differences in information asymmetry between public and private firms drive our results.

⁷ Since the late 1990s, CIQ provides data on accounting and director information for both private and public U.S. firms, with a similar level of detail as provided by Compustat and ExecuComp for public firms. Unique to CIQ, for all firms covered in CIQ, it provides links to the company filings, so that users can easily check the original source data. Gao and Li (2013) and Gao, Harford, and Li (2013) also use CIQ for their studies of CEO compensation and cash policies of private firms, respectively.

We start with all private and public U.S. firms with non-missing values for total assets in CIQ, from 1999 to 2008. We require that public firms be traded on the NYSE, AMEX, or NASDAQ. We also require that both private and public firms have financial data as well as data on CEO and board characteristics. Private firms in our sample are those that are not listed in any stock exchange. Thus, firms that have shares traded in the over-the-counter market are excluded from the sample. CIQ classifies a firm as either public or private according to its most recent listing status. For example, Synnex Corp. (NYSE:SNX), a California-based IT supply chain services company, is classified as a public firm throughout its history in CIQ even though it became public only in 2003. We search all the key dates for each firm in CIQ's IPO and delisting databases to help classify a firm's private (or public) status by backfilling. Returning to the Synnex example, given that its IPO was in November 2003, we classify Synnex as a private firm from 1999 to 2002 and then as a public firm from 2003 onward. To clearly capture any differences in board structure between public and private firms, in most of our analyses we omit the transitioning firm-year observation when a firm changes from being a private firm to a public firm or vice versa.

Our final sample consists of 7,563 private firm-year observations (2,712 unique private firms) and 23,790 public firm-year observations (4,318 unique public firms). A vast majority of the private firm-year observations in our sample (88.4%) come from Form 10-K and annual reports filed with the SEC; the remaining (11.6%) come from Form S-1 (and its supplemental Form 424B—less than 3% of the total sample) filed with the SEC due to public debt issuances or IPOs.

CEO ownership data on private firms are manually collected from the firms' annual reports

and proxy statements. For public firms, we obtain CEO ownership data from ExecuComp, Corporate Library, and IRRC. When CEO ownership is not available in these sources, we obtain it by searching each firm's annual report and proxy statement. CEO ownership is measured as the firm's shares owned by the CEO normalized by the total number of shares outstanding.

Our private sample firms have a total of 30,828 directors on their boards. For about 57% (17,418 directors) of these directors, CIQ records the beginning and ending years of their directorship in the firms, which allows us to exactly estimate the length of time they served in each firm. For the remaining 43% of directors, we search firms' annual reports and proxy statements to determine the exact years in which they acted as directors. For public firms, we collect director information from BoardEx and IRRC. Following Coles, Daniel, and Naveen (2008) and Linck, Netter, and Yang (2008), we classify directors who are executives in the firm as inside directors and directors who do not have any executive role in the firm as outside directors. Appendix 1 shows the composition of the directors on KMG America Corporation's board, one of our sample private firm boards, as of 2006, and their major affiliation prior to appointments to the board.

Table 1 Panel A presents the distribution of our sample of private and public firms by year and their board characteristics. Several findings are noteworthy. First, although board size is relatively stable in both private and public firms over time, private firms have a smaller board size than public firms in every year. Second, prior to the passage of the Sarbanes-Oxley Act(SOX)

in 2002,⁸ the proportion of outside directors on the board was relatively higher in private firms than in public firms. However, after 2002, there has been a clear, increasing trend in the proportion of outside directors in public firms, but the trend is reversed for private firms. These results seem to suggest that, to meet the SOX requirement that the majority of a public firm's board of directors be independent, some public firms may have to compete with private firms in hiring outside directors, which results in the increasing (decreasing) trend in the fraction of outside directors in public (private) firms. Finally, CEOs of private firms are less likely to be chairman of the board than CEOs of public firms across all years.

Overall, these results are broadly consistent with the substitution view that private firms' unique contracting environments (lack of external governance mechanism) influence them to choose board structures that are more powerful.

Table 1 Panel B presents the distribution of our sample of private and public firms by industry (Fama and French (1997) 48 industries). Our sample firms have broad industry representation covering all 48 industries, with business services (11.46%), banking (11.28%), and utilities (6.1%) having the highest representation among private firms, while banking (11.54%), business services (11.17%), and electronic equipment (7.07%) have the highest representation among public firms.⁹

⁸ SOX focuses primarily on the independence of audit committees in public firms and requires that each member of the audit committee be independent. The contemporary rule changes adopted by the NYSE and NASDAQ require firms to have a majority of independent directors on the board.

⁹ In untabulated tests, we re-estimate key regressions in the paper after excluding firms in either the financial services or utilities industries, and obtain qualitatively similar results.

3.2. Summary statistics

In the first six columns of Table 2, we compare board-, firm-, and CEO-specific characteristics for the full sample of private firms with those for the full sample of public firms. We winsorize all continuous variables at the 1st and 99th percentiles and convert all dollar values to 2008 dollars. Detailed definitions of the variables used in Table 2 are presented in Appendix 2.

We find that board size, the proportion of outside directors, and the fraction of firms with CEO-chairman duality are smaller in private firms than in public firms, significant at the 1% level. Specifically, for private (public) firms, the mean board size is 6.69 (8.81), the mean proportion of outside directors is 0.75 (0.78), and the mean percent of firms with CEO-chairman duality is 0.49 (0.65).

Turning to firm characteristics, we find that private firms are smaller and younger than public firms. In addition, private firms have poorer operating performance, higher leverage, higher R&D intensity, lower frequency of dividend payout, and fewer business segments.

We also find that compared to CEOs of public firms, those of private firms are less likely to be a founder of the firm, are younger, and are less likely to hold an MBA degree. They also have higher equity ownership (mean equity ownership of 14.84% compared with mean equity ownership of 4.76% in public firms).

The last six columns of Table 2 compare board-, firm-, and CEO-specific characteristics for matching samples of private and public firms, where the matching is conducted based on industry, size, and year. Specifically, for each private firm in our sample, we select a matching public firm in the same year that is in the same Fama-French (1997) 48 industry and closest in

sales. To ensure that the matching public firm is truly comparable in size to its private peer, we require that the public firm's sales be within [90%, 110%] of the private firm's sales. We drop a private firm from the matching sample if it is too small (i.e., the private firm's sales are less than 90% of the sales of all public firms in the same industry), in which case no matching public firm is available. These procedures result in a final sample of 4,099 matched pairs of private and public firms.

Not surprisingly, the mean sales for private and public matching firms are almost identical at \$1,205 million and \$1,207 million, respectively. We also observe that the differences in other firm characteristics between private and public firms are much smaller based on the matching samples than on the full samples, albeit the differences in several variables are still statistically significant. Most importantly, we find that board size and the fraction of firms with CEO-chairman duality are significantly smaller in private matching firms than in public matching firms. However, the mean and median proportions of outside directors on the boards become significantly higher for private matching firms than for public matching firms. These results are consistent with the substitution view that due to the lack of external monitoring from the stock market, the board structures of private firms are designed to give more power to the board of directors than those of public firms.

4. Comparison of Board Structures between Private and Public Firms

To better understand differences in the cross-sectional variation in board structures between private and public firms, this section presents estimates from multivariate regressions.

4.1. Baseline model

We begin our analysis by examining differences in the number of directors on the board between private and public firms. We estimate the following ordinary least squares (OLS) regression:

$$\begin{aligned} \text{Board Structure} &= \alpha + \beta_1 \text{Public} + \beta_2 \text{Firm Size} + \beta_3 \text{Leverage} + \beta_4 \text{Number of Segments} \\ &\quad + \beta_5 \text{R\&D} + \beta_6 \text{Other Firm Characteristics} + \beta_7 \text{CEO Characteristics} \\ &\quad + \text{Industry FE} + \text{Year FE} + \varepsilon. \end{aligned} \tag{1}$$

In column (1) of Table 3 Panel A, the dependent variable is $\ln(\text{Board size})$, the natural logarithm of the number of directors. Our key independent variable of interest is *Public*, which is an indicator that takes the value of one if the firm is publicly traded in a given year and zero otherwise. Following Boone, Field, Karpoff, and Raheja (2007) and Coles, Daniel, and Naveen (2008), to control for firm complexity, firm-specific knowledge, and the monitoring needs of the firm, we include *Firm Size* (natural logarithm of sales), *Leverage* (ratio of total debt to total assets), *Number of Segments* (number of segments in the firm), and *R&D* (ratio of R&D expenditures to total assets).¹⁰ The regression also includes the other firm and CEO characteristics used in Table 2 as additional control variables. Finally, we include *Industry FE* (fixed effects) to control for unobservable industry-specific heterogeneity and *Year FE* to account

¹⁰ In untabulated tests, we use as a measure of firm size the book value of total assets instead of sales and find almost identical results as those reported in Table 3.

for time trends. The coefficient estimate on *Public*, thus, measures the difference in board size between public and private firms that cannot be explained by differences in firm and CEO characteristics, and industry and year effects.

Table 3 Panel A column (1) presents the results using the full samples of private and public firms. The coefficient estimate on *Public* is positive and significant at the 1% level. The coefficient estimate of 0.160 on *Public* in regression (1) suggests that public firms have a 17.4% ($e^{0.160} - 1$) larger board size than private firms, consistent with the substitution view.

Turning to other firm and CEO characteristics, we find that board size is positively related to firm size, an indicator for dividend payments, the number of firm segments, firm age, and public bond indicator, but negatively related to leverage. We also find that firms with higher CEO ownership have a smaller board, supporting the view that board size is smaller when the interests of managers are better aligned with those of shareholders (Harris and Raviv, 2008). These results are broadly consistent with those of Boone, Field, Karpoff, and Raheja (2007) and Linck, Netter, and Yang (2008).¹¹

To investigate the difference in the proportion of outside directors across public and private firms, we reestimate Eq. (1) by replacing the dependent variable, $\ln(\text{Board size})$, with the proportion of outside directors. Panel A column (2) presents the regression results, using the full

¹¹ Stock exchanges typically require that board committees, such as compensation committees, audit committees, and nomination committees, consist entirely of outside directors. This requirement may (indirectly) lead public firms to have a larger board than private firms. In untabulated tests, we include the proportion of outside directors as an additional control variable to account for this exchange requirement and find that our results do not change. In addition, we compare the number of inside directors between public and private firms and find that public firms also have a larger number of inside directors than private firms. Thus, stock exchanges' requirement on board composition for public firms is unlikely to drive our results.

samples of private and public firms. The coefficient estimate on *Public* is a significant -0.052, indicating that the proportion of outside directors is approximately 5.2% higher in private firms than in public firms. This result supports the substitution view.

Next we examine the difference in the likelihood of a CEO being the chairman of the board between private and public firms by estimating a logit regression in which the dependent variable is a CEO-chairman duality indicator that takes the value of one if the CEO is the chairman of the board and zero otherwise. We use as explanatory variables those used in Eq. (1).

We report the marginal effects that measure the effect of a one-unit change in the continuous explanatory variables from the sample mean (moving from zero to one for indicator variables) on the dependent variable. Column (3) presents results using the full samples of private and public firms. Consistent with the substitution view, we find that the coefficient on *Public* is positive and significant at the 1% level. Its marginal effect has a coefficient of 0.156, suggesting that the probability of a CEO being the chairman of the board is approximately 15.6% higher in public firms than in private firms. Moreover, consistent with the view that powerful CEOs are more likely to hold the position of chairman of the board, we find that the likelihood of CEO-chairman duality is higher in firms with a founder CEO, firms in which the CEO has higher ownership, and firms with an older CEO.¹²

The results using the subsample of matching private and public firms in columns (4)-(6) echo those reported in columns (1)-(3), respectively. Overall, these findings support the substitution

¹² In untabulated tests, we remove all IPO firms from our sample of private firms and reestimate the regressions reported in Table 3. Our results do not change.

view.

4.2. Analysis of private firms with non-owner CEOs

To the extent that the monitoring role of a firm's board of directors is most applicable to firms with non-owner CEOs, in this subsection we conduct robustness tests using the subsample of private firms with non-owner CEOs. Specifically, we define a private firm CEO as a non-owner if the CEO is not the firm's founder and his stock ownership is less than 1% and obtain a total of 2,393 private firm-year observations (894 private firms) with non-owner CEOs. We then use the sample of public firms and the subsample of private firms with non-owner CEOs in reestimating Eq. (1).

The results are reported in Table 3Panel B. Consistent with the results in Table 3Panel A, we find that private firms have a smaller board, a higher proportion of outside directors, and a lower likelihood of the CEO being chairman of the board.¹³

4.3. Cross-sectional heterogeneity across public firms

To examine whether the differences in board structures between public and private firms documented in the previous sections are indeed due to the differences in their external governance effectiveness, in this subsection we divide public firms into two subgroups: namely, public firms that resemble private firms in terms of external governance environment and other public firms. We then examine whether the differences in board structure between the former

¹³ As an alternative definition, we use the sample median CEO ownership in private firms as the cutoff point in classifying private firm CEOs into non-owner CEOs and obtain almost identical results.

type of public firms and private firms are less pronounced than the differences in board structures between the latter type of public firms and private firms.

In Panel C of Table 3, we decompose the public firm indicator into two indicators: an indicator for S&P 1500 public firms and an indicator for other public firms. We then reestimate Eq. (1) by replacing the public firm indicator with these two indicators. Compared to the public firms that are not included in the S&P 1500 index, previous studies show that S&P 1500 public firms have more analyst coverage, more informative stock prices, and greater media and regulatory scrutiny (Cadman, Klasa, and Matsunaga, 2010). Thus, if the differences in board structures between public and private firms are mainly driven by the differences in their external governance environment, we expect these differences to be more pronounced for S&P 1500 public firms than for non-S&P 1500 public firms.

Supporting this prediction, we find that in all the six regressions (except for column (1)), the coefficient estimates on the indicator for S&P 1500 public firms are significantly larger than those on the indicator for non-S&P 1500 public firms. Specifically, in regression (4) in which the dependent variable is $\ln(\text{Board size})$, the coefficient estimate on the indicator for S&P 1500 public firms is a significant 0.167, while the coefficient estimate on the indicator for non-S&P 1500 public firms is a significant 0.126. The difference in coefficient estimates between these two indicators is significant at the 5% level. Thus, although both S&P and non-S&P 1500 public firms have a larger board than private firms, the difference is particularly pronounced for public firms included in the S&P 1500 index. In the full sample (match sample) regression, compared to private firms, S&P 1500 public firms have a 7.4% (7.0%) lower proportion of outside directors

while non-S&P 1500 public firms have a 3.2% (2.9%) lower proportion of outside directors (regressions (2) and (5)). The difference in these two coefficient estimates is significant at the 1% level. Finally, we find that CEOs in S&P 1500 public firms are 20.3% (full sample) and 17.0% (match sample) more likely to be appointed as chairman of the board than CEOs in private firms while the corresponding difference for CEOs in non-S&P 1500 public firms and private firms is only 10.4% (full sample) and 10.9% (match sample). The difference in these two coefficient estimates is again significant at the 1% level.

Overall, these results support our argument that the differences in board structures between private and public firms are largely driven by the difference in external governance environments.

4.4. Controlling for other governance mechanisms

In addition to stock market monitoring, public and private firms may also differ in other governance mechanisms, including CEO compensation structure (Ke, Petroni, and Safieddine, 1999; Gao and Li, 2013), monitoring by debtholder (Brav, 2009), and monitoring by external auditors (Hope, Thomas, and Vyas, 2013). Thus, it is possible that the differences in board structures between public and private firms documented in the previous sections are driven by these differences in governance mechanisms. To address this issue, we examine whether our results are robust to controlling for CEO compensation structure and the influence of banks and external auditors. As the measures of CEO compensation structure, we use the proportions of

bonus, restricted stock, and option grants in the CEO's total compensation.¹⁴ To measure the influence of banks and external auditors, we use the ratio of bank debt normalized by total assets and an indicator for having one of big 4 auditors as a firm's external auditor, respectively. Due to data limitation on these variables, our analysis is performed using a subsample of 4,616 private and 20,697 public firm-year observations during the 1999–2008 period (3,256 matching private and 3,256 matching public firm-year observations).¹⁵

The results are reported in Table 3 Panel D. We find that after controlling for these three governance mechanisms, private firms still have a smaller board, a higher proportion of outside directors, and a lower likelihood of the CEO being chairman of the board than public firms.¹⁶ Thus, private firms have a more powerful board than public firms, even after controlling for other dimensions of governance mechanisms.

5. Endogeneity Issues

¹⁴ The valuation method of restricted stock and option grants follows Gao and Li (2013). For restricted stock in both public and private firms, we take the value as reported by the firm. For stock options in public firms, we calculate the dollar value based on ExecuComp's modified Black-Scholes approach. For stock options in private firms, we apply Black-Scholes approach under the following assumptions: (1) the volatility is the 60-month return volatility of a public firm in the same industry and year with the closest cash flow volatility; (2) the risk-free rate is the seven-year Treasury bond yield prevailing on the grant date; (3) the grant-date stock price is the exercise price (the option is granted at-the-money); (4) the dividend yield is the ratio of the dividend paid out in the last year to the exercise price; and (5) the time to maturity is 70% of the stated maturity.

¹⁵ In untabulated tests, we find that, compared with public firms, private firms borrow more from banks, are less likely to have a big-four auditor, and use fewer performance-based compensation contracts for their CEOs.

¹⁶ Starting from 2004, Capital IQ also records information on large shareholders, which allows us to additionally control for equity ownership by top 5 largest outside shareholders in the regression for a subsample of firms during the 2004–2008 period. We still find that private firms have a smaller board and a lower likelihood of the CEO being chairman of the board than public firms.

Thus far, we have not explicitly taken into account the endogeneity of a firm's listing status and board structure. However, it is possible that some unobservable firm characteristics simultaneously affect both a firm's listing decision and its board's structure. In this section we perform several tests to mitigate this potential endogeneity bias concern.

5.1. Analysis of changes in board structure around IPOs

To address the endogeneity bias, we examine changes in board structure for the subset of our sample firms that transition from private to public status (i.e., IPOs) using a difference-in-difference approach. Specifically, using a sample of 324 firms (1,358 firm-year observations) that go public, we examine how their board structure (size, proportion of outside directors, and CEO-chairman duality) changes from the pre-IPO period to the post-IPO period. Although the IPO event is not completely exogenous in the sense that firms adopt a well-planned exit strategy long before they go public, it can nevertheless serve as an interesting setting to test the prediction that the differences in external governance mechanisms between private and public firms affect the differences in their board structures. Moreover, examining the transition from private to public status provides corroborating evidence on the cross-sectional patterns documented in our previous analyses. It also allows us to exploit within-firm variation in listing status and to control for unobservable, time-invariant firm characteristics that might have an effect on board structure.¹⁷

¹⁷Although examining the cases in which firms transition from public to private status is an alternative way to address the potential endogeneity of listing status, as Leslie and Oyer (2009) and Asker, Farre-Mensa, and Ljungqvist (2012) discuss, governance data on firms that go private are extremely difficult to obtain in the U.S.

For each IPO firm, we select a control private firm that is in the same industry and has the closest sales prior to IPO. We also require that the control firm does not change its private status during the sample period. Our key variable of interest is the *Post-IPO* indicator, which takes the value of one for an IPO firm in the post-IPO year and zero otherwise. We include year fixed effects to account for the variation over time associated with market conditions that may influence IPO timing. We also include firm fixed effects in order to control for within-firm variation associated with the public/private status. Thus, the *Post-IPO* indicator variable captures the change in board structure for private firms around the IPO.¹⁸ We include as control variables those used in Eq. (1).

Table 4 presents the results. In column (1), we regress the natural logarithm of board size on the *Post-IPO* indicator and control variables. The coefficient estimate on *Post-IPO* is 0.315, significant at the 1% level, suggesting that private firms expand their board size by approximately 37% ($e^{0.315} - 1$) after being listed in the stock exchanges. This result is consistent with those from the cross-sectional analysis reported in Table 3.

In column (2), we use the proportion of outside directors on the board as the dependent variable. We find that the coefficient estimate on *Post-IPO* is -0.057, significant at the 1% level, indicating that the proportion of outside directors decreases by 5.7% after IPOs. In column (3), we estimate a logit regression in which the dependent variable is a CEO-chairman duality indicator. The coefficient estimate on *Post-IPO* is 0.056, significant at the 5% level, suggesting

¹⁸Chemmanur, He, and Nandy (2013) use a similar approach to study the change in total factor productivity around IPOs.

that the probability of a CEO being appointed as chairman of the board increases by 5.6% after private firms become publicly listed. This result is in line with those in Table 3.¹⁹

Overall, the results in Table 4 indicate a significant shift in board structure as firms transition from private to public status in ways that corroborate our findings from the cross-sectional analyses.

5.2. SLS regressions

Although going-public events serve as a good experiment that mitigates the potential endogeneity problems inherent in tests of the differences in board structures between private and public firms, in this subsection we further address the endogeneity problems by using a 2SLS regression approach. In the first stage, we run a probit regression to predict the firm's *Public* status. In the second stage, we use the predicted *Public* status as the independent variable and examine how it influences board structures. For the purpose of identification, we need instrumental variables (IVs) that affect a firm's propensity of being public, but do not affect its board structure directly other than through the effect of being public.

Going public provides private firms with access to public equity capital, but when companies go public, the shares they sell tend to be underpriced (Ibbotson, 1975). IPO underpricing is costly to a firm's owners, because shares sold for personal account are at too low a price (Ljungqvist 2004). Therefore, we use industry average IPO underpricing (measured by the average value of

¹⁹ In untabulated tests, we also remove the firm-year observations from year -1 to year +1 around the IPO year (year 0) to account for the possibility that IPO firms may start to change their board structure prior to the IPO. Our inferences are unchanged.

the percentage difference between the offer price and the first trading day closing price in the industry-year) as the IV for *Public*. To the extent that a firm is more likely to go public after observing a lower IPO underpricing (lower cost) in its industry, our IV is expected to be negatively correlated with the likelihood of firms going public. Therefore, our instrument is likely to satisfy the relevance criteria. However, given its exogenous nature with respect to an individual firm, industry average IPO underpricing is unlikely to have any direct impact on a firm's board characteristics other than through the effect of being public. Thus, our instrument is likely to satisfy the exclusion restriction as well.

In the second-stage regression, we estimate regressions of board structure (size, proportion of outside directors, and CEO-chairman duality) on the predicted value of *Public* from the first stage and the other control variables used in Eq. (1).

The results using a pooled sample of 7,563 private and 23,790 public firm-year observations are reported in Table 5. As expected, the coefficient estimate on industry IPO volume is negative and significant at the 5% level in the first-stage regression (column (1)). The *F*-statistic on the test that industry IPO volume is equal to zero is 5.440, which rules out the weak instrument concern (Staiger and Stock, 1997).

Column (2) shows the results from the second-stage regression in which *Ln (Board size)* is used as the dependent variable. We find that the coefficient estimate on the predicted variable for *Public* is positive and significant at the 1% level. The magnitude of its coefficient (0.198) suggests that all else being equal, private firm boards have on average 22% ($e^{0.198} - 1$) fewer directors than public firm boards.

We also find that in column (3) ((4)), where the dependent variable is the proportion of outside directors (indicator variable for CEO-chairman duality), the coefficient estimate on the predicted variable for *Public* is a significant -0.116 (0.146). These results further support the substitution view that weak external governance from the stock market makes private firms rely more on powerful boards.

5.3. Propensity scores matching

To further address the potential sample selection concern in tests of the differences in board structures between private and public firms, in this subsection we follow Michaely and Roberts (2012) and use a propensity score matching approach. Although this approach cannot address the endogeneity bias caused by omitted *unobservable* firm and industry characteristics, it allows us to control for *observable* firm and industry characteristics that may affect a firm's listing status and board structure decisions.

We first estimate the propensity scores using a probit model in which the dependent variable is an indicator that takes the value of one for a public firm and zero for a private firm. To find optimal matches, we separately use three different matching techniques: nearest neighborhood, Gaussian kernel, and local linear regression. All matchings are conducted with replacement. The set of firm and CEO characteristics that we use to calculate the propensity score includes Ln(sales), ROA, sales growth, leverage, the ratio of capital expenditures to total assets, the ratio of R&D expenditures to total assets, a dividend payment indicator, number of segments, Ln(firm age), public bond indicator, founder CEO indicator, CEO ownership, Ln(CEO age), and CEO

MBA degree indicator. In addition to these firm and CEO characteristics, we use industry (Fama and French 48 industries (1997)) and year as additional matching criteria. We then use the predicted probabilities (i.e., propensity scores) from the probit regression to match each public firm-year observation to the private firm-year observation that minimizes the absolute value of the difference between the propensity scores. We use bootstrapped standard errors, based on 50 replications, to conduct statistical inferences. We also calculate bias-corrected 95% confidence intervals.

Table 6 reports the differences in board size, proportion of outside directors, and likelihood of CEO-chairman duality between our sample of private firms and matching public firms. Consistent with the results in Table 3, we find that, on average, compared to matching public firms, private firms have a significantly smaller board, higher proportion of outside directors, and lower frequency of CEO-chairman duality.²⁰

Overall, our key findings in previous sections appear to be robust to controlling for potential endogeneity concerns, further supporting the substitution view.

6. Advisory and Monitoring Roles of Outside Directors in Private Firms

Prior literature shows that boards of directors perform two primary functions: monitoring and advising management. In this section, to further provide evidence on the substitution view, we

²⁰ In untabulated tests, for a smaller subsample of private firms in the 1999-2008 period, we also include the ratio of bank debt to total assets, the indicator for big four auditors, and CEO performance-based pay as three additional independent variables in the first step of propensity score matching. We still find that private firms have a smaller board, a larger proportion of outside directors, and lower likelihood of their CEO being chairman of the board than their matching public firms.

examine how private firms design their board structure based on their monitoring and advising needs²¹ and whether they are more responsive to these needs than public firms.

6.1. Advisory and monitoring needs and outside directors

Prior literature shows that firms' advising needs can be measured in several different ways. For example, Hermalin and Weisbach (1988) suggest that CEOs of diversified firms need more advice. Klein (1998) argues that the CEOs' advisory needs increase with the extent to which the firm depends on the environment for resources, suggesting that larger firms need more advice. Besides, firms with high project verification costs (e.g., R&D intensive firms) or firms with better investment opportunities (e.g., high capital expenditure firms) are also likely to need more advice. To capture firms' advisory needs, we compute a variable *Advising Need*, which is a factor score based on the number of segments, Ln(sales), the ratio of R&D expenditures to total assets, and the ratio of capital expenditures to total assets. The factor score for a firm-year observation is a linear combination of the transformed (to standard normal) values of these variables.

Similarly, some firms may have more monitoring needs than others. For example, when the firm has less outstanding debt (Jensen, 1986), when it pays less dividend (Easterbrook, 1984), when it grows rapidly (Jensen, 1986), when the CEO of the firm is not the founder (Villalonga and Amit, 2006), or when the CEO holds little ownership of the firm (Jensen and Meckling, 1976), there are likely to be more agency problems, and thus, these firms may need better

²¹ Coles, Daniel, and Naveen (2008) investigate how public firms' board structures differ depending on their advising and monitoring needs.

monitoring. We construct a variable *Monitoring Need* to capture shareholders' need to monitor the management. *Monitoring Need* is a linear combination of the transformed (to standard normal) values of the following five variables: non-debt ratio (1 - leverage ratio), sales growth, indicator for no dividend payout, non-founder CEO indicator, and equity ownership by non-CEOs (1- CEO ownership).

The substitution view suggests that firms with more advisory and monitoring needs should have more outsiders on the board for their better advisory and monitoring services (Hermalin and Weisbach, 1988; Agrawal and Knoeber, 2001) and this effect is stronger in private firms than in public firms. Specifically, we estimate the following OLS regression:

$$\begin{aligned}
 & \textit{Proportion of outside director} \\
 &= \alpha + \beta_1 \textit{Public} + \beta_2 \textit{Advising Need} + \beta_3 \textit{Monitoring Need} \\
 &+ \beta_4 \textit{Advising Need} \times \textit{Public} + \beta_5 \textit{Monitoring Need} \times \textit{Public} \\
 &+ \beta_6 \textit{Other Firm Characteristics} + \beta_7 \textit{CEO Characteristics} \\
 &+ \textit{Industry FE} + \textit{Year FE} + \varepsilon. (2)
 \end{aligned}$$

Firm and CEO characteristics used in Eq. (2) are the same as those used in the Table 3 regressions, except for Ln(sales), sales growth, leverage, Capex, R&D, dividend, number of segments, CEO founder indicator, and CEO ownership. These variables are not included in estimating the regressions because they are already used in the construction of *Advising Need* and *Monitoring Need* variables. The substitution view predicts β_4 and β_5 to be negative and significant.

Table 7 presents the results. Column (1) shows that in a pooled sample of public and private firms, the proportion of outside directors on the board increases significantly with firms' advising

and monitoring needs. In columns (2) and (3), we add as independent variables the interaction terms of *Advising Need* and *Monitoring Need* with *Public*, respectively. We find that the coefficient estimates on both interaction terms are significantly negative, indicating that the sensitivity of the positive relation between firms' advising(monitoring) needs and the proportion of outside directors on the board is stronger in private firms than in public firms. More specifically, when the advising (monitoring) needs increase by one unit, the proportion of outside directors on the board increases 1.3% (1.4%) more in private firms than in public firms. When we include both interaction terms in the same regression (column (4)), the coefficient estimates on *Advising Need*, *Monitoring Need*, and their interaction terms with *Public* remain significant.

These results suggest that both private firms and public firms tend to design their board structure based on their advisory and monitoring needs, but private firms are more responsive to these needs than public firms, supporting the substitution view.²²

6.2. Likelihood of CEO turnover in private firms

In this subsection we examine whether outside directors in private firms indeed perform monitoring roles. To the extent that prior literature on monitoring roles of outside directors is limited to public firms, examining the functions performed by outside directors in private firms not only cross-validates existing evidence on the roles of corporate boards, it also provides a new

²² In an untabulated analysis, we find that the association between the proportion of outside directors and monitoring needs is stronger in private firms run by non-owner CEOs than in private firms run by owner CEOs, consistent with the view that the board's monitoring role is more important when the CEO has more severe agency problems.

perspective on such roles when firms have weak external governance mechanisms. Thus, the analysis in this subsection helps provide additional evidence on the substitution view.

To investigate whether outside directors in private firms play an active monitoring role, we examine the likelihood of CEO turnover. To the extent that outside directors play an instrumental role in internal governance and the board structure in private firms is designed to empower directors to do what is good for shareholders, we expect that outside directors in private firms play an important role in disciplining top executives when firm performance is poor. To examine the likelihood of CEO turnover, we perform logit regressions in which the dependent variable equals one if a CEO turnover event occurs in a given year and zero otherwise.²³ Our key variable of interest is the interaction term between industry-adjusted ROA and the proportion of outside directors on the board. The regressions also include control variables as reported in Table 3. To compute the marginal effect of the interaction term, we follow the approach developed by Ai and Norton (2003).

Table 8 Panel A reports the results. Column (1) shows that the coefficient estimate on the proportion of outside directors is positive and significant at the 1% level, suggesting that outside directors in private firms play an important role in CEO turnover decisions. Not surprisingly, the coefficient estimate on past industry-adjusted ROA is negative and significant at the 5% level, indicating that poorly performing private firms are more likely to change their CEOs.

²³We obtain information on CEO turnover from CIQ. Because CIQ provides detailed information on CEO turnover starting from 2001, our tests in this section are conducted over a slightly smaller sample of private firms corresponding to the 2001-2008 period. Of the 4,383 private firm-year observations for which we have data during this period, we find 469 CEO turnover events.

In column (2), we add the interaction term between the proportion of outside directors and past industry-adjusted ROA. We find that the coefficient estimate on this interaction term is negative and significant at the 5% level, suggesting that private firms with a higher proportion of outside directors are more likely to change CEOs in response to poor operating performance.

The management changes that we identify with CIQ include both forced and voluntary CEO turnovers. To the extent that voluntary CEO turnovers occur due to nongovernance- or nonperformance-related reasons, they may add noise to the turnover regressions above. Thus, to focus on CEO turnover events that are more likely due to nonroutine reasons, we classify the following three types of CEO changes as normal, if: 1) the departing CEO is at least 65 years old; 2) the departing CEO is at least 60 years old; or 3) the departing CEO is a founder. We then delete firms that experience each type of these CEO changes from the full sample, respectively, and reestimate regression (2) separately for each of these subsamples.

The results are reported in columns (3)-(5) of Table 8 Panel A. We find that, across all regressions, the coefficient estimates on the interaction term between the proportion of outside directors and past industry-adjusted ROA are negative and significant at or lower than the 10% level. These results suggest that outside directors in private firms do indeed play a significant monitoring role in CEO turnover.

In Table 8 Panel B, we pool public and private firms with negative industry-adjusted ROA and test whether the association between the likelihood of CEO turnover and the proportion of outside directors is different between poorly performing public and private firms. Our key variable of interest is the interaction term between the *Public* indicator and the proportion of

outside directors. Given that we focus on only the subsample of firms with poor performance, the coefficient on this interaction term shows the differential effects of outside directors in dismissing poorly-performing CEOs in public and private firms. In column (1) we find that the coefficient estimate on the proportion of outside directors is positive and significant at the 1% level, suggesting that outside directors in private and public firms play an important role in CEO turnover decisions. Further, we find that the coefficient estimate on the interaction term of the proportion of outside directors with *Public* is negative and significant at the 1% level, indicating that when the operating performance is poor, outside directors in private firms are more likely to change CEOs than those in public firms. In columns (2)-(4), we focus on CEO turnover events that are more likely due to nonroutine reasons. Again, we find that across all regressions, the coefficient estimates on the interaction term are negative and significant at the 1% level. These results suggest that outside directors in private firms play a more active monitoring role in CEO turnover than those in public firms, further supporting the substitution view.

6.3. Likelihood of going public and IPO valuation

IPOs are one of the most important exit strategies that allow private firm shareholders to diversify their holdings and/or to cash out some of their investment. Thus, IPOs can be considered one of the key financial decisions that a private firm's board has to make to maximize shareholder wealth. If outside directors in private firms play an important role in facilitating these exit transactions, we expect that the probability of a private firm going public increases with the proportion of outside directors on the board. To test this prediction, we estimate logit

regressions in which the dependent variable is an indicator that equals one if the private firm goes public in a given year during our sample period and zero otherwise. We use as explanatory variables those used in the Table 3 regressions. In addition, we control for an indicator for venture-backed firms (Barry et al., 1990). Out of 2,712 private firms, we find that 324 go public during our sample period.

The results are presented in the first three columns of Table 9 Panel A. The coefficient estimates on the proportion of outside directors are positive and significant in all three regressions, indicating that outside directors help private firm shareholders exit via IPOs.

One concern with the logit regressions above is that they do not explicitly take into account the well-known endogeneity problem in board composition. To address the concern that the appointments of outside directors may be endogenously determined, we perform 2SLS regressions. In the first stage, we regress the proportion of a firm's outside directors on two instruments for board composition, namely, state- and industry-level average proportions of outside directors, and the firm and CEO characteristics used in column (3). To the extent that the proportion of a firm's outside directors is influenced by board composition policies of peer firms in the same area (Knyazeva, Knyazeva, and Masulis, 2013), we expect firms located in a state in which geographically proximate firms have outsider-dominated boards to have more outside directors on their boards. Similarly, we expect firms operating in the same industry in which peer firms have outsider-dominated boards to have more outside directors on their boards. Thus, both of our instruments are likely to be highly correlated with a selection variable (i.e., the proportion of outside directors), but due to their exogenous nature they are unlikely to be directly related to

outcome variables (i.e., firm's IPO decision).

In the second stage, we estimate a logit regression of the likelihood of going public using the predicted value of the proportion of outside directors from the first stage as explanatory variables, and the other control variables used in column (3) of Table 9 Panel A. For brevity, we only report the results from the second stage in column (4).²⁴ The coefficient estimate on the predicted value of the proportion of outside directors is a significant 0.017, indicating that outside directors in private firms play a valuable role in facilitating IPO activities, even after correcting for potential endogeneity bias.²⁵

However, these results are also consistent with an alternative explanation that private firms planning to go public hire more outside directors prior to their IPOs to meet board composition requirements as imposed by SOX. To address this concern, in column (5) we use a firm's proportion of outside directors in 1999 (the earliest year in our sample) to predict the likelihood of going public during the entire sample period and find that a higher proportion of outside directors increases the probability of going public. Moreover, in untabulated tests we reestimate the regressions using only the pre-SOX period and obtain similar results as those reported in the table. Thus, our results are unlikely to be driven by board composition requirements imposed by SOX.

To further test the role of outside directors in private firms, we examine whether a private

²⁴ In the first stage, we find that both state- and industry-level average proportions of outside directors have positive and significant coefficients. The test of the joint significance of the two instruments results in an *F*-statistic of 100, which confirms the validity of our instruments (Staiger and Stock, 1997).

²⁵ In untabulated tests, we also use a 2SLS regression method in estimating CEO turnover regressions in Table 8 Panel A. We find that our results do not change.

firm value around IPOs is related to the proportion of outside directors on the board. If outside directors' monitoring and advisory functions help private firms receive higher values at the IPOs, we expect IPO valuations to be higher for private firms with a higher proportion of outside directors than those with a lower proportion of outside directors. To address this issue, we estimate OLS regressions in which the dependent variable is the ratio of IPO valuation to sales (IPO firm's market capitalization on the first trading date, calculated as first-trading-day stock price multiplied by total shares outstanding, over sales prior to the IPO) and the explanatory variables are those used in Table 9 Panel A. We include *Reputable Underwriter* (indicator that equals one if the lead underwriter has a ranking of 9 on a 9-point scale based on Jay Ritter's underwriter rankings and zero otherwise) and $\ln(IPO\ Proceeds)$ as additional control variables (Schenone, 2004).

The estimates from the OLS regressions are reported in the first three columns of Table 9 Panel B. We use a sample of 324 private firms that go public to estimate the regressions. We find that the coefficient estimates on the proportion of outside directors are positive and significant in all three regressions. Correcting for an endogeneity bias in column (4) and using the proportion of outside directors in 1999 as the independent variable in column (5) do not change the results. Thus, IPOs by firms with a higher proportion of outside directors are greeted more positively by investors than those by firms with a lower proportion of outside directors.

Overall, these results provide strong evidence that outside directors in private firms play an important value-enhancing role in helping shareholders receive high transaction prices from firms' exit strategies, which further supports the substitution view.

7. Summary and Conclusion

Unlike public firms, private firms do not face stock market monitoring (e.g., no stock market regulatory requirements, little analyst and media scrutiny, and no hostile takeover threat) since their stocks are not listed on stock exchanges. This external governance environment of private firms allows us to examine whether boards of directors serve as a substitute or as a complement to external governance in a more powerful way than prior studies that exclusively focus only on public firms. We find that consistent with the substitution view, the weak external governance of private firms provides their shareholders with stronger incentives to structure more efficient and powerful boards than shareholders of public firms.

More specifically, we find that compared with public firms of similar characteristics, private firms have a smaller board, a board with a higher fraction of outside directors, and a board in which the CEO is less likely to be chairman. In addition, private firms select their outside directors in a more responsive way to their advisory and monitoring needs than public firms. We also find that CEO turnover-performance sensitivity in private firms and the likelihood of private firms going public increase with the proportion of outside directors on the board. Moreover, IPO valuation on the first trading date is higher for private firms with a high proportion of outside directors than those with a low proportion of outside directors. These results suggest that outside directors in private firms perform important value-enhancing functions.

Overall, these results support the view that board serves as a substitute for external governance mechanisms.

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Table 1. Sample distribution by year and industry

The sample consists of 7,563 private firm-year observations and 23,790 public firm-year observations during the 1999-2008 period, obtained from the Capital IQ database. Definitions of all variables are provided in Appendix 2. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

Panel A: Distribution of Sample Firms by Year

Year	Sample Size		Mean (Median) Board Size				Mean (Median) Proportion of Outside Directors				Mean (Median) CEO-Chairman Duality (Indicator)			
	Private Firms	Public Firms	Private Firms (1)	Public Firms (2)	Test of Difference (1) – (2): <i>p</i> -value		Private Firms (3)	Public Firms (4)	Test of Difference (3) – (4): <i>p</i> -value		Private Firms (5)	Public Firms (6)	Test of Difference (5) – (6): <i>p</i> -value	
					<i>t</i> -test	Wilcoxon Z-test			<i>t</i> -test	Wilcoxon Z-test			<i>t</i> -test	Wilcoxon Z-test
1999	615	991	5.66 (5)	9.30 (9)	0.00***	0.00***	0.75 (0.83)	0.69 (0.78)	0.00***	0.00***	0.59 (1)	0.77 (1)	0.00***	0.00***
2000	741	1489	6.35 (6)	9.22 (9)	0.00***	0.00***	0.78 (0.83)	0.71 (0.78)	0.00***	0.00***	0.57 (1)	0.75 (1)	0.00***	0.00***
2001	832	1603	6.53 (6)	9.37 (9)	0.00***	0.00***	0.78 (0.86)	0.76 (0.80)	0.00***	0.00***	0.53 (1)	0.75 (1)	0.00***	0.00***
2002	843	1701	6.57 (6)	9.29 (9)	0.00***	0.00***	0.77 (0.83)	0.77 (0.81)	0.52	0.00***	0.51 (1)	0.75 (1)	0.00***	0.00***
2003	906	2939	6.64 (6)	8.59 (8)	0.00***	0.00***	0.77 (0.83)	0.79 (0.82)	0.09*	0.00***	0.50 (1)	0.69 (1)	0.00***	0.00***
2004	859	3125	6.86 (6)	8.69 (8)	0.00***	0.00***	0.77 (0.86)	0.80 (0.83)	0.00***	0.36	0.48 (0)	0.65 (1)	0.00***	0.00***
2005	746	3420	6.91 (6)	8.67 (8)	0.00***	0.00***	0.75 (0.83)	0.81 (0.83)	0.00***	0.15	0.47 (0)	0.63 (1)	0.00***	0.00***
2006	738	3134	7.13 (7)	8.57 (8)	0.00***	0.00***	0.74 (0.83)	0.81 (0.85)	0.00***	0.00***	0.43 (0)	0.58 (1)	0.00***	0.00***
2007	644	3229	7.21 (7)	8.54 (8)	0.00***	0.00***	0.72 (0.82)	0.82 (0.86)	0.00***	0.01***	0.41 (0)	0.57 (1)	0.00***	0.00***
2008	639	2159	6.96 (6)	8.94 (8)	0.00***	0.00***	0.69 (0.80)	0.80 (0.83)	0.00***	0.00***	0.39 (0)	0.59 (1)	0.00***	0.00***
Pre SOX (1999-2001)	2188	4083	6.22 (6)	9.20 (9)	0.00***	0.00***	0.77 (0.83)	0.67 (0.73)	0.00***	0.00***	0.56 (1)	0.76 (1)	0.00***	0.00***
Post SOX (2002-2008)	5375	19707	6.87 (6)	8.71 (8)	0.00***	0.00***	0.75 (0.83)	0.80 (0.83)	0.00***	0.00***	0.46 (0)	0.63 (1)	0.00***	0.00***
Total	7563	23790	6.69 (6)	8.81 (8)	0.00***	0.00***	0.75(0.83)	0.78 (0.83)	0.00***	0.00***	0.49 (0)	0.65 (1)	0.00***	0.00***

Panel B: Distribution of Sample Firms by Industry

Fama-French (1997) 48 Industry	Private Firms		Public Firms		Total
	Sample Size	%	Sample Size	%	
1. Agriculture	66	0.87%	41	0.17%	107
2. Food Products	161	2.13%	301	1.27%	462
3. Candy & Soda	21	0.28%	92	0.39%	113
4. Beer & Liquor	15	0.20%	55	0.23%	70
5. Tobacco Products	14	0.19%	37	0.16%	51
6. Recreation	60	0.79%	129	0.54%	189
7. Entertainment	205	2.71%	195	0.82%	400
8. Printing and Publishing	153	2.02%	236	0.99%	389
9. Consumer Goods	132	1.75%	370	1.56%	502
10. Apparel	50	0.66%	308	1.29%	358
11. Healthcare	147	1.94%	419	1.76%	566
12. Medical Equipment	175	2.31%	786	3.30%	961
13. Pharmaceutical Products	246	3.25%	1,397	5.87%	1,643
14. Chemicals	197	2.60%	430	1.81%	627
15. Rubber and Plastic Products	104	1.38%	124	0.52%	228
16. Textiles	56	0.74%	68	0.29%	124
17. Construction Materials	116	1.53%	319	1.34%	435
18. Construction	68	0.90%	278	1.17%	346
19. Steel Works Etc	53	0.70%	332	1.40%	385
20. Fabricated Products	27	0.36%	48	0.20%	75
21. Machinery	157	2.08%	748	3.14%	905
22. Electrical Equipment	79	1.04%	357	1.50%	436
23. Automobiles and Trucks	73	0.97%	264	1.11%	337
24. Aircraft	25	0.33%	89	0.37%	114
25. Shipbuilding, Railroad Equipment	4	0.05%	46	0.19%	50
26. Defense	11	0.15%	48	0.20%	59
27. Precious Metals	20	0.26%	63	0.26%	83
28. Non-Metallic and Industrial Metal Mining	50	0.66%	88	0.37%	138
29. Coal	30	0.40%	62	0.26%	92
30. Petroleum and Natural Gas	156	2.06%	868	3.65%	1,024
31. Utilities	461	6.10%	849	3.57%	1,310
32. Communication	266	3.52%	651	2.74%	917
33. Personal Services	77	1.02%	257	1.08%	334
34. Business Services	867	11.46%	2,658	11.17%	3,525
35. Computers	195	2.58%	851	3.58%	1,046
36. Electronic Equipment	157	2.08%	1,681	7.07%	1,838
37. Measuring and Control Equipment	66	0.87%	520	2.19%	586
38. Business Supplies	96	1.27%	226	0.95%	322
39. Shipping Containers	16	0.21%	61	0.26%	77
40. Transportation	119	1.57%	602	2.53%	721
41. Wholesale	344	4.55%	789	3.32%	1,133
42. Retail	303	4.01%	1,243	5.22%	1,546
43. Restaurants, Hotels, Motels	284	3.76%	450	1.89%	734
44. Banking	853	11.28%	2,745	11.54%	3,598
45. Insurance	210	2.78%	869	3.65%	1,079
46. Real Estate	160	2.12%	83	0.35%	243
47. Trading	292	3.86%	489	2.06%	781
48. Other	126	1.67%	168	0.71%	294
Total	7,563	100%	23,790	100%	31,353

Table 2. Descriptive statistics

The full sample consists of 7,563 private firm-year observations and 23,790 public firm-year observations during the 1999-2008 period, obtained from the Capital IQ database. The subsample of matching firms consists of 4,099 private and 4,099 public firm-year observations, where the matching is conducted based on industry, size, and year. Specifically, for each private firm in our sample, we select a matching public firm in the same year that is in the same Fama-French (1997) 48 industry and closest in sales. To ensure that the matching public firm is truly comparable in size to its private peer, we require that the public firm's sales be within [90%, 110%] of the private firm's sales. We drop private firms from the matching subsample that are too small (i.e. the private firm's sales are smaller than 90% of the sales of all public firms in the same industry), in which case there is no matching public firm available. Definitions of all variables are provided in Appendix 2. All dollar values are in 2008 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

	Full Sample of Public and Private Firms						Subsample of Matching Public and Private Firms					
	Private Firms (1)		Public Firms (2)		Test of Difference (1)-(2): <i>p</i> -value		Private Firms (3)		Public Firms (4)		Test of Difference (3)-(4): <i>p</i> -value	
	Mean	Median	Mean	Median	<i>t</i> -test	Wilcoxon Z-test	Mean	Median	Mean	Median	<i>t</i> -test	Wilcoxon Z-test
Board size	6.69	6	8.81	8	0.00***	0.00***	7.44	7	8.63	8	0.00***	0.00***
Proportion of outside directors	0.75	0.83	0.78	0.83	0.00***	0.00***	0.80	0.86	0.77	0.83	0.00***	0.00***
CEO-chairman duality (indicator)	0.49	0	0.65	1	0.00***	0.00***	0.49	0	0.63	1	0.00***	0.00***
Sales (millions of dollars)	871	123	2,732	482	0.00***	0.00***	1,205	374	1,207	374	0.98	0.90
ROA	-7.10%	1.16%	2.86%	4.04%	0.00***	0.00***	1.82%	3.10%	2.53%	3.74%	0.00***	0.00***
Industry-adjusted ROA	-10.3%	-1.12%	-0.2%	0.25%	0.00***	0.00***	-1.50%	-0.30%	-0.80%	0.00%	0.00***	0.00***
Sales growth	24.18%	4.82%	17.76%	9.55%	0.00***	0.00***	21.40%	7.75%	18.35%	8.72%	0.01***	0.24
Leverage	40.85%	33.65%	18.31%	14.58%	0.00***	0.00***	40.62%	36.55%	20.27%	15.97%	0.00***	0.00***
Capex	4.17%	2.10%	4.14%	2.51%	0.77	0.00***	3.83%	2.40%	4.26%	2.57%	0.00***	0.00***
R&D	17.73%	0	10.04%	0	0.14	0.00***	12.99%	0	2.64%	0	0.04**	0.00***
Dividend (indicator)	0.17	0	0.45	0	0.00***	0.00***	0.21	0	0.45	0	0.00***	0.00***
Number of segments	1.50	1	2.15	2	0.00***	0.00***	1.67	1	2.11	2	0.00***	0.00***
Firm age (years)	29.39	14	46.12	29	0.00***	0.00***	37.39	20	44.49	27	0.00***	0.00***
Public bond (indicator)	0.222	0	0.322	0	0.00***	0.00***	0.314	0	0.281	0	0.00***	0.00***
CEO founder (indicator)	0.12	0	0.14	0	0.00***	0.00***	0.10	0	0.15	0	0.00***	0.00***
CEO ownership	14.84%	3.40%	4.76%	1.00%	0.00***	0.00***	11.36%	2.00%	5.53%	1.30%	0.00***	0.02***
CEO age (years)	51.73	52	53.93	54	0.00***	0.00***	52.55	53	53.77	54	0.00***	0.00***
MBA (indicator)	0.15	0	0.19	0	0.00***	0.00***	0.17	0	0.17	0	0.86	0.80

Table 3. Differences in board structure between public and private Firms

The full sample consists of 7,563 private and 23,790 public firm-year observations during the 1999-2008 period, obtained from the Capital IQ database. The subsample of matching firms consists of 4,099 private and 4,099 public firm-year observations, where the matching is conducted based on industry, size, and year. Specifically, for each private firm in our sample, we select a matching public firm in the same year that is in the same Fama-French (1997) 48 industry and closest in sales. To ensure that the matching public firm is truly comparable in size to its private peer, we require that the public firm's sales be within [90%, 110%] of the private firm's sales. We drop private firms from the matching subsample that are too small (i.e. the private firm's sales are smaller than 90% of the sales of all public firms in the same industry), in which case there is no matching public firm available. We use OLS regression when the dependent variables are the natural logarithm of board size and proportion of outside directors, and logit regression model when the dependent variable is the CEO-chairman duality indicator variable. The coefficients reported under logit regressions are estimates of the marginal effect on the probability when all of the independent variables are at their mean value. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. In Panel B, non-owner CEO is the CEO who is not the firm's founder and holds less than 1% of the firm's stock. In Panel D, the sample consists of 4,616 private and 20,697 public firm-year observations during the 1999-2008 period (3,256 matching private and 3,256 matching public firm-year observations) in which information on bank debt, the identity of external auditing firms, and CEO compensation are available. Definitions of all variables are provided in Appendix 2. All dollar values are in 2008 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard errors clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

Panel A: Baseline Model

	Full Sample of Public and Private Firms			Subsample of Matching Public and Private Firms		
	Ln(Board Size) (1)	Proportion of Outside Directors (2)	CEO-Chairman Duality (3)	Ln(Board Size) (4)	Proportion of Outside Directors (5)	CEO-Chairman Duality (6)
Public (indicator)	0.160*** [0.000]	-0.052*** [0.000]	0.156*** [0.000]	0.151*** [0.000]	-0.046*** [0.000]	0.141*** [0.000]
Ln (sales)	0.063*** [0.000]	0.011*** [0.000]	0.038*** [0.000]	0.058*** [0.000]	0.012*** [0.000]	0.024*** [0.000]
ROA	0.009 [0.735]	0.023 [0.137]	-0.064*** [0.002]	-0.228*** [0.001]	-0.085*** [0.009]	-0.016 [0.813]
Sales growth	0.010** [0.043]	0.004 [0.115]	0.022*** [0.000]	0.001 [0.892]	-0.009** [0.036]	0.040*** [0.002]
Leverage	-0.106*** [0.000]	-0.013 [0.156]	0.010 [0.451]	-0.103*** [0.003]	0.005 [0.753]	-0.046* [0.058]
Capex	0.246*** [0.001]	-0.012 [0.749]	0.098 [0.141]	0.313* [0.054]	-0.038 [0.580]	0.627*** [0.000]
R&D	-0.001 [0.283]	0.000 [0.950]	0.001 [0.330]	0.000 [0.740]	0.001 [0.126]	0.002 [0.459]
Dividend (indicator)	0.070*** [0.000]	-0.002 [0.569]	0.060*** [0.000]	0.100*** [0.000]	-0.015* [0.051]	0.051*** [0.001]
Number of segments	0.011*** [0.000]	0.002 [0.209]	0.001 [0.601]	0.018*** [0.007]	0.005* [0.067]	0.014*** [0.010]
Ln (firm age)	0.026*** [0.000]	0.002 [0.264]	0.013*** [0.000]	0.031*** [0.001]	0.004 [0.259]	0.011* [0.084]
Public bond (indicator)	0.037*** [0.000]	0.010** [0.037]	0.055*** [0.000]	0.052** [0.024]	0.012 [0.223]	0.078*** [0.000]
CEO founder (indicator)	-0.011 [0.300]	-0.014** [0.015]	0.227*** [0.000]	-0.025 [0.275]	-0.014 [0.201]	0.247*** [0.000]
CEO ownership	-0.587*** [0.000]	-0.270*** [0.000]	0.850*** [0.000]	-0.566*** [0.000]	-0.250*** [0.000]	0.889*** [0.000]
Ln (CEO age)	0.132*** [0.000]	-0.003 [0.789]	0.763*** [0.000]	0.163*** [0.006]	0.034 [0.175]	0.733*** [0.005]
MBA (indicator)	0.015* [0.074]	0.010** [0.018]	0.003 [0.672]	0.021 [0.309]	0.008 [0.442]	-0.001 [0.954]
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.846*** [0.000]	0.791*** [0.000]		0.690*** [0.004]	0.619*** [0.000]	
Observations	30,547	30,547	30,547	7,957	7,957	7,957
Adjusted R^2 / Pseudo R^2	43%	18%	43%	28%	11%	15%

Panel B: Comparison of Board Structures between Private Firms with Non-Owner CEOs and Public Firms

	Full Sample of Public and Private Firms			Subsample of Matching Public and Private Firms		
	Ln(Board Size) (1)	Proportion of Outside Directors (2)	CEO-Chairman Duality (3)	Ln(Board Size) (4)	Proportion of Outside Directors (5)	CEO-Chairman Duality (6)
Public (indicator)	0.126*** [0.000]	-0.046*** [0.000]	0.245*** [0.000]	0.159*** [0.000]	-0.027** [0.035]	0.160*** [0.000]
Other controls	Same as column (1) of Panel A	Same as column (2) of Panel A	Same as column (3) of Panel A	Same as column (4) of Panel A	Same as column (5) of Panel A	Same as column (6) of Panel A
Observations	25,567	25,567	25,567	3,034	3,034	3,034
Adjusted R^2	38%	25%	16%	23%	9%	18%

Panel C: Comparison of Board Structures between Public Firms with Different External Governance and Private Firms

	Full Sample of Public and Private Firms			Subsample of Matching Public and Private Firms		
	Ln(Board Size) (1)	Proportion of Outside Directors (2)	CEO-Chairman Duality (3)	Ln(Board Size) (4)	Proportion of Outside Directors (5)	CEO-Chairman Duality (6)
Indicator for S&P 1500 public firms: (1)	0.184*** [0.000]	-0.074*** [0.000]	0.203*** [0.000]	0.167*** [0.000]	-0.070*** [0.000]	0.170*** [0.000]
Indicator for non-S&P 1500 public firms: (2)	0.177*** [0.000]	-0.032*** [0.000]	0.104*** [0.000]	0.126*** [0.000]	-0.029*** [0.000]	0.109*** [0.000]
Other controls	Same as column (1) of Panel A	Same as column (2) of Panel A	Same as column (3) of Panel A	Same as column (4) of Panel A	Same as column (5) of Panel A	Same as column (6) of Panel A
Observations	30,547	30,547	30,547	7,957	7,957	7,957
Test-of-difference in coefficients between (1) and (2): F -statistic	0.67	86.54***	152.78***	5.17**	20.04***	11.46***

Panel D: Controlling for Bank Debt Ratio, Presence of One of the Big Four Auditing Firms, and CEO Performance-based Pay

	Full Sample of Public and Private Firms			Subsample of Matching Public and Private Firms		
	Ln(Board Size) (1)	Proportion of Outside Directors (2)	CEO-Chairman Duality (3)	Ln(Board Size) (4)	Proportion of Outside Directors (5)	CEO-Chairman Duality (6)
Public (indicator)	0.139*** [0.000]	-0.050*** [0.000]	0.153*** [0.000]	0.141*** [0.000]	-0.055*** [0.000]	0.141*** [0.000]
Bank debt ratio	-0.011** [0.025]	-0.013*** [0.000]	-0.001 [0.800]	0.000 [0.319]	-0.000 [0.461]	0.000 [0.442]
Big four auditors(indicator)	0.016* [0.094]	0.013*** [0.003]	0.001 [0.900]	-0.034 [0.138]	-0.002 [0.815]	-0.006 [0.745]
CEO performance-based pay	0.038*** [0.000]	0.023*** [0.000]	0.093*** [0.000]	0.085*** [0.000]	0.047*** [0.000]	0.076*** [0.003]
Other controls	Same as column (1) of Panel A	Same as column (2) of Panel A	Same as column (3) of Panel A	Same as column (4) of Panel A	Same as column (5) of Panel A	Same as column (6) of Panel A
Observations	24,971	24,971	24,971	6,395	6,395	6,395

Table 4. Changes in board structure around the IPOs

The sample consists of 324 IPO firms (1,358 firm-year observations) and 324 control non-IPO private firms during the 1999-2008 period. For each IPO firm, we select a control private firm that is in the same industry and has the closest sales prior to IPO. We require that the control firm does not change its private status during the sample period. The dependent variables are the natural logarithm of board size in column (1), the proportion of outside directors in column (2), and an indicator for CEO-chairman duality in column (3). Columns (1) and (2) are estimated using OLS regressions and column (3) is estimated using a logit regression. The coefficients reported in column (3) are estimates of the marginal effect on the probability when all of the independent variables are at their mean value. The *Post-IPO* indicator takes the value of one for the IPO firm in the post-IPO period and zero otherwise. Regressions include year and firm fixed effects. Definitions of all variables are provided in Appendix 2. All dollar values are in 2008 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard errors clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

	Ln(Board Size): OLS (1)	Proportion of Outside Directors: OLS (2)	CEO-Chairman Duality: Logit (3)
Post-IPO (indicator)	0.315*** [0.000]	-0.057*** [0.000]	0.056** [0.044]
Ln (sales)	0.028 [0.110]	-0.002 [0.761]	0.035*** [0.000]
ROA	-0.089 [0.243]	-0.005 [0.907]	-0.115 [0.196]
Sales growth	-0.007 [0.279]	-0.007** [0.028]	-0.001 [0.0911]
Leverage	0.134** [0.049]	-0.009 [0.726]	0.042 [0.300]
Capex	-0.231 [0.208]	-0.004 [0.947]	0.619*** [0.000]
R&D	-0.065 [0.483]	-0.023 [0.386]	-0.003 [0.977]
Dividend (indicator)	-0.029 [0.301]	-0.004 [0.723]	0.086*** [0.001]
Number of segments	0.013 [0.283]	0.012*** [0.001]	-0.012 [0.187]
Ln (firm age)	0.009 [0.894]	0.002 [0.958]	0.010 [0.420]
Public bond (indicator)	0.087* [0.083]	0.012 [0.559]	0.024 [0.467]
CEO founder (indicator)	-0.039 [0.390]	0.003 [0.846]	0.396*** [0.000]
CEO ownership	-0.283* [0.079]	-0.071 [0.331]	0.681*** [0.000]
Ln (CEO age)	0.019 [0.837]	-0.022 [0.584]	1.022*** [0.000]
MBA (indicator)	0.034 [0.228]	0.002 [0.864]	-0.045 [0.113]
Year & firm fixed effects	Yes	Yes	Yes
Constant	1.630*** [0.000]	0.917*** [0.000]	
Observations	2,558	2,558	2,558
Adjusted R^2 / Pseudo R^2	26%	23%	21%

Table 5. Controlling for endogeneity bias: Instrumental variables approach (2SLS)

The sample consists of 7,563 private firm-year observations and 23,790 public firm-year observations during the 1999-2008 period, obtained from the Capital IQ database. Column (1) reports the first-stage probit regression of the likelihood of a firm being publicly listed, where we use as explanatory variables *Industry average IPO underpricing* (instrumental variable) and the other variables used in Table 3. *Industry average IPO volume* is the average value of the percentage difference between offer price and first trading day price for all IPO deals in a certain industry-year. Columns (2)-(4) report the estimates from the second-stage regressions. The dependent variables are the natural logarithm of board size in column (2), the proportion of outside directors in column (3), and an indicator variable for CEO-chairman duality in column (4). The coefficients reported in column (4) are estimates of the marginal effect on the probability when all of the independent variables are at their mean value. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. Definitions of all variables are provided in Appendix 2. All dollar values are in 2008 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard errors clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

	1 st Stage	2 nd Stage:		
	Being a Public Firm: Probit (1)	Ln (Board Size): OLS (2)	Proportion of Outside Directors: OLS (3)	CEO-Chairman Duality: Logit (4)
Public (indicator)		0.198*** [0.000]	-0.116*** [0.000]	0.146*** [0.000]
Industry average IPO underpricing	-0.001** [0.020]			
Ln (sales)	0.152*** [0.000]	0.062*** [0.000]	0.013*** [0.000]	0.038*** [0.000]
ROA	0.689*** [0.000]	0.006 [0.827]	0.033** [0.050]	-0.078*** [0.000]
Sales growth	-0.005 [0.752]	0.010** [0.023]	0.004 [0.159]	0.024*** [0.000]
Leverage	-1.986*** [0.000]	-0.090*** [0.000]	-0.041** [0.016]	-0.007 [0.741]
Capex	1.644*** [0.000]	0.233*** [0.008]	0.008 [0.830]	0.141* [0.058]
R&D	-0.003 [0.114]	-0.001 [0.526]	0 [0.877]	0.001 [0.443]
Dividend	0.617*** [0.000]	0.066*** [0.000]	0.006 [0.191]	0.056*** [0.000]
Number of segments	0.128*** [0.000]	0.010*** [0.001]	0.003** [0.023]	0.001 [0.526]
Ln (firm age)	0.200*** [0.000]	0.024*** [0.000]	0.004* [0.082]	0.017*** [0.000]
Public bond (indicator)	0.175*** [0.000]	0.035*** [0.003]	0.012** [0.026]	0.056*** [0.000]
CEO founder (indicator)	0.073*** [0.002]	-0.013 [0.111]	-0.024*** [0.000]	0.130*** [0.000]
CEO ownership	-1.507*** [0.000]	-0.569*** [0.000]	-0.291*** [0.000]	0.899*** [0.000]
Ln (CEO age)	0.291*** [0.000]	0.131*** [0.000]	0.005 [0.690]	0.739*** [0.000]
MBA (indicator)	-0.005 [0.859]	0.015* [0.057]	0.008* [0.062]	0.003 [0.673]
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Constant	-1.892*** [0.000]	0.837*** [0.000]	0.792*** [0.000]	
Observations	30,547	30,547	30,547	30,547
Adjusted R^2 / Pseudo R^2	37%	42%	18%	13%
Test of Industry IPO volume = 0: F -statistic 5.44**				

Table 6. Propensity score matching

The sample consists of 7,563 private firm-year observations and 23,790 public firm-year observations during the 1999-2008 period, obtained from the Capital IQ database. We match each private firm with a public firm using the nearest neighborhood, a Gaussian kernel, and local linear regression matching approaches. The variables we use in matching are Ln (sales), ROA, sales growth, leverage, the ratio of capital expenditures to total assets, the ratio of R&D expenditures to total assets, a dividend payment indicator, number of segments, Ln (firm age), public bond indicator, Ln (CEO age), CEO ownership, founder CEO indicator, CEO MBA degree indicator, industry (Fama-French 48 industries (1997)) indicators, and year indicators. All dollar values are in 2008 dollars. All continuous variables are winsorized at the 1st and 99th percentiles. Bootstrapped standard errors are based on 50 replications with replacement. *P*-values are reported in parentheses. Bias-corrected 95% confidence intervals are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

Variables	Nearest neighborhood	Gaussian Kernel	Local linear regression
Board size	-0.881*** (0.000) [-1.104, -0.659]	-1.047*** (0.000) [-1.253, -0.841]	-1.111*** (0.000) [-1.285, -0.937]
Proportion of outside directors	0.015** (0.046) [0.000, 0.031]	0.016*** (0.000) [0.008, 0.024]	0.019*** (0.000) [0.010, 0.030]
CEO-chairman duality	-0.128*** (0.000) [-0.184, -0.072]	-0.144*** (0.000) [-0.180, -0.108]	-0.153*** (0.000) [-0.180, -0.125]

Table 7. Outside directors and advisory and monitoring needs

The sample consists of 7,563 private firm-year observations and 23,790 public firm-year observations during the 1999-2008 period. The dependent variable is the proportion of outside directors on the board. *Advising need* is a linear combination of the transformed (to standard normal) values of Ln (sales), the ratio of R&D expenditures to total assets, the number of segments, and the ratio of capital expenditures to total assets. *Monitoring need* is a linear combination of the transformed (to standard normal) values of non-debt ratio (1 - leverage ratio), sales growth, indicator for no dividend payout, non-founder CEO indicator, and equity ownership by non-CEOs (1-CEO ownership). Other control variables, including ROA, Ln (firm age), Public bond (indicator), Ln (CEO age), and MBA (indicator), are included but not reported for the sake of brevity. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. Definitions of all variables are provided in Appendix 2. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard errors clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Public (indicator)	-0.039*** [0.000]	-0.045*** [0.000]	-0.022*** [0.002]	-0.027*** [0.001]
Advising need	0.007*** [0.000]	0.016*** [0.000]	0.006*** [0.000]	0.016*** [0.000]
Monitoring need	0.017*** [0.000]	0.016*** [0.000]	0.023*** [0.000]	0.024*** [0.000]
Public × Advising need		-0.013*** [0.000]		-0.013*** [0.000]
Public × Monitoring need			-0.014*** [0.000]	-0.014*** [0.000]
Other controls	Yes	Yes	Yes	Yes
Year & industry fixed effects	Yes	Yes	Yes	Yes
Observations	30,547	30,547	30,547	30,547
Adjusted R^2	14%	15%	15%	15%

Table 8. Outside directors and the likelihood of CEO turnover in private firms

In Panel A, the sample consists of 4,383 private firm-year observations during the 2001-2008 period, obtained from the Capital IQ database (CIQ). Data on CEO turnover is obtained from the CIQ. There are a total of 469 CEO turnover events during the sample period. In Panel B, the sample consists of 3,662 private firm-year observations and 9,688 public firm-year observations whose industry-adjusted ROA is negative. The dependent variable is an indicator that takes the value of one if a CEO turnover event occurs in a given year and zero otherwise. The coefficients reported are estimates of the marginal effect on the probability when all of the independent variables are at their mean value. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. Definitions of all variables are provided in Appendix 2. All continuous variables are winsorized at the 1st and 99th percentiles and all independent variables are measured in the year prior to the CEO turnover. *P*-values based on robust standard errors clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

Panel A: Private Firms Only

	Full Sample of Private Firms		Subsample of Private Firms		
	(1)	(2)	Excluding CEOs Whose Age >= 65: (3)	Excluding CEOs Whose Age >= 60: (4)	Excluding Founder CEO: (5)
Proportion of outside directors:(a)	0.135*** [0.000]	0.131*** [0.000]	0.131*** [0.000]	0.113*** [0.000]	0.133*** [0.000]
Industry-adjusted ROA: (b)	-0.001** [0.048]	-0.001* [0.072]	-0.001* [0.067]	-0.001** [0.046]	-0.001* [0.069]
(a) × (b)		-0.150** [0.043]	-0.150* [0.053]	-0.145** [0.049]	-0.145* [0.076]
Ln (sales)	0.002 [0.263]	0.003* [0.095]	0.003 [0.138]	0.002 [0.308]	0.002 [0.338]
Sales growth	-0.052** [0.001]	-0.053*** [0.001]	-0.048*** [0.004]	-0.054*** [0.001]	-0.053*** [0.003]
Leverage	-0.017 [0.231]	-0.017 [0.228]	-0.016 [0.273]	-0.010 [0.466]	-0.017 [0.260]
Capex	0.131 [0.152]	0.150 [0.101]	0.146 [0.124]	0.028 [0.765]	0.160 [0.113]
R&D	0.056 [0.264]	0.035 [0.496]	0.032 [0.541]	0.002 [0.969]	0.062 [0.287]
Dividend (indicator)	-0.023** [0.002]	-0.021*** [0.004]	-0.021*** [0.007]	-0.019** [0.015]	-0.022*** [0.006]
Number of segments	0.002 [0.407]	0.002 [0.496]	0.002 [0.402]	0.002 [0.443]	0.003 [0.286]
Ln (firm age)	-0.001 [0.817]	-0.001 [0.810]	-0.001 [0.837]	-0.002 [0.440]	-0.001 [0.819]
Public bond (indicator)	0.004 [0.621]	0.005 [0.512]	0.005 [0.568]	0.005 [0.542]	0.004 [0.641]
CEO founder (indicator)	-0.003 [0.833]	-0.004 [0.775]	-0.003 [0.857]	0.005 [0.752]	
CEO ownership	-0.132** [0.000]	-0.133*** [0.000]	-0.132*** [0.000]	-0.149*** [0.000]	-0.150*** [0.000]
Ln (CEO age)	0.066*** [0.008]	0.069*** [0.005]	0.055** [0.045]	-0.036 [0.205]	0.066** [0.016]
MBA (indicator)	0.015 [0.105]	0.014 [0.127]	0.015 [0.127]	0.017* [0.077]	0.014 [0.160]
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	4,383	4,383	4,109	3,653	3,981
Pseudo <i>R</i> ²	10%	10%	9%	10%	9%

Panel B: Pooled Sample of Public and Private Firms with Negative Industry-adjusted ROA

	All Firms with Negative Industry-adjusted ROA (1)	Excluding Firms with CEOs Age >= 65 (2)	Excluding Firms with CEOs Age >= 60 (3)	Excluding Firms with Founder CEO (4)
Industry-adjusted ROA	-0.080*** [0.000]	-0.067*** [0.002]	-0.060*** [0.006]	-0.084*** [0.000]
Public: (a)	0.115*** [0.000]	0.108*** [0.000]	0.101*** [0.000]	0.111*** [0.000]
Proportion of outside director: (b)	0.167*** [0.000]	0.154*** [0.000]	0.140*** [0.000]	0.155*** [0.000]
(a) × (b)	-0.174*** [0.000]	-0.161*** [0.000]	-0.148*** [0.000]	-0.165*** [0.000]
Other controls	Same as column (2) of Panel A	Same as column (3) of Panel A	Same as column (4) of Panel A	Same as column (5) of Panel A
Year & industry fixed effects	Yes	Yes	Yes	Yes
Observations	13,350	12,393	10,708	11,824
Pseudo R2	5%	5%	4%	5%

Table 9. Likelihood of going public and IPO valuation: Role of outside directors in private firms

The sample consists of 7,563 private firm-year observations during the 1999-2008 period, obtained from the Capital IQ database. In Panel A, the dependent variable is an indicator that takes the value of one if the firm goes public in a given year during the sample period (324 cases) and zero otherwise. The coefficients reported are estimates of the marginal effect on the probability when all of the independent variables are at their mean value. In Panel B, the dependent variable is the ratio of market capitalization on the first trading date (first-trading-day stock price multiplied by total shares outstanding) to sales prior to the IPO. Predicted proportion of outside directors is estimated from the first stage of the two-stage least squares (2SLS) regression, in which we regress the proportion of a firm's outside directors on two instruments for board composition, namely, state- and industry-level average proportions of outside directors, and firm and CEO characteristics used in column (3) of this table. Regressions include indicators for each Fama-French (1997) 48 industry and year. Definitions of all variables are provided in Appendix 2. All continuous variables are winsorized at the 1st and 99th percentiles and all independent variables are measured in the year prior to the IPO. *P*-values based on robust standard errors clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10% levels, respectively.

Panel A: Likelihood of Going Public

	Logit			2SLS: 2 nd Stage	2SLS: 2 nd Stage
	(1)	(2)	(3)	(4)	(5)
Proportion of outside directors	0.005*** [0.003]	0.003** [0.040]	0.002* [0.074]		
Predicted proportion of outside directors				0.017*** [0.004]	
Predicted proportion of outside directors in 1999					0.020*** [0.003]
Ln (sales)	0.001*** [0.000]	0.001*** [0.000]	0.001*** [0.000]	0.001*** [0.010]	0.001*** [0.002]
ROA		0.002 [0.222]	0.001 [0.460]	0.000 [0.813]	0.000 [0.729]
Sales growth		0.002*** [0.000]	0.001*** [0.000]	0.001*** [0.001]	0.001*** [0.001]
Leverage		-0.006*** [0.001]	-0.003** [0.030]	-0.003** [0.034]	-0.003* [0.097]
Capex		0.062*** [0.000]	0.044*** [0.000]	0.045*** [0.000]	0.049*** [0.000]
R&D		0.000 [0.459]	0.000 [0.181]	0.000 [0.420]	0.000 [0.628]
Dividend (indicator)		-0.003*** [0.000]	-0.002*** [0.001]	-0.003*** [0.003]	-0.003*** [0.004]
Number of segments		0.000 [0.576]	0.000 [0.649]	0.000 [0.949]	-0.000 [0.939]
Ln (firm age)		-0.000 [0.141]	-0.000 [0.646]	-0.000 [0.665]	-0.000 [0.407]
Public bond (indicator)		-0.004*** [0.000]	-0.003*** [0.000]	-0.003*** [0.000]	-0.003*** [0.001]
Venture-backed firm		0.021*** [0.000]	0.017*** [0.000]	0.016*** [0.001]	0.017*** [0.000]
CEO founder (indicator)			0.007*** [0.000]	0.008*** [0.000]	0.008*** [0.000]
CEO ownership			-0.010** [0.030]	0.002 [0.783]	0.006 [0.439]
Ln (CEO age)			-0.010*** [0.000]	-0.011*** [0.000]	-0.010*** [0.000]
MBA (indicator)			0.002 [0.116]	0.001 [0.199]	0.001 [0.169]
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	7,563	7,369	7,215	7,215	7,215
Pseudo R^2	18%	25%	28%	28%	28%

Panel B: First-Trading-Day IPO Valuation

	OLS			2SLS: 2 nd Stage	2SLS: 2 nd Stage
	(1)	(2)	(3)	(4)	(5)
Proportion of outside directors	44.080** [0.011]	29.234* [0.093]	32.611* [0.094]		
Predicted proportion of outside directors				68.368** [0.022]	
Predicted proportion of outside directors in 1999					73.037** [0.037]
Ln (sales)	-8.996*** [0.000]	-8.822*** [0.000]	-8.978*** [0.000]	-10.432*** [0.000]	-10.450*** [0.000]
ROA		-66.108*** [0.000]	-62.203*** [0.001]	-62.647** [0.032]	-62.041*** [0.006]
Sales growth		-6.184*** [0.009]	-6.211** [0.012]	-6.123** [0.019]	-6.110** [0.046]
Capex		-22.537 [0.580]	-21.05 [0.622]	-26.998 [0.313]	-24.258 [0.483]
R&D		-33.214 [0.157]	-31.181 [0.197]	-28.122 [0.283]	-27.936 [0.409]
Dividend (indicator)		1.88 [0.812]	2.531 [0.757]	3.013 [0.634]	2.606 [0.339]
Number of segments		0.995 [0.707]	0.289 [0.921]	-0.012 [0.988]	0.078 [0.970]
Ln (firm age)		-2.112 [0.439]	-2.757 [0.356]	-3.590*** [0.003]	-4.025* [0.079]
Public bond (indicator)		1.548 [0.869]	-0.27 [0.978]	-2.486 [0.624]	-2.128 [0.665]
Venture-backed firm (indicator)		5.846 [0.347]	5.174 [0.427]	3.498 [0.340]	5.423 [0.220]
Reputable underwriter (indicator)		6.13 [0.252]	7.327 [0.188]	7.251 [0.292]	7.239*** [0.009]
Ln (IPO proceeds)		3.822** [0.016]	4.192** [0.011]	3.957*** [0.000]	3.971*** [0.010]
CEO founder (indicator)			-8.896 [0.138]	-9.427 [0.245]	-8.441* [0.093]
CEO ownership			-0.139 [0.995]	18.701 [0.571]	22.337 [0.451]
Ln (CEO age)			-11.279 [0.502]	-5.054 [0.735]	-3.291 [0.862]
MBA (indicator)			-5.087 [0.383]	-5.877* [0.082]	-5.909 [0.345]
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	12.22 [0.730]	10.365 [0.775]	63.848 [0.363]	25.989 [0.740]	13.808 [0.854]
Observations	312	307	309	309	309
Adjusted R^2	26%	32%	33%	32%	33%

Appendix 1. KMG America Corporation's board composition as of 2006

This table shows the composition of the directors on KMG America's board as of 2006 and their major affiliation prior to their appointment to the board. KMG America is a privately held company that provides group and voluntary employee benefit insurance solutions and third-party health claims administrative services. The company was founded in 2004 and is based in Minnetonka, Minnesota. In 2006, there were seven board members.

Name	Primary Job Functions	Inside or Outside Directors
Kuk, Kenneth	CEO, President, Chairman of the Board	Inside
Johnson, Stanley	President and CEO of Kanawha Insurance Company, a subsidiary of KMG America Corp.	Inside
DeLong III, Scott	CFO	Inside
Flittie, John	Actuarial Consultant	Outside
Laszewski, Robert	President of Health Policy and Strategy Associates, Inc.	Outside
Mathisen, Dennis	CEO of Marshall Bankfirst Corp.	Outside
Ritchie, James	CFO of FAC, the Intermediate Holding of White Mountains Insurance Group Ltd.	Outside

Appendix 2. Variable definitions

This appendix provides a detailed description of the construction of all the variables used in the tables.

<i>Variable</i>	<i>Definition</i>
Advising need	Linear combination of the transformed (to standard normal) values of Ln (sales), the ratio of R&D expenditures to total assets, the number of segments, and the ratio of capital expenditures to total assets.
Bank debt ratio	Bank debt normalized by book value of total assets.
Big four auditors	Indicator that equals one if the firm's auditor is one of the big four auditing firms and zero otherwise.
Board size	Number of directors on the board.
Leverage	Total debt normalized by book value of total assets.
Capex	Capital expenditure normalized by book value of total assets.
CEO age	CEO's age.
CEO-chairman duality	Indicator that equals one if the CEO is the chairman of the board and zero otherwise.
CEO ownership	Firm's shares owned by the CEO normalized by the total number of shares outstanding.
CEO performance-based pay	The proportion of bonus, restricted stock, and option grants in the CEO's total compensation.
CEO turnover	Indicator that equals one if a CEO turnover event occurs in a given year and zero otherwise.
Dividend	Indicator that equals one if the firm pays dividend and zero otherwise.
Firm age	Number of years since the firm's incorporation.
Founder	Indicator that equals one if the CEO is one of the firm's founders and zero otherwise.
Reputable underwriter	Indicator that equals one if the lead underwriter has a ranking of 9 on a 9-point scale based on Jay Ritter's underwriter rankings and zero otherwise.
Indicator for non-S&P 1500 public firms	Indicator that equals one if the firm is publicly listed but not in the S&P 1500 index and zero otherwise.
Indicator for S&P 1500 public firms	Indicator that equals one if the firm is in the S&P 1500 index and zero otherwise.
Industry-adjusted ROA	Industry-median adjusted ROA
Industry average IPO underpricing	The average value of the percentage difference between offer price and first trading day price for all IPO deals in a certain industry-year.
IPO Proceeds	Number of shares issued in the IPO times the offer price (in \$millions).
MBA	Indicator that equals one if the CEO holds an MBA degree and zero otherwise.
Monitoring need	Linear combination of the transformed (to standard normal) values of non-debt ratio (1-leverage ratio), sales growth, indicator for no dividend payout, non-founder CEO indicator, and equity ownership by non-CEOs (1-CEO ownership).
Number of segments	Number of segments a firm has.
Post-IPO	Indicator that equals one for the IPO firm in the post-IPO period and zero otherwise.
Proportion of outside directors	Proportion of outside directors on the board. Outside directors are directors who do not have any executive role in the firm.
Public	Indicator that equals one if the firm is publicly listed and zero otherwise.
Public bond	Indicator that equals one if the firm has public bond outstanding and zero otherwise.
ROA	Operational income normalized by book value of total assets.
R&D	R&D expenditures normalized by book value of total assets.
Sales growth	$\text{Sales}(t) / \text{Sales}(t-1) - 1$
Venture-backed firm	Indicator that equals one if the venture capitalist holds at least 10% of the firm's stock and zero otherwise.

Essay Two:

Does Board Expertise Matter? Evidence from IPO Firms

Abstract

We examine the impact of board expertise on IPO underpricing using detailed biographical data on directors sitting on the boards of IPO firms over the period 2002 to 2008. We find that IPO firms whose boards have a higher proportion of directors with experience in investment banking, venture capital, and public firms (as directors or CEOs), or as lawyers, realize smaller underpricing. Directors' investment banking and public firm expertise also help lower underwriting fees and enhance firm value as measured by ratio of market capitalization on the first trading date to pre-IPO sales. These results are more pronounced when the directors have served on the boards of the IPO firms longer. We also find that board expertise has a stronger mitigating effect on IPO underpricing when firms have more advisory needs such as when they are large, when they have high leverage, or when their IPOs are not backed by venture capitalists. Overall these results suggest that board expertise plays an important role in helping reduce IPO underpricing and increase shareholder value.

JEL Classification: G32, G34

Keywords: Director expertise; Investment banking experience; Public firm experience; Board advisory role; IPO underpricing; IPO valuation

1. Introduction

It is well-known that boards of directors perform two primary functions: monitoring and advising management. For example, as the vigilant protector of shareholder interests, boards of directors are expected to play an important role in monitoring the performance of managers (Fama, 1980; Hermalin and Weisbach, 1998); Monks and Minow, 2000). In addition to this monitoring function, boards also serve an advisory function for management in establishing corporate strategies and policies (Fama and Jensen, 1983). Recent studies further show that director qualifications and experience are key elements in their effectiveness in performing their advisory role. For example, Guner, Malmendier, and Tate (2008) investigate how boards with financial expertise affect corporate decisions and find that commercial bankers on boards of directors are associated with increase in external funding and decrease in investment to cash flow sensitivity while investment bankers on the boards are associated with larger bond issues but worse acquisition outcomes.²⁶ Other studies also show that directors' industry experience is positively related to firm performance. For example, Custódio and Metzger (2010) find that CEOs with work experience in a target firm's industry increase their shareholders' wealth during takeovers. Papakonstantinou (2007) documents the positive effect of board industry experience on firm performance and Kroll, Walters, and Wright (2008) show that boards with more industry experience are associated with superior acquisition outcomes. Fahlenbrach, Low, and Stulz (2010) find that stock markets react more favorably to the appointment of a CEO outside

²⁶ Similarly, Ramirez (1995) finds that firms that had J.P. Morgan executives on their boards display lower investment to cash flow sensitivity at the turn of the century.

director because the presence of a CEO outside director leads investors to a more positive view of the firm.

Although these studies enhance our understanding of the importance of director expertise to the capacity of boards to play their advisory role, it is not entirely clear under which circumstances director expertise is particularly important in enhancing firm value and the channel through which it affects corporate policies and performance. In this paper, we seek to shed further light on this issue by examining how board expertise in private firms helps reduce IPO underpricing and increase market valuation.²⁷ An IPO is one of the most significant events in the life of a business, and requires various specific advisory services from the board of directors in areas such as investment banking, public firms, and legal services. These unique needs allow us to examine the advisory role of directors and the importance of their qualifications and experience in performing such a role in a richer and more meaningful way. For example, according to Westenberg (2010), the board of directors in IPO firms should play an important role during the IPO process such as in “selecting the underwriters; ensuring the placement of appropriate policies, controls, and procedures; establishing an appropriate governance structure; approving various matters related to the IPO; reassessing compensation programs in the context of becoming a public company; overseeing the preparation of the Form S-1; and

²⁷ Our paper is closely related to the study by Baker and Gompers (2003) which examines the role of venture capitalist directors in a sample of 1,116 IPO firms from 1978 to 1987. However, unlike our study, their focus is on how the IPO firms’ board structure is determined as an outcome of bargaining between the CEO and outside shareholders and they do not examine how director expertise is related to IPO performance.

authorizing the filing of, and signing, the Form S-1.”²⁸ These requirements for the board of directors in IPO firms suggest that director expertise such as knowledge and experience in investment banking (to handle complex underwriting issues); public firms (to help the management team successfully transition from private to public); and legal matters (to deal with the wide array of legal requirements, e.g., filing the prospectus with the SEC, complying with state securities laws, drawing underwriting contracts, etc.) are particularly important for successful IPOs.

IPO underpricing is a key focus in the IPO literature, and several explanations have been proposed to explain IPO underpricing. The best-known explanations are based on asymmetric information models. For example, Rock (1986)’s winner’s curse theory assumes informed investors can avoid participation in overvalued IPOs and new issues have to be deliberately underpriced in order to ensure the continued participation of uninformed investors in the market.²⁹ Baron (1982) offers an agency-based explanation for underpricing and argues that lowering the agency cost between issuer and underwriter will help reduce IPO underpricing or other IPO costs like underwriting fees.³⁰ These studies suggest that reputable institutions and other

²⁸ Similarly, Lipman (2009) argues that boards’ careful advance planning is crucial to a successful IPO, such as developing an impressive management and professional team, growing the company’s business with an eye to the public marketplace, establishing antitakeover defenses and developing good corporate governance, taking advantage of IPO windows, etc.

²⁹ Benveniste and Spindt (1989) also assume that underpricing compensates better-informed investors for revealing their information truthfully. In addition to the theoretical models, Johnston and Madura (2009) indicate in their empirical analysis that IPO firms subject to more asymmetric information will need a greater degree of underpricing. Allen and Faulhaber (1989) and Welch (1989) argue that underpricing is used by the issuer to signal the quality of the issue.

³⁰ Loughran and Ritter (2004) in their studies also highlight the potential agency problems between the underwriting investment bank and the issuing firm.

mechanisms that reduce information asymmetry or agency problems between issuers and underwriters can help reduce IPO underpricing. In other explanations, IPO underpricing is considered to serve as the insurance against securities litigation (Hughes and Thakor, 1992; Hensler, 1995), be advantageous for tax purposes (Taranto, 2003) or act as a means to entrench managerial control (Brennan and Franks, 1997).

Although we do not yet have universally agreed upon explanations for IPO underpricing, there are several reasons to expect the financial, public firm or legal knowledge and expertise held by directors to help reduce IPO underpricing and increase firm value. For example, past experience as an investment banker can make a director more capable of giving constructive suggestions to the issuers and reduce the agency problems between the issuers and the underwriters. Thus, directors with investment banking expertise are more likely to be able to reduce IPO costs (IPO underpricing and underwriter fees) than other types of directors and thus enable IPO firms to enjoy high post-IPO firm value.

Venture capitalists have long been considered as a critical source of capital to meet the financing needs of small and private entrepreneurial firms. Gompers (1995) shows that venture capitalists provide advice and support to small entrepreneurial start-ups. Hellmann and Puri (2002) argue that venture capitalists can help with the professionalization of a firm's management. Directors with venture capitalist experience thus are also considered to have better knowledge and expertise in helping the management to achieve success in the IPO market.

Experience in public firms is also expected to play an important role in helping reduce firms' IPO costs and increase firms' value. The job functions of directors in public firms is different from that of directors in private firms. Public firm directors need to be more skillful in dealing with financial analysts, the media, stock market regulators, and investors. Therefore, private firm directors with experience as directors on the boards of public firms are expected to do a better job dealing with these issues than those without such experience. Similarly, directors who have been public firm CEOs can utilize their public firm management expertise in advising and monitoring the IPO firm's management and can also provide the IPO firms more insightful advice on what the public stock market likes and dislikes. Moreover, public firm CEOs may have special information or unique social networks that help reduce the information asymmetry inherent in an IPO. Since an IPO is an important event for a private firm to gain access to the public stock market for the first time, directors with public firm experience (either as board directors or CEOs) are also expected to be particularly helpful in getting an IPO firm ready for stock market listing. They would be able to provide valuable advice to firms' management and thus help reduce IPO costs and increase firm value.

Legal knowledge and experience are likely to be also important for successful IPOs. Issuing firms need a large amount of legal services during the IPO process, in preparing and revising SEC filings, drafting underwriting contracts and advising the firm regarding required notices and consents, etc. Thus, if the directors have legal experience and are familiar with corporate law, they can provide assistance and advice

on legal issues to the management, which helps reduce IPO costs and increase firm value.

To examine the role of board expertise in reducing IPO underpricing and increasing firm value, we manually collect detailed biographical data on directors sitting on the boards of IPO firms from 2002 to 2008. Specifically, we collect data on whether the directors have financial expertise, either as investment bankers, commercial bankers, executives of private equity firms including venture capital firms, or financial executives; whether they have public firm expertise either as directors or CEOs; whether they have legal expertise as lawyers; and whether they have other expertise, either as professors or governors.

We find that the directors' financial, public firm, and legal expertise are important in helping reduce IPO underpricing. Specifically, we find that IPO firms whose boards have a higher percentage of directors with investment banking, venture capital, public firm, or legal experience realize smaller underpricing at the end of the first trading day. We also observe that directors' investment banking and public firm expertise help lower underwriting fees and enhance firm value after the IPO, as measured by ratio of market capitalization on the first trading date to pre-IPO sales. These results suggest that director qualifications and experience indeed play an important role for directors to perform a valuable advisory function.

Our results are different from those of Guner, Malmendier, and Tate (2008) who examine how directors with financial expertise affect public firms' policies. Unlike their study which shows that commercial bank directors in public firms play a more

value-enhancing role than investment bank directors, we find that, on IPO firm boards, investment bankers play a more important role than commercial bankers. We also find that compared to the sample of public firms used in Guner, Malmendier, and Tate (2008), our sample of IPO firms have more financial experts on their boards, especially investment bankers. These differences in board composition between public and private firms are not surprising given that the firms in our sample are transitioning from private to public, and have greater advisory needs in investment banking areas to reduce information asymmetry and agency problems between IPO issuers and the underwriters. Similarly, our sample IPO firms are more likely to need directors with public firm knowledge and experience for their valuable advice about public firm management and monitoring. To the extent that the public firm directorship or public firm CEO position held by a private firm's director serves as a good proxy for their qualification and reputational capital as an advisor, our results further suggest that director expertise is an important element of their effectiveness in performing the advisory role.

We conduct several additional tests to check the robustness of our results. First we adopt a two-stage least squares (2SLS) regression approach to control for potential endogeneity bias for board's financial expertise and public firm expertise. Specifically we use state-level private equity firm numbers and state-level public firm size as instrument variables (IV) to predict the percentage of venture capitalist directors and public firm directors on firms' boards, respectively. We find that the predicted values of venture capitalist expertise and public director expertise are both significantly and

negatively related to IPO underpricing.

Second, we test how IPO underpricing is related to the tenure of the directors on the boards. One concern is that our analysis does not consider the possibility that board structure is endogenously determined prior to the IPOs. To the extent that IPOs are predictable, it is possible that firms choose to optimize their board structure before they go public. For example, if private firms anticipating a future IPO are more likely to appoint directors with investment banking expertise immediately prior to their IPO, and if IPO underpricing simply reflects this adjustment in board structure, we might detect a spurious relation between the presence of a director with investment banking expertise and IPO underpricing. On the other hand, for directors who are appointed long before the IPOs, it is less likely that they were chosen because the firms anticipate future IPOs. Thus, if board adjustment immediately prior to an IPO drives our results, we expect our results to be more pronounced for newly appointed directors (directors whose tenure at the firm prior to the IPO is shorter than one year) than for non-newly appointed directors (directors whose tenure at the firm prior to the IPO is longer than one year). However, we find that only non-newly appointed directors help reduce IPO underpricing and increase IPO valuation. These results provide little support for the board adjustment explanation but yield additional support for the board expertise explanation.

Third, we investigate whether the impacts of directors' investment banking expertise on IPO underpricing are different between those who have been affiliated with the underwriters prior to the IPOs and those without prior affiliation. We find

that affiliated directors are associated with higher mitigating effect on IPO underpricing than unaffiliated directors. This result further provides support for the view that director expertise is an important qualification for a director to play an important role in providing valuable advisory services.

Finally, we examine whether the effect of board expertise on IPO underpricing is different depending on firms' advisory needs. To the extent that board expertise is more important for firms with greater advisory needs, we expect the mitigating effect on IPO underpricing to be more pronounced for firms with higher advisory needs. Consistent with this view, we find that board expertise is associated with smaller IPO underpricing only for large firms, high leverage firms, and firms whose IPOs are not backed by venture capitalists.

Our study contributes to the literature in several ways. First, it extends the literature on the role of the board of directors by showing that director qualifications and experience are important elements of the effectiveness of directors in their advisory role.³¹ We show that IPO firms whose boards have a higher proportion of directors with financial or public firm experience realize smaller underpricing, have higher firm value, and pay lower underwriting fees.

Second, our study extends the literature on the role of the board of directors by

³¹ For studies that examine the advisory role of the boards, see also Klein (1998), Booth and Deli (1999), Agrawal and Knoeber (2001), Adams and Mehran (2003), Adams and Ferreira (2007), Minton, Taillard, and Williamson (2011), and Coles, Daniel, and Naveen (2008). For example, Coles, Daniel, and Naveen (2008) show that firms tend to design the board structure according to their advisory needs. Adams and Ferreira (2007) argue that increasing board independence reduces the CEO's propensity to disclose information to non-executive directors and show the importance of information sharing between management and directors in board advising.

providing the first detailed evidence of how private firm directors perform an advisory role in important corporate events such as IPOs. Existing evidence on the effects of board expertise on corporate decision and performance is limited mainly to public firms. Due to lack of available data for private firms, especially lack of detailed biographical data for private firm directors, the literature is silent on the advisory role performed by directors on private firm boards. By manually collecting data on private firm directors, we examine how private firm directors perform an advisory role and how board structures and director expertise are different between private and public firms.

Finally, our study contributes to the IPO literature by documenting that board composition and director expertise are important determinants of IPO underpricing and firm value at the time of an IPO. Previous IPO literature shows that various reputable institutions and mechanisms such as reputable underwriters (Carter and Manaster, 1990; Carter, Dark, and Singh, 1998) reputable auditors (Titman and Trueman, 1986), venture capitalists (Barry et al., 1990), institutional investors (Chemmanur, Hu, and Huang, 2010), large customers (Johnson, Kang, and Yi, 2010), and banks (Schenone, 2004) help mitigate IPO underpricing. However, previous studies have not paid much attention to how the board of directors in IPO firms is related to IPO underpricing and firm value. To the best of our knowledge, our paper is the first to present empirical evidence on the impact of director expertise on IPO underpricing and firm value.

The paper is organized as follows. In Section 2, we describe the data, key

variable construction, and sample characteristics. In Section 3, we examine how board expertise affects IPO underpricing and underwriting fees. In Section 4, we examine the impacts of board expertise on IPO firm valuation. Section 5 presents the results from robustness tests. Finally, we present a summary and concluding remarks in Section 6.

2. Data, Variable Construction, and Summary Statistics

2.1. Data and variable construction

We obtain our initial sample of U.S. IPO firms from the Security Data Corporation (SDC) new issues database from 2002 to 2008. We restrict our sample firms to those covered by the Capital IQ (CIQ) database since we obtain directors' biographical information from this database.³² The data on directors' public directorships are from the BoardEx database. We start the sample period in 2002 because data on public directorships are available only after 2001 in the BoardEx database. Unit offers, closed-end funds, real estate investment trusts (REITs), firms with an offer price below \$5, and firms in the finance (SIC codes 6000–6999) and utilities (SIC codes 4900–4999) industries are excluded from the sample. We also exclude firms that do not have stock return and financial data available on CRSP and Compustat, respectively, after the fiscal year of their IPOs. These requirements result in a final sample of 537 IPO firms and 3,851 board directors.

³² CIQ is an affiliate of S&P and provides financial and director data on private U.S. firms that file their financial statements to the SEC starting from the late 1990s. For each director, CIQ provides biographical information including past employment experience, past board directorships, special awards, and educational backgrounds.

We obtain the board of directors' expertise information immediately before a firm's IPO from the most recent proxy statements (S-1, S-1/A filings) prior to the offer date available in the SEC's Edgar online database. From these proxy statements, we manually collect information on each director's name, age, gender, position, starting year of board membership, share ownership in an IPO firm prior to the offering, and biography. When firms do not report enough information on past experience of directors in their proxy statements, we obtain relevant information from the CIQ and BoardEx databases. Using these biographical information, we code each director's past employment experience into the following categories: (1) investment bankers; (2) commercial bankers; (3) venture capitalists; (4) other finance executives (CFOs, accountants, treasurers, or vice presidents of finance); (5) public directors; (6) public firm CEOs; (7) lawyers; and (8) others (government employees or professors). We consider that a director has a certain experience if she has corresponding experience either prior to or at the time of an IPO.³³ Specifically, we consider that a director has investment banking experience if she was or is an investment banker or an executive in one of the investment banking firms listed in the Carter-Manaster IPO underwriter reputation rankings updated by Loughran and Ritter (2004). Following Guner, Malmendier, and Tate (2008), we consider that a director has commercial banking experience if she was or is an executive in one of the banks in the Federal Deposit Insurance Corporation's list of U.S. chartered commercial banks. To be considered as having venture capitalist experience, a director should have work experience as an

³³Since the director can have various employment experience prior to the IPO, the assignment of director experience into a certain category is not mutually exclusive.

executive or managing partner of a firm that is registered as a venture capital firm in the VentureXpert database in the Securities Data Company (SDC) database. To be considered as having other finance executive experience, the director should have previous or current experience as CFO, accountant, treasurer, or vice president of finance. To be considered as having public firm director or CEO experience, the director should be a past or current board member or CEO of a public firm. Finally, since directors' prior government experience may provide firms with valuable connections and unique information about the public policy process (Hillman, Zardkoohi, and Bierman, 1999) and directors with government experience are more likely to help enhance the value of firms with government sales (Kang and Zhang, 2011), we consider their government experience. A director is deemed to have government experience if she was an official in the state government. We also obtain information about whether directors have specialized academic degrees such as Juris Doctor (JD), PhD (excluding JD), and MBA degrees and classify the directors according to these educational backgrounds.

Using the employment (education) experience of each director, for each firm, we measure the board's specific expertise as the percentage of outside directors on the board who have a certain employment (education) experience. For example, we measure the board's investment banking expertise (*% investment banker*) as the ratio of the number of outside directors who have investment banking experience to the total number of directors on the board. Other board expertise measures such as *% commercial banker*, *% venture capitalist*, *% other finance executive*, *% public*

director, % *public firm CEO*, % *lawyer*, % *government*, % *professor*, % *JD*, % *MBA*, and % *PhD* are calculated in a similar way. The Appendix provides detailed descriptions of the construction of these variables.

Other board characteristics including equity ownership held by directors, CEO-chair duality, and gender are manually collected from the proxy statements. Deal characteristics including IPO proceeds, the number of shares offered in the IPO, offer price, and whether the deal is backed by a venture capitalist are obtained from SDC and CIQ databases. Following the IPO literature, we measure IPO underpricing as the percentage return from the offer price to the closing price on the first day of public trading.

2.2. Summary statistics

Table 1 presents the number of IPO firms in the sample and their mean and median IPO underpricing by year. It also shows the mean and median board size and the mean and median numbers of investment banker and public directors on the board by year. The frequency of IPOs is the highest in 2006 (116 IPOs) and lowest in 2008 (15 IPOs). The mean and median IPO underpricing during our sample period are 10.99% and 6.08%, respectively, which are consistent with the findings in Loughran and Ritter (2004). The mean and median board sizes of IPO firms are 7.07 and 7, respectively, and are relatively stable over time. The IPO firms in our sample on average have less than one director with investment banking experience with the median being 0, suggesting that not all IPO boards have directors with investment

banking expertise. The mean (median) number of public directors on the IPO firms' boards is 4.19 (4), suggesting that more than half of the board members in IPO firms have director experience in public firms prior to or at the time of IPO.

Table 2 Panel A reports the summary statistics for the 3,851 directors in our sample. We find that directors with investment banking, commercial banking, venture capital or private equity, and other finance executive experience account for, respectively, 11%, 3.6%, 26.2%, and 15.8% of all directors in the sample. Although we do not have any comparable statistics for public firm directors, these results suggest that private firms have a relatively large number of directors with financial expertise, particularly expertise in venture capital or private equity firms, prior to their IPOs.³⁴

Besides financial expertise, we also find that a large number of IPO firm directors have public firm experience. About 58.4% (14.4%) of the directors have director (CEO) experience at a public firm prior to or at the time of IPO. Further classification shows that firms appoint a large number of directors with public firm director experience immediately prior to IPO: 45.5% of the directors hold public firm directorship at the time of IPO. This result suggests that firms adjust their board structure prior to important events such as IPOs.

Directors with lawyer, government, and professor experience make up 4.8%, 4.4%, and 6.8% of all IPO directors, respectively. Female directors account for 4.5% of all directors. On average, directors are 52.6 years old and own 9% of the firms' shares

³⁴ About 44.1% of the IPO firms in our sample are backed by venture capitalists.

prior to the offering. Finally, the directors on average hold 1.86 public firm directorships prior to or at the time of IPO.

On average, directors serve on the IPO boards for 4.02 years and the tenure of outside directors is only 3.46 years. Considering only outside directors, the tenure of investment bankers and lawyers are 3.20 years and 3.06 years respectively, indicating that their tenure is shorter than average; the tenure of public directors and venture capitalist directors are 3.50 years and 4.17 years respectively, indicating their tenure is longer than average. The tenure of directors with different expertise are consistent with the expectation that investment banking and legal advice are needed shortly before an IPO, but public firm and venture capital experience are helpful in preparing for listing long before an IPO.

We transform director-level characteristics in Panel A into firm-level characteristics and report the results in Table 2 Panel B. The mean *% investment banker* (the percentage of outside board members who have investment banking experience) is 10.1%, indicating that on average 10.1% of the directors on the IPO firm boards have investment banking experience prior to or at the time of IPOs. The corresponding numbers for commercial bankers (*% commercial bankers*), venture capitalists (*% venture capitalist*), and other finance executives (*% other finance executive*) experiences are 2.7%, 24.0% and 12.3%, respectively. We also find that 49.9% of the outside directors on the IPO firm boards have public firm director experience prior to or at the time of IPO (*% public director*) and 39.9% of the outside directors hold public firm directorship at the time of IPO. Public firm CEOs, both

incumbent and retired, account for 11.1% of the outside directors on the IPO firm boards (*% public firm CEO*). Lawyers, government employees, and professors account for 4.2%, 3.6%, and 4.8% of the outside directors on IPO firm boards, respectively. The mean (median) board size of IPO firms is 7.1 (7) and the mean (median) proportion of outside directors on the board is 75.2% (80%). For 38% of our sample IPO firms, the CEO is also the chairman of the board and for 25.7% of the firms, there is at least one female director on the board.

Turning to deal characteristics, we find that the mean offer size of the IPOs is \$178.42 million and the mean sales of the firms prior to IPOs is \$398.47 million. The mean percentage of shares offered (number of shares offered divided by total number of shares outstanding after the IPO), *Fraction offered*, is 32%. Out of 537 IPOs, 44% are venture capital-backed IPOs and 30% are in high-tech industries. On average, IPO firms in our sample are 17 years old, with the median being 9 years. These firm and IPO deal characteristics are generally consistent with those in Ritter and Welch (2002).

Table 2 Panel C reports Pearson pair-wise correlation coefficients as being among our key variables of interest. IPO underpricing is negatively and significantly correlated with *% investment banker* and *% public firm CEO*, suggesting that underpricing is lower when IPO firm boards consist of more directors with investment banking experience or those with public firm CEO experience. These results support our hypothesis that board expertise in private firms helps reduce IPO underpricing. We also find that underpricing is significantly higher for IPOs in high-tech industries,

venture capital-backed IPOs, and IPOs with larger offer size.

% investment banker is significantly positively correlated with *% venture capitalist* and *% public director*, but significantly negatively correlated with *% other finance executive*. Similarly, we find that *% venture capitalist* is significantly negatively correlated with *% other finance executive*, but significantly positively correlated with *% public director*. These results suggest that IPO firms view investment banking, venture capitalist, and public firm experience of directors as unique different traits that are important in helping the management team successfully transition from private to public.³⁵

3. Board Expertise and IPO Cost

3.1. Board expertise and IPO underpricing

To better understand the cross-sectional variation in IPO underpricing, we perform ordinary least squares (OLS) regressions in which the dependent variable is the first day return and the key independent variables of interest relate to board expertise. To measure board expertise, we first classify director experience into four categories: finance experience, public firm experience, law experience, and other experience. Finance experience includes investment banking, commercial banking, venture capital or private equity, or other finance executive experience. Public firm experience includes public firm director or public firm CEO experience. Law experience includes experience as a lawyer or education in the form of a JD degree. Other experience

³⁵ Most of the board finance expertise variables are negatively correlated with *% public firm CEO* (the correlations are statistically insignificant, possibly due to for the low number of directors with public firm CEO experience).

includes experience in the government or as a professor. We then measure board financial expertise using *% finance expertise*, which is calculated as the ratio of the number of directors who have investment banking, commercial banking, venture capital, or other finance executive experience to the total number of directors on the boards. *% public firm experience*, *% law experience*, and *% other experience* are calculated in a similar way.

Following previous literature on IPOs, we control for following variables in the regressions: offer size measured as the natural logarithm of IPO proceeds in million dollars (*Ln (proceeds)*); firm size measured as the natural logarithm of the sales prior to IPOs (*Ln (sales)*); R&D expenditures normalized by total asset (*R&D*); the age of the issuer (*Ln (firm age)*); underwriter reputation measured as an indicator that takes the value of 1 if the ranking of the underwriter in Carter and Manaster (1990)'s ranking system is 8 or 9, and 0 otherwise (*Reputable underwriter*); an indicator that takes the value of 1 if the offering is backed by a venture capitalist, and 0 otherwise (*VC-backed*); an indicator that takes the value of 1 if the issuer operates in a high-tech industry defined by Loughran and Ritter (2004) (*Tech-firm*); the ratio of the number of shares offered to the total number of shares outstanding after the IPO (*Fraction offered*), and the standard deviation of the IPO stocks' raw returns estimated using daily returns for 255 trading days commencing 6 trading days after the offer (*Std return*). *Std return* is used to control for the riskiness of firms' future cash flows (Carter, Dark, and Singh, 1998).

We also control for several board characteristics, including the proportion of

outside directors (*% outside directors*); board size ($\ln(\text{board size})$); an indicator for CEO-chair duality (*CEO chairman*); an indicator that takes the value of 1 if there is at least one female director on the board and 0 otherwise (*female board*); and equity ownership held by all directors (*director ownership*). Finally, to control for potential time trend effects, we include year fixed effects in all regressions.

The results are reported in Table 3. Columns (1)–(4) report the results using board expertise in finance, public firms, law, and other areas as the key independent variables of interest. We find that the coefficient estimates on *% finance experience* and *% public firm experience* are negative and significant in columns (1) and (2), respectively, suggesting that IPO firms whose board members have more expertise in finance or public firms experience significantly smaller underpricing. The coefficient estimate of -13.994 on *% finance experience* in column (1) suggests that one standard deviation increase in finance expertise (0.291) is associated with a 4.07 (0.291×13.994) percentage point decrease in IPO underpricing. Similarly, the coefficient estimate of -7.795 on *% public firm experience* in column (2) suggests that one standard deviation increase in public firm expertise (0.269) is associated with a 2.097 percentage point decrease in IPO underpricing. However, *% law experience* and *% other experience* have an insignificant effect on IPO underpricing, as seen in columns (3) and (4). When we include all four board expertise variables in column (5), we still find that finance and public firm expertise significantly lower IPO underpricing.

Turning to firm-, deal-, and other board-specific characteristics, we find that consistent with Loughran and Ritter (2004) and Cai, Li, and Pan (2012), IPOs with

larger offer size, venture capital-backed IPOs, and IPOs in high-tech industries experience significantly higher IPO underpricing compared to other types of IPOs. In contrast, IPO firms that issue a large percentage of shares and those with high R&D intensity experience significantly lower IPO underpricing.³⁶ All other variables are not significantly related to IPO underpricing.³⁷ These results are broadly consistent with those in previous literature (Ritter and Welch, 2002; Loughran and Ritter, 2004).

3.2. Further breakdown of board expertise

To further identify the types of director experience that help to reduce IPO underpricing, we break down board expertise used in the above analysis into more detailed expertise as discussed in Table 2 Panel A. Specifically, we break down *% finance experience* into *% investment banker*, *% commercial banker*, *% venture capitalist*, and *% finance executive*; *% public firm experience* into *% public director* and *% public firm CEO*; and *% law experience* into *% lawyers* and *% JD*, and examine how each of these board expertise is related to IPO underpricing.

Table 4 presents the regression results. Columns (1)–(4) report the results for the

³⁶The significant negative coefficient estimate on *R&D* is somewhat surprising. According to Ljungqvist (2007), the relations between IPO underpricing and many firm characteristics differ depending on time periods studied and the measures of firm characteristics used.

³⁷ Firm size and firm age does not show up to be significantly related to IPO underpricing in our regression. Actually, both IPO underpricing and the relations between IPO underpricing and many firm characteristics change over time (Loughran and Ritter, 2004; Ljungqvist, 2007). For example, Loughran and Ritter (2004) find a significant negative relationship between IPO underpricing and firm age during the 1980–1990 and 1990–1998 periods. However the relationship became insignificant in the 1999–2000 and 2001–2003 periods. Change in the relationship between firm size and IPO underpricing is also reported in Loughran and Ritter (2004)’s analysis. In a recent study using a sample of 465 IPO firms from 2001 to 2008, which has a similar sample period as ours, Cai, Li, and Pan (2012) also report an insignificant relationship between IPO underpricing and firm age.

breakdown of board finance expertise into investment banking, commercial banking, venture capital / private equity, and other finance expertise, respectively. Although all these expertise measures are negatively related to IPO underpricing, only % *investment banker* and % *venture capitalist* have significant coefficients. Investment banking expertise has a strong effect in reducing IPO underpricing, with a coefficient estimate of -12.613 (p -value=0.010). This coefficient estimate suggests that one standard deviation increase in the ratio of number of directors with investment banking experience to the total number of directors on the board (0.142) is associated with a 1.791 percentage point decrease in IPO underpricing. Directors' experience in venture capital firms also help reduce IPO underpricing significantly, with the coefficient estimate on % *venture capitalist* of -20.540 (p -value=0.000). Thus, one standard deviation increase in the ratio of number of directors with venture capital firm experience to the total number of directors on the board (0.212) is related to a 4.355 percentage point decrease in IPO underpricing.

These results, together with those of Guner, Malmendier, and Tate (2008), who find that commercial bankers on public firm boards help to increase external funding but investment bankers on public firm boards are associated with worse acquisition performance, suggest that the role of board expertise shifts depending on firms' advisory needs, which vary across different stages of firms' life cycle.

Columns (5) and (6) report the results for the breakdown of board public firm expertise into public firm director and CEO expertise. We find that both types of expertise are negatively and significantly related to IPO underpricing. The coefficient

estimate on *% public director* is a significant -7.295, indicating that one standard deviation increase in the proportion of public firm directors on the board (0.211) is associated with a 1.539 percentage point decrease in IPO underpricing. As for *% public firm CEO*, its coefficient estimate is an insignificant -6.681, suggesting that one standard deviation increase in the proportion of public firm CEOs on the board (0.118) leads to a 0.788 percentage point decrease in IPO underpricing.

When we decompose *% law experience* into *% lawyers* and *% JD* in columns (7) and (8), respectively, we find that the coefficient estimate on *% law experience* is negative and marginally significant, but the coefficient estimate on *% JD* is not significant. If lawyer expertise reflects not only specialized knowledge in the legal field that is important in the IPO process but also lawyers' connections and social networks, then it is not surprising to find experience as lawyers plays a more important role in IPOs than a JD degree.

In columns (9) and (10), we include all board expertise measures used in the previous regressions as explanatory variables. Since *% public director* is highly correlated with *% venture capitalist* (correlation coefficient 0.384) and *% public firm CEO* (correlation coefficient 0.279), we control these expertise separately. In column (9), we exclude *% public director* and in column (10) we exclude *% venture capitalist* and *% public firm CEO*. We find that all the significant board expertise measures in columns (1)–(8) remain significant in columns (9) and (10).

Overall, we find that investment banking, venture capital, public firm director, public firm CEO, and lawyer expertise help to reduce IPO underpricing, supporting

our hypothesis that director qualifications and experience underpin the capacity of directors to perform their advisory function effectively and add value to the firms.

3.3. Further breakdown of investment banking expertise

In this subsection, we further investigate how IPO underpricing is related to the presence of different types of investment bankers on the boards. We first divide the investment banker directors into incumbent and former investment bankers,³⁸ and examine whether IPO underpricing is affected by whether the investment banker directors currently work for investment banks. Table 5 column (1) shows that IPO firms with a higher proportion of former investment bankers on the board experience significantly smaller IPO underpricing while those with a higher proportion of incumbent investment bankers do not.

In column (2), we divide our investment banker directors into investment bankers with affiliations with the IPO underwriters prior to or at the time of IPO (affiliated investment bankers) and those who without (nonaffiliated investment bankers),³⁹ and examine whether IPO underpricing is affected by investment banker directors' connection to the IPO underwriters. If investment bankers can use their expertise as well as their connections to underwriters to help to reduce information

³⁸ Incumbent investment bankers are those who currently work for investment banks at the time of IPO and former investment bankers are those who worked for investment banks prior to the IPO but have retired at the time of IPO. We find that out of 425 investment banker directors in our sample, 33 (7.76%) are incumbent investment bankers and 389 (92.24%) are former investment bankers. Out of 33 incumbent investment bankers, 16 (3.79%) are affiliated with the IPO underwriters.

³⁹ Out of 425 investment banker directors, 78 (18.35%) can be classified as affiliated investment bankers.

asymmetry between the issuer and the underwriter, we would expect affiliated investment bankers to play a more important role in reducing IPO underpricing than nonaffiliated investment bankers. Consistent with this view, we find that affiliated investment bankers help to reduce IPO underpricing more than unaffiliated investment bankers. The coefficient estimate on *% affiliated investment bankers* is -28.192, which is significant at the 5% level, while that on the *% unaffiliated investment bankers* is only -8.602, and not significant.

Overall, these results suggest that by using their investment banking expertise and their connections to underwriters, investment bankers on the boards of directors play an important advisory role in reducing IPO underpricing.

3.4. Further breakdown of public firm expertise

In this subsection, we investigate how IPO underpricing is related to the presence of different types of public firm directors/CEOs on the boards. We first divide our public firm directors into former and incumbent public firm directors. Former public firm directors are the directors who had held a public firm directorship prior to IPO but not at the time of IPO. Incumbent public firm directors are the directors who hold a public directorship at the time of IPO. Incumbent public firm directors may have a better understanding of current stock markets and industry developments, so they are expected to provide IPO firms with more current advice on market and industry conditions, which helps to reduce the information asymmetry between outside investors and the issuer. If the market could rationally incorporate this potential

difference in advisory roles between incumbent and former public firm directors into stock prices, then we would expect IPO underpricing to be lower for firms whose boards have more incumbent public firm directors.

Table 5 column (3) shows the results. Consistent with our expectation, we find that a higher percentage of incumbent public firm directors is associated with significantly smaller IPO underpricing while a higher percentage of former public firm directors is not. The coefficient estimate of -8.540 on *% incumbent public director* suggests that one standard deviation increase in the percentage of incumbent public firm directors on the board (0.215) is associated with a 1.836 percentage point decrease in IPO underpricing.

Similarly, we divide directors with public firm CEO experience into those with incumbent public firm CEO experience and those with former public firm CEO experience. The results are reported in Table 5 column (4). Consistent with the findings in column (3), we find that IPO underpricing is significantly lower only for firms with more incumbent public firm CEOs. The coefficient estimate of -24.300 on *% incumbent public firm CEO* suggests that one standard deviation increase in the percentage of incumbent public firm CEOs on the board is associated with a 2.163 percentage point decrease in IPO underpricing.

Interestingly, a higher proportion of former public firm CEOs is associated with significantly higher IPO underpricing. To examine why this is so, we further divide former public firm CEOs into successful and unsuccessful CEOs. We classify former public firm CEOs as unsuccessful CEOs if they hold no public firm directorship at the

time of IPO or if the public firms where they served as CEO in the past have been delisted at the time of IPO. Former public firm CEOs are considered to be successful CEOs if they hold a public firm directorship at the time of IPO and if the public firms where they served as CEO in the past are still listed on the stock exchange at the time of IPO. Prior studies show that the number of board seats held by retiring CEOs is positively related to firm performance prior to their retirement (Brickley, Linck, and Coles, 1999), suggesting that the ability of the retiring CEOs to run their firms successfully is an important determinant of their board seats. Thus, we expect IPO underpricing to be higher for firms with a higher proportion of unsuccessful former public firm CEOs on the board. Consistent with this prediction, we find in Table 5 column (5) that IPO underpricing is greater when firms have more unsuccessful former CEOs on their boards. When firms have more successful former CEOs on their boards, IPO underpricing is lower but the effect is not statistically significant.

Overall, these results suggest that directors who currently hold director / CEO positions at public firms play an important role in reducing IPO underpricing, possibly due to their ability to provide constructive suggestions to the IPO firms.

3.5. Board expertise and IPO underwriting fee

If directors on the IPO boards could reduce information asymmetry between the underwriters and the firms or monitor the underwriters more effectively, we expect that these directors could also help to reduce underwriting fees that the IPO firms need to pay. For example, if directors' expertise and their internal information about the IPO firms help to reduce the underwriters' effort in information collection, firms

are likely to pay smaller underwriting fees. Alternatively, directors can reduce agency conflicts between the underwriters and the issuing firms if they can monitor the investment banks' selling effort and bargain hard over the price (Ljungqvist, 2007; Loughran and Ritter, 2004). To examine whether director expertise helps to reduce underwriting fees, we rerun the Table 3 regressions by replacing the dependent variable, *First day return (%)*, with *Underwriting fee* (ratio of total underwriting fee to IPO proceeds).

Table 6 presents the results. In column (1), we find that a higher proportion of investment bankers on IPO firm boards is associated with smaller underwriting fees, albeit this relationship is not significant. In column (2), we divide investment bankers in our sample into affiliated and unaffiliated investment bankers and rerun regression (1). We find that IPO firms with more affiliated investment bankers on their boards pay significantly lower underwriting fees. The coefficient estimate of -0.793 on % *affiliated investment bankers* suggests that one standard deviation increase in affiliated investment bankers on the board (0.048) is associated with a 0.038 percentage point decrease in underwriting fees. In a typical IPO with mean proceeds of \$178.42 million, this 0.038 percentage point decrease is equivalent to reducing underwriting fees by almost \$0.068 million. Directors with venture capital or private firm experience, however, do not help to reduce underwriting fees (column (3)).

In columns (4) and (5), we find that a higher proportion of public firm directors and a higher proportion of public firm CEOs on IPO firm boards are significantly associated with smaller underwriting fees. Higher proportion of lawyers on the board is also associated with smaller underwriting fees, albeit this relation is not significant (column (6)). When all these different types of director expertise are included in the regression, we find that affiliated investment bankers and public firm directors play

the most significant role in reducing underwriting fees (column (7)).

Overall, these results are consistent with those reported in previous tables and further support the view that boards of directors with finance and public firm expertise play an important advisory role and help reduce IPO costs.

4. Board Expertise and IPO Valuation

Another way to test whether directors on the boards of IPO firms play an important advisory role is to examine whether the presence of directors with specific expertise on the board is positively related to IPO valuation. IPOs provide investors and firm managers with the important opportunity to value a set of corporate assets and observe price signals from the public capital markets (Aggarwal, Bhagat, and Rangan, 2009). If the stock market incorporates IPO firm directors' efforts and ability to add value through their advisory role in the stock prices, we would expect IPO firms with board expertise to experience higher IPO valuations.

Following Aggarwal, Bhagat, and Rangan (2009), we measure IPO value as total offer value (offer price multiplied by post-IPO shares outstanding) divided by sales in the IPO year. We use the logarithm of this variable as the dependent variable in the Table 3 regressions.

The results are reported in Table 7. In columns (1), (3), and (5), we find that IPO firms with more investment bankers, more public firm directors, and more lawyers on the boards have significantly higher IPO valuations. The coefficient estimate on % *investment banker* is 0.473. This coefficient magnitude suggests that one standard deviation increase in the proportion of investment bankers on the board (0.142) is associated with a 6.95% ($e^{0.473 \times 0.142} - 1$) increase in IPO valuation. For a typical IPO issuer with the average sales of \$398.47 million, this 6.95% increase is equivalent

to \$27.69 million increase in IPO offer valuation. Similarly, the coefficient estimate on *% public director* is 0.457, suggesting that one standard deviation increase in the proportion of public firm directors on the board (0.211) is associated with a 10.12% increase in IPO valuation. However, having more venture capitalists or more public firm CEOs on the board are not significantly associated with IPO valuation. When we include all types of directors in the regression, only the coefficient estimates on *% investment banker* and *% public director* are positive and significant. Thus, directors with investment banking expertise and those with public firm director expertise play the most important value-enhancing role when their firms go public.

5. Additional Tests of Director Advisory Role

To verify the robustness of our findings and to further test the advisory role of directors on IPO firm boards, we conduct following additional tests:

5.1. 2SLS regressions

It is possible that some unobservable firm characteristics simultaneously affect both a firm's IPO performance and its board expertise. Besides, directors with certain types of expertise may be more or less likely to predict the firms that will experience underpricing and will sit on those boards that match their preferences better. In this subsection we address these endogeneity problems by adopting a 2SLS regression approach. In the first stage, we run an OLS regression to predict the firm's board expertise. Since we have different board expertise measures in our main analysis, we need to take each board expertise measure as a different endogenous variable and run 2SLS regressions separately. We use *% venture capitalist* and *% public director* to

represent the IPO boards' financial expertise and public firm expertise, respectively. In the second stage, we use the predicted value of board expertise (*% venture capitalist* and *% public director*) as the independent variable and examine how it influences IPO underpricing.

For the purpose of identification, we need instrumental variables (IVs) that affect a firm's board expertise, but do not affect its IPO underpricing directly other than through the effect of board expertise. Specifically we take *% venture capitalist* as the endogenous variable. Huang et al. (2014) argue that geographic proximity increases the chance for firms' executives and financial experts to interact socially and decreases the personal cost (primarily travel time) for financial experts to serve on boards. Therefore we use $\ln(\text{state PE firm number})$ as an instrument variable. *State PE firm number* is defined as the total number of private equity firms in a certain state-year, scaled by the total market capitalization of all the financial firms in the same state-year. To the extent that an IPO firm is located in a state where there is higher proportion of private equity firms in the finance industry, the pool of potential venture capitalist directors is likely to be large. Thus our IV is expected to be positively correlated with the venture capitalist expertise on board (*% venture capitalist*). With respect to an independent firm, the state-level PE firm number is likely to affect a firm's IPO performance either through the influence of venture capitalists on its board or through the impact of a venture capitalist-backed IPO. Since we control the dummy variable indicating whether the deal is backed by a venture capitalist, our IV is not likely to affect a firm's IPO performance other than through

the effect of venture capitalist directors on the firm's board.

We estimate regressions of IPO underpricing (*First day return*) on the predicted value of % *venture capitalist* from the first stage and the other control variables used in Table 4 column (3).

The 2SLS regression results for % *venture capitalist* as an endogenous variable are reported in Table 8 column (1) and column (2). As expected, in the first stage regression (column (1)), the coefficient estimate on *Ln(state PE firm number)* is positive and significant at the 5% level. The *F*-statistic on the test that our IV is equal to 0 is 4.92, which rules out the weak instrument concern (Staiger and Stock, 1997).

Column (2) shows the results from the second-stage regression. We find that the coefficient estimate on the predicted value of % *venture capitalist* is negative and significant at the 5% level, indicating that the venture capitalist directors on the boards play an important role in reducing the firms' IPO underpricing, even after controlling for potential endogeneity bias.

In our second set of 2SLS regressions, we address the endogeneity concern related to public firm expertise on the IPO firms' boards. Specifically we use *Ln(State public firm number)* as an instrument variable and use % *public director* as the dependent variable. *State public firm number* is defined as the size weighted public firm number in a certain state-year, using the state public firm total market capitalization as the weight. The instrument reflects not only the number of public firms in a state, but also the size and prevalence of large public firms in a state (large public firm directors are more likely to hold more directorships). If an IPO firm is located in a state where

there are more public firms and larger public firms, the pool of potential public firm directors is likely to be large. Thus our IV is expected to be positively correlated with % *public director*. However, size weighted state public firm number is unlikely to have any direct impact on a firm's IPO underpricing other than through the effect of public firm directors on IPO firms' boards.

Similar results are found in Table 8 column (3) and column (4) where the endogenous variable is % *public director*. In the first-stage regression (column (3)), the coefficient estimate on $\ln(\text{state public firm number})$ is positive and significant at the 5% level. The F -statistic on the test that our IV is equal to 0 is 6.12, which rules out the weak instrument concern (Staiger and Stock, 1997). Column (4) reports the second-stage results. We find that the coefficient estimate on the predicted value of % *public director* is negative and significant at the 1% level, confirming our results in Table 4 column (5) that public firm directors on IPO firms' boards play an important role in mitigating IPO underpricing.

Overall, these results further support our previous evidence that both financial expertise and public firm expertise on IPO firms' boards help reduce IPO underpricing, after controlling for potential endogeneity bias.

5.2. Director tenure and IPO underpricing

Thus far, we have argued that the presence of directors with special expertise in IPO firms help to reduce underpricing since they can mitigate information asymmetry and provide better advice to the issuer. However several theoretical models show that

board structure is optimally determined based on several considerations (Hermalin and Weisbach, 1998; Raheja, 2005; Harris and Raviv, 2008). Hermalin and Weisbach (1998) argue that board structure is the balance of bargaining power between the CEO and other directors. In their recent empirical study, Gao, He, and Kang (2012) find that the unique contracting environments of private firms, such as concentrated ownership, lack of a liquid market for the firms' shares, and stable shareholder base, provide private shareholders with stronger incentive to structure more powerful boards. They report a significant shift in board structure as firms transition from private to public status. To the extent that IPOs are predictable, it is possible that firms choose to optimize their board structure before they go public. For example, if private firms anticipating a future IPO are more likely to appoint directors with investment banking expertise immediately prior to the IPO, and if IPO underpricing simply reflects this adjustment in board structure, we might detect a spurious relation between the presence of a director with investment banking expertise on the board and IPO underpricing.

To address this possibility, we examine how director tenure is related to IPO underpricing. If director expertise helps to lower IPO underpricing by mitigating information asymmetry and providing constructive advice, we expect that the longer the directors have been on the board, the better their capacity to play an advisory role in the IPO and thus the lower IPO underpricing is. On the other hand, if the presence of directors with expertise on the boards just represents an adjustment of board structure toward an optimal level immediately prior to IPO, we expect IPO

underpricing to be lower if the board consists of more newly appointed directors and fewer non-newly appointed directors, because for non-newly appointed directors, it is unlikely that they were chosen because the firms anticipated a future IPO. We calculate the tenure of directors according to specific types of expertise as follows. For investment bankers, we measure their tenure by dividing the total years of board service by all investment banker directors by the total number of directors on the board. For example, if the firm has two investment bankers on the board and they have been on the board for four and two years, respectively and the board size is seven, then, the tenure of investment banker directors, *investment bankers yrs on bd*, is calculated as $(4+2)/7$. The tenures of other types of directors are calculated in a similar way. We use these tenure measures to explain IPO underpricing and valuation.

Table 9 shows the results. In columns (1) through (8), the dependent variable is IPO underpricing and key independent variables of interest are the tenures of different types of directors. In columns (1), (5), and (7), we find significant negative coefficient estimates on the tenures of investment bankers, public firm CEOs, and venture capitalists, respectively, suggesting that the longer these directors have been on the boards, the more they can help to reduce IPO underpricing. In column (3), we find a negative coefficient estimate on the tenure of public firm directors, but this effect is not significant.

In columns (2), (4), (6) and (8), we divide the directors with investment banking, public firm director, public firm CEO, and venture capital experience in our sample into directors with short and long tenures and examine whether IPO underpricing

differs between these two types of directors. Directors with short tenure are those who joined the IPO firm boards in the IPO year and directors with long tenure are those who join IPO firm boards at least one year from the date of IPO. We find that only directors with long tenure are significantly associated with lower IPO underpricing. In column (8), we find both short tenure and long tenure venture capitalists on the boards are significantly associated with lower IPO underpricing, but the long tenure venture capitalists' effect is significant at the 1% level while short tenure venture capitalists' effect is only significant at the 5% level.

These results suggest that our findings in the previous sections are largely driven by the advisory role of directors in IPO firms, not the effect of optimizing board structure when firms transition from private to public.

5.3. Advisory needs of IPO firms

In the previous subsection, we show that lower IPO underpricing and higher IPO valuation are largely due to the advisory role of directors with certain types of expertise rather than board adjustment effects. In this subsection we further investigate the importance of the advisory role of directors in IPO firms by examining whether the role of board expertise in mitigating IPO underpricing is different across firms with different advisory needs. We expect board expertise to have a stronger mitigating effect when firms have more advisory needs. Three proxy variables are used to measure the IPO firms' advisory needs. The first variable is firm size, defined as the natural logarithm of the firm's sales in the year prior to the IPO (Coles, Daniel,

and Naveen, 2008). Klein (1998) suggests that the advisory needs of firms' management increase with the extent to which the firm depends on the environment for resources. Larger firms are likely to face more complicated contracting relationships (Booth and Deli, 1996) and thus need more advice from the boards (Coles, Daniel, and Naveen, 2008). The second variable we use is leverage. Prior studies suggest that firms with high leverage depend on external resources to a greater extent and could have greater advisory requirements (Pfeffer, 1972; Klein, 1998). Coles, Daniel, and Naveen (2008) find that high leverage firms design a larger board to provide more advice to the management. Our third variable is whether the IPO is backed by a venture capitalist. Hellmann and Puri (2002) find that venture capital is related to a variety of professionalization measures, such as human resource policies, the adoption of stock option plans, and faster founder replacement in the development of new firms. Barry et al. (1990) show that venture capitalists specialize when it comes to their investments in IPO firms so as to provide intensive monitoring services. These findings suggest that IPOs not backed by venture capitalists have more advisory needs than IPOs backed by venture capitalists.

In Table 10, we compare IPO underpricing across subgroups divided according to these three measures of firms' advisory needs. Panel A reports the univariate results for large and small IPO firms. We use the sample median of a firm's sales to divide the sample into large and small IPO firms. Within large and small IPO firm subsamples, we further divide the issuers into terciles according to the percentage of directors with investment banker expertise on the boards (i.e., *% investment banker*).

We find that in large firms, firms with a high percentage of investment bankers on the boards on average have a significant 4.388 percentage points smaller IPO underpricing than firms with a low percentage of investment bankers on the boards. However, for small firms, we do not observe a significant difference in IPO underpricing between firms with low and high percentage of investment bankers on the boards. These results are consistent with the view that directors on IPO firm boards indeed play an important advisory role that contributes to mitigating IPO underpricing.

In the panel A ‘Leverage’ subsection, we use the sample median of leverage to divide firms into two groups. The results show that in high leverage firms, firms with a high percentage of investment bankers on the boards have a significant 3.599 percentage point smaller IPO underpricing than those with a low percentage of investment bankers on the boards. However, we do not find such results for low leverage firms. Thus, the negative relation between director expertise and IPO underpricing is stronger when firms have more advisory needs.

In the Panel A ‘VC-backed’ subsection, we divide the sample according to whether IPOs are backed by venture capitalists. We find that for issuers not backed by venture capitalists, issuers with a high percentage of investment bankers on the boards have a significant 3.710 percentage point smaller IPO underpricing than those with a low percentage of investment bankers on the boards. However, we do not find such results for venture capitalist-backed IPOs. These results are again consistent with the view that directors on IPO firm boards play an important advisory role.

Table 10 Panel B presents the results from OLS regressions in which the dependent variable is IPO underpricing. Consistent with the univariate results in Panel A, we find that the significant negative relation between investment banker expertise on the boards and IPO underpricing exists only among large firms, high leverage firms, and IPOs not backed by venture capitalists.

In untabulated tests, we also redo the analyses in Table 10 using public firm director, public firm CEO and venture capital experience as director expertise and find similar results: issuers with more public firm directors or those with more public firm CEOs on their boards experience significantly lower IPO underpricing only in subsamples of large firms, high leverage firms, and IPOs not backed by venture capitalists. These results suggest that the board of directors in IPO firms plays an important advisory role in mitigating IPO underpricing.

5.4. Other endogenous concerns

We control several firm and deal characteristics to address the potential endogenous bias. For example, firms in different industries may need different types of directors to provide advice prior to IPO and high-tech firms are likely to need special advice from industry experts. We thus control high-tech firm dummy variable to correct for the industry bias in our regressions. Besides, whether the IPO was venture capital-backed or not and the underwriter's reputation may also affect the robustness of our findings. These deal characteristics and underwriter characteristics are also taken into consideration in our regression controls.

It is also possible that high quality firms are capable of inviting high quality directors. In the untabulated test, we do find that large firms and high ROA firms have significantly higher proportion of investment bankers on the boards prior to their IPOs than small firms and low ROA firms. However, according to signaling models (Allen and Faulhaber, 1989; Grinblatt and Hwang, 1989; Welch, 1989), high quality firms have incentive to use lower issue price to signal their high quality. Therefore, these high quality firms are likely to have higher, rather than lower, IPO underpricing and our findings that board expertise help reduce IPO underpricing are not likely to be driven by the endogenous bias.

6. Summary and Conclusion

We provide the first empirical evidence that the expertise of boards of directors in private firms helps to reduce IPO underpricing and increase market valuation using detailed biographical data for directors on IPO firm boards from 2002 to 2008. We find important results supporting the view that board expertise plays an important role in helping to reduce IPO underpricing and increase IPO firms' shareholder value.

More specifically, we find that IPO firms with more investment bankers, venture capitalists, public firm directors, public firm CEOs, and lawyers on their boards experience smaller IPO underpricing. We also find that IPO firms with more investment bankers, public firm directors, and public firm CEOs on the boards pay lower underwriting fees. Moreover, post-IPO firm value, as measured by ratio of market capitalization on the first trading date to pre-IPO sales, is significantly higher

for issuers that have more investment bankers, public firm directors, and lawyers on the boards. To the extent that directors' investment banking, venture capital, public firm, and legal expertise are particularly important for firms transitioning from private to public, these results suggest that director qualifications and experience are important elements for directors to perform a valuable advisory function.

Our robustness tests indicate that our findings remain the same, even after controlling for potential endogeneity bias. They further show that the mitigating effect of director expertise on IPO underpricing is indeed driven by the advisory role of directors. We find that the mitigating effect mainly comes from directors who have been on the IPO board for a long time prior to the IPO. We also find that board expertise is associated with smaller IPO underpricing only for firms with greater advisory needs such as large firms, high leverage firms, and firms whose IPOs are not backed by venture capitalists.

Although our study examines the role of director expertise in explaining IPO performance, it does not investigate other potentially important issues regarding IPOs. For example, do directors with expertise play an equally important advisory role in post-IPO performance and strategy development? Do they leave the boards shortly after the IPO or stay long with the firm? Do they receive higher compensation or other benefits than directors with less or no expertise? Are directors with little public firm experience more likely to be replaced after the IPO? Examining these issues represents useful areas for future research.

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Table 1. Sample distribution by year

The sample consists of 537 IPOs during the 2002–2008 period. *First day returns* is the ratio of the closing price on the first trading day of public trading less the offer price to the offer price. *Board size* is the number of members on the board of directors. *Number of investment bankers on the board* is the number of directors on the board with investment banking experience prior to or at the time of IPO. The director is considered to have investment banking experience if she had worked or works as an investment banker or as an executive at one of the investment banks listed in the Carter-Manaster IPO underwriter reputation rankings from Jay Ritter's dataset (Loughran and Ritter, 2004). *Number of public directors on the board* is the number of directors holding public directorship(s) prior to or at the time of IPO.

Offer Year	Number of IPOs	First day return (%)		Board size		Number of investment bankers on the board		Number of public directors on the board	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median
2002	48	7.18	8.45	6.75	7	0.65	0	3.33	3
2003	37	14.08	14.29	7.24	8	0.73	0	4.30	4
2004	109	11.61	7.14	7.18	7	0.75	0	4.50	5
2005	103	9.09	5.31	7.09	7	0.83	0	4.23	4
2006	116	9.00	3.84	6.99	7	0.99	1	4.11	4
2007	109	14.80	6.61	7.09	7	0.61	0	4.21	4
2008	15	11.91	0.12	7.00	7	1.00	0	4.40	4
2002–2008	537	10.99	6.08	7.07	7	0.79	0	4.19	4

Table 2. Descriptive statistics

This table reports summary statistics of 3,851 directors and 537 IPO firms in my sample for the 2002–2008 period. Panel A reports directors' summary statistics, Panel B reports summary statistics at firm level and Panel C reports correlation coefficients. In Panel A, for each director, *Investment banker* is an indicator variable that equals to 1 if the director had been an investment banker prior to or at the time of IPOs and 0 otherwise. *Public director* is an indicator variable that equals to 1 if the director held public firm directorship(s) prior to or at the time of IPOs and 0 otherwise. *CEO* is an indicator variable that equals to 1 if the director had been CEO of public firm(s) prior to or at the time of IPO and 0 otherwise. All other variables are defined similarly in the Appendix. In Panel B, for each IPO firm, the board experience measures are the percentage of outside directors on the board who had focused experience as reported in Panel A prior to or at the time of IPO. All the variables are defined in the Appendix.

Panel A: Director summary statistics

	Sample size	Mean	Median	Standard deviation
Investment banker	3851	0.110	0	0.313
Commercial banker	3851	0.036	0	0.187
Venture capitalist	3851	0.262	0	0.440
Other finance executive	3851	0.158	0	0.365
Public director	3851	0.584	1	0.493
Incumbent public director	3851	0.455	0	0.498
Public firm CEO	3851	0.144	0	0.351
Lawyer	3851	0.048	0	0.214
Governor	3851	0.044	0	0.206
Professor	3851	0.068	0	0.252
JD	3851	0.064	0	0.245
PhD	3851	0.160	0	0.367
MBA	3851	0.344	0	0.475
Female	3851	0.045	0	0.208
Age	3851	52.628	53	10.124
Director Ownership	3851	0.090	0	0.192
Number of public firm directorship	3851	1.860	1	2.590
Director tenure	3851	4.019	3	3.797

Panel B: IPO firm summary statistics

	Sample size	Mean	Median	Standard deviation
% investment banker	537	0.101	0	0.142
% commercial banker	537	0.027	0	0.071
% venture capitalist	537	0.240	0.222	0.212
% other finance executive	537	0.123	0.125	0.115
% public director	537	0.499	0.500	0.211
% incumbent public director	537	0.399	0.400	0.215
% public firm CEO	537	0.111	0.111	0.118
% lawyer	537	0.042	0	0.080
% JD	537	0.056	0	0.092
% governor	537	0.036	0	0.088
% professor	537	0.048	0	0.088
Board Size	537	7.065	7	1.910
% outside directors	537	0.752	0.800	0.145
CEO-chairman (indicator)	537	0.380	0	0.486
Female (indicator)	537	0.257	0	0.437
Offer size	537	178.420	89.000	764.550
Fraction offered	537	0.320	0.276	0.167
Sale	537	398.470	79.702	1041
VC backed (indicator)	537	0.441	0	0.497
Tech firm	537	0.298	0	0.458
Firm age	537	17.084	9	22.815

Panel C: Correlation matrix

	First day return	% investment banker	% commercial banker	% venture capitalist	% other fin exec	% public director	% public firm CEO	% lawyer	% governor	% professor	Board size	% outsider	Firm age
% investment banker	-0.073 [0.089]												
% commercial banker	0.013 [0.759]	0.108 [0.012]											
% venture capitalist	-0.125 [0.004]	0.190 [0.000]	-0.105 [0.015]										
% other finance executive	0.011 [0.796]	-0.103 [0.017]	0.044 [0.304]	-0.130 [0.003]									
% public director	-0.041 [0.344]	0.152 [0.000]	-0.018 [0.669]	0.384 [0.000]	0.057 [0.186]								
% public firm CEO	-0.075 [0.083]	-0.080 [0.065]	0.005 [0.906]	-0.040 [0.350]	-0.033 [0.446]	0.279 [0.000]							
% lawyer	-0.040 [0.358]	0.045 [0.294]	0.030 [0.495]	-0.090 [0.038]	-0.071 [0.102]	-0.042 [0.331]	-0.002 [0.966]						
% governor	0.008 [0.851]	-0.101 [0.019]	0.011 [0.793]	-0.136 [0.002]	-0.059 [0.173]	-0.041 [0.340]	-0.056 [0.198]	0.190 [0.000]					
% professor	-0.004 [0.919]	-0.106 [0.014]	-0.072 [0.098]	0.068 [0.114]	-0.085 [0.049]	0.111 [0.010]	0.012 [0.788]	0.003 [0.948]	0.150 [0.001]				
Board Size	0.008 [0.860]	0.012 [0.783]	0.063 [0.142]	0.171 [0.000]	-0.029 [0.501]	0.239 [0.000]	0.051 [0.242]	-0.015 [0.729]	0.141 [0.001]	0.155 [0.000]			
% outside directors	-0.003 [0.941]	0.180 [0.000]	0.084 [0.051]	0.347 [0.000]	0.122 [0.005]	0.507 [0.000]	0.183 [0.000]	0.017 [0.688]	0.056 [0.195]	0.135 [0.002]	0.353 [0.000]		
Firm age	-0.019 [0.655]	0.127 [0.003]	0.040 [0.350]	-0.107 [0.013]	0.018 [0.669]	-0.004 [0.929]	-0.002 [0.969]	0.040 [0.353]	0.008 [0.845]	-0.089 [0.039]	0.071 [0.103]	0.071 [0.087]	
Log (proceeds)	0.106 [0.014]	0.160 [0.000]	0.204 [0.000]	-0.120 [0.005]	0.026 [0.546]	0.063 [0.147]	0.015 [0.722]	0.122 [0.005]	0.054 [0.214]	-0.149 [0.001]	0.119 [0.006]	0.055 [0.200]	0.173 [0.000]

Table 3. Directors' expertise and IPO underpricing

This table reports OLS regression results using 537 IPO firms during the 2002-2008 period. The dependent variable is *First day return*, computed as the ratio of the closing price of the stock on its first trading day less the offer price to the offer price. Directors' backgrounds are divided into four categories. Finance experience includes past experience of being investment bankers, commercial bankers, executives in venture capital or private equity firms, and CFOs (accountants, treasurer, or vice president of finance). Public firm experience includes experience of being CEOs of public firms or of sitting on public firms' boards. Law experience includes experience of being a lawyer or an educational qualification of a Juris Doctor (JD) degree. Other experience includes experience of being professors and governors. Regressions include indicator variables for each IPO year. Definitions of all variables are provided in the Appendix. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)
% finance experience	-13.994*** [0.000]				-13.961*** [0.000]
% public firm experience		-7.795** [0.019]			-7.231** [0.027]
% law experience			-3.928 [0.450]		-5.494 [0.285]
% other experience				5.523 [0.368]	-0.853 [0.891]
Log (proceeds)	3.929*** [0.001]	4.005*** [0.000]	3.776*** [0.001]	3.690*** [0.001]	4.252*** [0.000]
Log (sales)	0.086 [0.872]	0.084 [0.876]	0.138 [0.798]	0.176 [0.745]	0.043 [0.936]
R&D	-16.047*** [0.001]	-14.211*** [0.003]	-15.719*** [0.001]	-15.812*** [0.001]	-15.398*** [0.001]
Log (firm age)	0.362 [0.588]	0.300 [0.654]	0.414 [0.538]	0.404 [0.547]	0.254 [0.703]
VC-backed (indicator)	8.942*** [0.000]	8.581*** [0.000]	8.473*** [0.000]	8.456*** [0.000]	9.070*** [0.000]
Reputable underwriter (indicator)	-0.148 [0.936]	-0.522 [0.779]	-0.734 [0.694]	-0.649 [0.728]	-0.103 [0.956]
% outside directors	-3.002 [0.632]	-3.610 [0.565]	-6.644 [0.283]	-6.362 [0.305]	-0.391 [0.951]
Log (board size)	-2.119 [0.479]	-1.816 [0.545]	-2.164 [0.473]	-2.481 [0.417]	-1.960 [0.518]
Director ownership	0.848 [0.648]	-0.147 [0.936]	-0.078 [0.966]	-0.147 [0.937]	0.594 [0.751]
CEO chairman (indicator)	0.949 [0.480]	0.706 [0.600]	0.826 [0.542]	0.815 [0.547]	0.947 [0.482]

(Continued)

Table 3: Directors' expertise and IPO underpricing (Continued)

	(1)	(2)	(3)	(4)	(5)
Female board (indicator)	0.897 [0.552]	1.077 [0.476]	1.027 [0.499]	0.905 [0.553]	0.963 [0.525]
Tech firm (indicator)	3.420** [0.022]	3.507** [0.019]	3.696** [0.014]	3.819** [0.011]	3.184** [0.033]
Std return	47.801 [0.337]	51.611 [0.300]	55.198 [0.270]	55.629 [0.266]	43.846 [0.377]
Fraction offered	-0.187*** [0.000]	-0.188*** [0.000]	-0.192*** [0.000]	-0.188*** [0.000]	-0.187*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	2.949 [0.739]	3.616 [0.684]	3.372 [0.706]	3.049 [0.732]	4.232 [0.633]
Observations	537	537	537	537	537
Adjusted R^2	14%	14%	13%	13%	14%

Table 4. Breakdown of directors' expertise and IPO underpricing

This table reports OLS regression results using 537 IPO firms during the 2002-2008 period. The dependent variable is *First day return*, computed as the ratio of the closing price of the stock on its first trading day less the offer price to the offer price. Directors' past experience in this table includes experience of being investment bankers, commercial bankers, executives in venture capital or private equity firms, CFOs (accountants, treasurer, or vice president of finance), CEOs of public firms, board members of public firms, lawyers and directors holding a Juris Doctor degree. Regressions include indicator variables for each IPO year. Definitions of all variables are provided in the Appendix. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
% investment banker	-12.613*** [0.010]								-8.469* [0.086]	-11.618** [0.020]
% commercial banker		-4.158 [0.701]							-6.847 [0.515]	-2.335 [0.829]
% venture capitalist			-20.540*** [0.000]						-22.133*** [0.000]	
% other finance executive				-0.29 [0.961]					-9.196 [0.115]	-2.548 [0.667]
% public director					-7.295** [0.045]					-7.089* [0.053]
% public firm CEO						-6.681 [0.231]			-12.364** [0.024]	
% lawyer							-13.382 [0.105]		-26.201** [0.012]	-21.572** [0.043]
% JD								-1.762 [0.810]	12.927 [0.158]	10.558 [0.263]

(Continued)

Table 4: Breakdown of directors' expertise and IPO underpricing (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log (proceeds)	3.867*** [0.001]	3.732*** [0.001]	3.827*** [0.001]	3.705*** [0.001]	3.953*** [0.001]	3.841*** [0.001]	3.893*** [0.001]	3.719*** [0.001]	3.851*** [0.001]	4.133*** [0.000]
Log (sales)	0.145 [0.787]	0.139 [0.797]	0.03 [0.955]	0.146 [0.787]	0.124 [0.817]	0.064 [0.905]	0.128 [0.812]	0.141 [0.794]	-0.092 [0.860]	0.213 [0.692]
R&D	-16.469*** [0.000]	-15.479*** [0.001]	-15.214*** [0.001]	-15.381*** [0.001]	-14.249*** [0.003]	-15.211*** [0.001]	-16.157*** [0.001]	-15.431*** [0.001]	-13.209*** [0.004]	-15.566*** [0.001]
Log (firm age)	0.393 [0.556]	0.415 [0.537]	0.437 [0.514]	0.411 [0.541]	0.336 [0.616]	0.349 [0.602]	0.416 [0.535]	0.415 [0.536]	0.348 [0.591]	0.454 [0.496]
VC-backed (indicator)	8.541*** [0.000]	8.423*** [0.000]	9.216*** [0.000]	8.414*** [0.000]	8.672*** [0.000]	8.321*** [0.000]	8.528*** [0.000]	8.451*** [0.000]	10.372*** [0.000]	8.976*** [0.000]
Reputable underwriter (indicator)	-0.405 [0.827]	-0.693 [0.711]	-0.197 [0.916]	-0.67 [0.720]	-0.482 [0.796]	-0.712 [0.702]	-0.805 [0.666]	-0.685 [0.714]	0.834 [0.647]	-0.458 [0.805]
% outside directors	-4.936 [0.424]	-6.669 [0.281]	-2.351 [0.718]	-6.789 [0.276]	-3.79 [0.549]	-6.02 [0.329]	-6.85 [0.267]	-6.64 [0.283]	9.656 [0.140]	1.038 [0.879]
Log (boardsize)	-2.34 [0.434]	-2.064 [0.495]	-2.016 [0.502]	-2.14 [0.478]	-1.817 [0.546]	-2.093 [0.486]	-2.352 [0.434]	-2.133 [0.479]	-2.329 [0.425]	-2.177 [0.470]
Director ownership	0.241 [0.895]	-0.016 [0.993]	0.986 [0.605]	-0.053 [0.977]	0.069 [0.970]	-0.407 [0.826]	-0.18 [0.922]	-0.03 [0.987]	1.949 [0.288]	0.236 [0.899]
CEO chairman (indicator)	1.145 [0.397]	0.776 [0.567]	0.703 [0.602]	0.781 [0.564]	0.676 [0.617]	0.798 [0.554]	0.909 [0.501]	0.779 [0.565]	1.087 [0.407]	1.098 [0.418]
Female board (indicator)	0.816 [0.589]	1.027 [0.500]	0.798 [0.599]	1.028 [0.500]	1.113 [0.463]	0.954 [0.529]	1.051 [0.488]	1.012 [0.506]	0.643 [0.661]	1.019 [0.501]

(Continued)

Table 4: Breakdown of directors' expertise and IPO underpricing (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tech firm (indicator)	3.247** [0.030]	3.760** [0.012]	3.617** [0.015]	3.746** [0.012]	3.612** [0.015]	3.544** [0.018]	3.633** [0.015]	3.737** [0.013]	3.153** [0.031]	3.079** [0.040]
Std return	51.53 [0.300]	55.479 [0.268]	49.155 [0.325]	55.907 [0.264]	50.112 [0.316]	57.635 [0.248]	55.53 [0.266]	55.575 [0.267]	54.570 [0.259]	56.202 [0.258]
Fraction offered	-0.192*** [0.000]	-0.190*** [0.000]	-0.191*** [0.000]	-0.189*** [0.000]	-0.188*** [0.000]	-0.189*** [0.000]	-0.198*** [0.000]	-0.190*** [0.000]	-0.189*** [0.000]	-0.199*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.009 [0.734]	2.783 [0.755]	1.075 [0.904]	3.115 [0.730]	2.894 [0.745]	4.117 [0.644]	4.176 [0.640]	2.953 [0.741]	-1.693 [0.845]	0.354 [0.969]
Observations	537	537	537	537	537	537	537	537	537	537
Adjusted R^2	14%	13%	13%	13%	13%	13%	13%	13%	19%	14%

Table 5. Breakdown of investment banking, public firm CEO, and public firm director expertise and IPO underpricing

This table reports OLS regression results using 537 IPO firms during the 2002-2008 period. The dependent variable is *First day return*, computed as the ratio of the closing price of the stock on its first trading day less the offer price to the offer price. Investment bankers are divided into those who had been affiliated and those who had not been affiliated with the IPO underwriters prior to or at the IPO event time. Public firm CEOs (directors) are divided into incumbent CEOs (directors) and former CEOs (directors). Definitions of all variables are provided in the Appendix. Regressions include indicator variables for each IPO year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)
% incumbent investment banker	-7.240 [0.616]				
% former investment banker	-12.941** [0.011]				
% affiliated investment banker		-28.192** [0.012]			
% unaffiliated investment banker		-8.602 [0.169]			
% incumbent public director			-8.540** [0.023]		
% former public director			-4.591 [0.460]		
% incumbent public firm CEO				-24.300*** [0.001]	-22.657*** [0.002]
% former public firm CEO				11.889 [0.132]	
% successful former public firm CEO					-6.474 [0.507]
% unsuccessful former public firm CEO					37.522*** [0.002]
Log (proceeds)	3.941*** [0.001]	3.899*** [0.001]	4.322*** [0.000]	4.300*** [0.000]	4.472*** [0.000]
Log (sales)	0.117 [0.827]	0.198 [0.711]	0.005 [0.993]	-0.207 [0.697]	-0.238 [0.649]
R&D	-16.805*** [0.000]	-16.377*** [0.001]	-13.286*** [0.005]	-17.783*** [0.000]	-16.186*** [0.000]
Log (firm age)	0.390 [0.560]	0.403 [0.544]	0.358 [0.591]	0.178 [0.787]	0.109 [0.867]
VC-backed (indicator)	8.616*** [0.000]	8.625*** [0.000]	8.286*** [0.000]	8.194*** [0.000]	7.733*** [0.000]

(Continued)

Table 5: Breakdown of investment banking, public firm CEO, and public firm director expertise and IPO underpricing
(Continued)

	(1)	(2)	(3)	(4)	(5)
Reputable underwriter (indicator)	-0.327 [0.861]	-0.536 [0.772]	-0.323 [0.862]	-1.279 [0.484]	-1.268 [0.482]
% outside directors	-4.771 [0.440]	-5.624 [0.362]	-3.725 [0.555]	-6.774 [0.263]	-7.023 [0.240]
Log (boardsize)	-2.414 [0.420]	-1.861 [0.535]	-1.925 [0.521]	-2.668 [0.365]	-2.089 [0.473]
Director ownership	0.172 [0.925]	-0.061 [0.974]	-0.009 [0.996]	-1.032 [0.571]	-1.177 [0.512]
CEO chairman (indicator)	1.159 [0.391]	1.247 [0.355]	0.536 [0.690]	0.467 [0.724]	-0.230 [0.861]
Female board (indicator)	0.826 [0.585]	0.959 [0.525]	1.237 [0.413]	1.341 [0.367]	1.798 [0.222]
Tech firm (indicator)	3.273** [0.028]	3.107** [0.037]	3.092** [0.040]	3.682** [0.012]	3.122** [0.031]
Std return	51.736 [0.298]	54.820 [0.269]	50.187 [0.313]	65.175 [0.183]	56.979 [0.238]
Fraction offered	-0.193*** [0.000]	-0.199*** [0.000]	-0.189*** [0.000]	-0.195*** [0.000]	-0.196*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	2.779 [0.754]	2.864 [0.746]	1.672 [0.850]	6.074 [0.487]	4.503 [0.602]
Observations	537	537	537	537	537
Adjusted R^2	14%	14%	14%	17%	19%

Table 6. Directors' expertise and IPO underwriter fee

This table reports OLS regression results using 537 IPO firms during the 2002-2008 period. The dependent variable is *Underwriting fee*, which represents total underwriting fee as a percentage of IPO proceeds. Definitions of all variables are provided in the Appendix. Regressions include indicator variables for each IPO year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent variable: Underwriting fee / IPO proceeds						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
% investment banker	-0.011 [0.953]						
% affiliated investment banker		-0.793* [0.068]					-0.823* [0.061]
% unaffiliated investment banker		0.132 [0.488]					0.135 [0.486]
% venture capitalist			-0.095 [0.466]				-0.173 [0.196]
% public director				-0.127 [0.325]			-0.034 [0.802]
% public firm CEO					-0.440** [0.028]		-0.449** [0.030]
% lawyer						-0.136 [0.650]	-0.219 [0.463]
Log (proceeds)	-0.519*** [0.000]	-0.518*** [0.000]	-0.523*** [0.000]	-0.508*** [0.000]	-0.513*** [0.000]	-0.521*** [0.000]	-0.505*** [0.000]
Log (sales)	-0.002 [0.920]	0.002 [0.921]	0.000 [0.992]	-0.003 [0.856]	-0.006 [0.703]	-0.002 [0.916]	0.000 [0.990]
R&D	-0.196 [0.123]	-0.188 [0.136]	-0.192 [0.129]	-0.147 [0.245]	-0.186 [0.139]	-0.191 [0.133]	-0.158 [0.213]
Log (firm age)	0.036 [0.107]	0.036 [0.109]	0.036 [0.106]	0.033 [0.141]	0.034 [0.126]	0.036 [0.105]	0.031 [0.165]
VC-backed (indicator)	0.062 [0.286]	0.067 [0.253]	0.050 [0.401]	0.073 [0.212]	0.056 [0.336]	0.062 [0.289]	0.054 [0.366]
Reputable underwriter (indicator)	0.224*** [0.001]	0.220*** [0.001]	0.215*** [0.001]	0.230*** [0.000]	0.219*** [0.001]	0.222*** [0.001]	0.213*** [0.001]
% outside directors	0.586*** [0.002]	0.544*** [0.003]	0.517*** [0.008]	0.681*** [0.000]	0.600*** [0.001]	0.572*** [0.002]	0.571*** [0.004]
Log (boardsize)	-0.122 [0.197]	-0.090 [0.341]	-0.121 [0.198]	-0.104 [0.265]	-0.120 [0.200]	-0.119 [0.205]	-0.083 [0.377]
Director ownership	0.134** [0.036]	0.122* [0.055]	0.118* [0.073]	0.135** [0.032]	0.116* [0.070]	0.132** [0.039]	0.090 [0.169]

(Continued)

Table 6: Directors' expertise and IPO underwriter fee (Continued)

	Dependent variable: Underwriting fee / IPO proceeds						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CEO chairman (indicator)	-0.080*	-0.075	-0.082*	-0.088*	-0.082*	-0.083*	-0.074
	[0.085]	[0.105]	[0.078]	[0.058]	[0.077]	[0.075]	[0.108]
Female board (indicator)	-0.082	-0.076	-0.077	-0.077	-0.084	-0.081	-0.069
	[0.116]	[0.145]	[0.140]	[0.136]	[0.108]	[0.122]	[0.181]
Tech firm (indicator)	-0.005	-0.015	0.001	-0.007	-0.009	-0.001	-0.024
	[0.927]	[0.777]	[0.979]	[0.890]	[0.863]	[0.986]	[0.639]
Std return	-3.405**	-3.201*	-3.271*	-3.593**	-3.302*	-3.367*	-3.214*
	[0.048]	[0.061]	[0.057]	[0.036]	[0.053]	[0.050]	[0.059]
Fraction offered	-0.003*	-0.003*	-0.003*	-0.002*	-0.003*	-0.003*	-0.003*
	[0.085]	[0.051]	[0.090]	[0.095]	[0.091]	[0.088]	[0.057]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.377***	9.368***	9.396***	9.390***	9.428***	9.376***	9.457***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	537	537	537	537	537	537	537
Adjusted R^2	43%	44%	43%	44%	44%	43%	45%

Table 7. Directors' expertise and IPO valuation

This table reports OLS regression results using 537 IPO firms during the 2002-2008 period. The dependent variable is *IPO valuation*, computed as the number of shares outstanding after the offering times the offer price (in \$millions) divided by sales in the IPO year. Definitions of all variables are provided in the Appendix. Regressions include indicator variables for each IPO year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent variable: Log (IPO Valuation) = Log (offer price * shares outstanding / sales)					
	(1)	(2)	(3)	(4)	(5)	(6)
% investment banker	0.473* [0.057]					0.435* [0.087]
% venture capitalist		-0.032 [0.863]				-0.193 [0.322]
% public director			0.457** [0.012]			0.498*** [0.009]
% public firm CEO				-0.062 [0.824]		-0.209 [0.467]
% lawyer					0.482 [0.237]	0.488 [0.229]
Log (proceeds)	0.943*** [0.000]	0.947*** [0.000]	0.917*** [0.000]	0.944*** [0.000]	0.937*** [0.000]	0.909*** [0.000]
Log (sales)	-0.967*** [0.000]	-0.964*** [0.000]	-0.960*** [0.000]	-0.962*** [0.000]	-0.964*** [0.000]	-0.965*** [0.000]
R&D	1.118*** [0.000]	1.079*** [0.000]	0.951*** [0.000]	1.088*** [0.000]	1.124*** [0.000]	1.030*** [0.000]
Log (firm age)	0.031 [0.350]	0.028 [0.394]	0.033 [0.322]	0.030 [0.363]	0.029 [0.384]	0.035 [0.292]
VC-backed (indicator)	-0.140* [0.098]	-0.142 [0.104]	-0.136 [0.108]	-0.135 [0.116]	-0.143* [0.094]	-0.130 [0.134]
Reputable underwriter (indicator)	-0.191** [0.039]	-0.178* [0.057]	-0.194** [0.035]	-0.171* [0.067]	-0.167* [0.072]	-0.194** [0.036]
% outside directors	-0.020 [0.949]	0.041 [0.900]	-0.127 [0.681]	0.067 [0.827]	0.083 [0.786]	-0.102 [0.752]
Log (boardsize)	-0.024 [0.869]	-0.035 [0.815]	-0.046 [0.756]	-0.031 [0.833]	-0.022 [0.885]	-0.025 [0.867]
Director ownership	0.133 [0.145]	0.143 [0.132]	0.145 [0.110]	0.157* [0.089]	0.159* [0.083]	0.154 [0.101]
CEO chairman (indicator)	0.049 [0.465]	0.068 [0.316]	0.081 [0.227]	0.069 [0.304]	0.061 [0.369]	0.056 [0.406]
Female board (indicator)	0.087 [0.245]	0.079 [0.296]	0.065 [0.386]	0.077 [0.307]	0.076 [0.313]	0.070 [0.352]

(Continued)

Table 7: Directors' expertise and IPO valuation (Continued)

	Dependent variable: $\text{Log (IPO Valuation)} = \text{Log (offer price * shares outstanding / sales)}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Tech firm (indicator)	-0.044 [0.551]	-0.068 [0.364]	-0.039 [0.600]	-0.067 [0.368]	-0.062 [0.404]	-0.016 [0.833]
Std return	-5.351** [0.030]	-5.494** [0.028]	-5.177** [0.035]	-5.611** [0.024]	-5.557** [0.025]	-5.158** [0.036]
Fraction offered	-0.020*** [0.000]	-0.020*** [0.000]	-0.020*** [0.000]	-0.020*** [0.000]	-0.019*** [0.000]	-0.019*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.039*** [0.000]	9.048*** [0.000]	9.086*** [0.000]	9.012*** [0.000]	8.960*** [0.000]	8.998*** [0.000]
Observations	537	537	537	537	537	537
Adjusted R^2	83%	83%	83%	83%	83%	83%

Table 8. Controlling for endogeneity bias: Instrumental variables approach (2SLS)

This table reports 2SLS regression results using 537 IPO firms during the 2002-2008 period. Column (1) reports the first-stage OLS regression to predict % venture capitalist, where we use as explanatory variables $\ln(\text{state PE firm number})$ (instrumental variable) and the other variables used in Table 3. State PE firm number is the total number of private equity firms in a certain state-year, scaled by the total market capitalization of all the financial firms in the same state-year. Columns (2) report the estimates from the second-stage regressions. The dependent variable is the IPO underpricing represented by First day return. Column (3) reports the first-stage OLS regression to predict % public director, where we use as explanatory variables $\ln(\text{state Public firm total size})$ (instrumental variable) and the other variables used in Table 3. State Public firm number is the size weighted public firm number in a certain state-year, using the state public firm total market capitalization as the weight. Columns (4) report the estimates from the second-stage regressions. The dependent variable is the IPO underpricing represented by First day return. Definitions of all variables are provided in Appendix. All continuous variables are winsorized at the 1st and 99th percentiles. P-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	1 st Stage	2 nd Stage	1 st Stage	2 nd Stage
	% venture capitalist: OLS (1)	IPO underpricing: OLS (2)	% public director: OLS (3)	IPO underpricing: OLS (4)
Instrumented % venture capitalist		-96.615** [0.022]		
<i>Ln(state PE firm number)</i> (IV)	0.022** [0.027]			
Instrumented % public director				-31.957*** [0.001]
<i>Ln(state public firm number)</i> (IV)			0.001** [0.014]	
Log (Proceed)	-0.014 [0.266]	3.359** [0.013]	0.022 [0.128]	5.127*** [0.000]
Log (sales)	-0.010* [0.063]	-0.836 [0.235]	0.009 [0.229]	0.431 [0.495]
R&D	0.105** [0.010]	-2.28 [0.664]	0.092* [0.053]	-8.627** [0.017]
Log (firmage)	-0.003 [0.741]	-0.096 [0.890]	-0.003 [0.730]	0.372 [0.557]
VC-backed (indicator)	0.095*** [0.000]	18.542*** [0.000]	0.051** [0.018]	11.199*** [0.000]
Reputable underwriter (indicator)	0.079*** [0.000]	6.286* [0.061]	0.013 [0.583]	-0.765 [0.733]

(Continued)

Table 8: Controlling for endogeneity bias: Instrumental variables approach (2SLS) (Continued)

	1 st Stage	2 nd Stage	1 st Stage	2 nd Stage
	% venture capitalist: OLS (1)	IPO underpricing: OLS (2)	% public director: OLS (3)	IPO underpricing: OLS (4)
% outside directors	0.499*** [0.000]	39.436* [0.076]	0.743*** [0.000]	16.283** [0.175]
Log (boardsize)	0.019 [0.537]	-1.355 [0.639]	0.052 [0.112]	-1.485 [0.573]
Director ownership	0.116*** [0.000]	11.845** [0.025]	0.070*** [0.004]	2.308 [0.286]
CEO chairman (indicator)	-0.004 [0.807]	0.742 [0.646]	-0.011 [0.500]	0.700 [0.662]
Female board (indicator)	-0.023 [0.169]	-0.521 [0.798]	0.018 [0.329]	2.305 [0.164]
Tech firm (indicator)	0.005 [0.774]	3.752* [0.052]	0.056 [0.143]	2.935 [0.158]
Std return	-0.442 [0.430]	15.144 [0.830]	-0.234 [0.701]	67.744 [0.258]
Fraction offered	0.000 [0.602]	-0.202*** [0.000]	0.000 [0.465]	-0.226*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes
Constant	-0.065 [0.552]	-13.696 [0.315]	-0.325** [0.016]	-8.185 [0.453]
Observations	526	526	530	530
Adjusted R^2 / Pseudo R^2	35%	13%	33%	14%
Test IV =0:	F -statistic 4.92**		F -statistic 6.12**	

Table 9. Directors' tenure on the board and IPO performance

This table reports OLS regression results using 537 IPO firms during the 2002-2008 period. The dependent variable for columns (1)–(8) is *First day return*, computed as the ratio of the closing price of the stock on its first trading day less the offer price to the offer price; and the dependent variable for columns (9)–(12) is *IPO valuation*, computed as the number of shares outstanding after the offering times the offer price (in \$millions) divided by sales in the IPO year. Investment banker directors, public directors, CEO directors, and venture capitalist directors are divided into two groups respectively: the short tenure directors are those who became the directors of the IPO firms in the IPO year, and long tenure directors, those who had been directors in the IPO firms for at least one year prior to the IPO. Definitions of all variables are provided in the Appendix. Regressions include indicator variables for each IPO year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent variable: First day return (%)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Investment bankers' yrs on bd	-2.849*							
	[0.070]							
% short tenure investment banker		-6.174						
		[0.385]						
% long tenure investment banker		-12.223***						
		[0.008]						
Public director's yrs on bd			-0.594					
			[0.270]					
% short tenure public director				-3.247				
				[0.410]				
% long tenure public director				-8.236***				
				[0.009]				
CEOs' yrs on bd					-2.429**			
					[0.029]			

(Continued)

Table 9: Directors' tenure on the board and IPO performance (Continued)

	Dependent Variable: First day return (%)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% short tenure public firm						-0.56		
CEO						[0.933]		
% long tenure public firm						-8.201		
CEO						[0.136]		
Venture capitalists' yrs on bd							-3.936***	
							[0.000]	
% short tenure venture capitalist								-22.677**
								[0.046]
% long tenure venture capitalist								-20.506***
								[0.000]
Log (proceeds)	4.233***	3.818***	4.353***	4.398***	4.362***	4.297***	4.229***	4.332***
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Log (sales)	0.069	0.215	0.09	0.071	-0.004	-0.004	0.06	0.047
	[0.897]	[0.664]	[0.868]	[0.895]	[0.995]	[0.994]	[0.912]	[0.930]
R&D	-16.535***	-14.182***	-14.864***	-14.531***	-15.226***	-15.797***	-16.194***	-16.800***
	[0.001]	[0.002]	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]	[0.000]
Log (firm age)	-0.114	0.069	-0.237	-0.235	-0.108	-0.166	-0.149	-0.107
	[0.880]	[0.924]	[0.753]	[0.754]	[0.886]	[0.825]	[0.843]	[0.887]
VC-backed (indicator)	7.776***	6.459***	7.998***	8.138***	7.532***	7.734***	7.748***	7.877***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Reputable underwriter (indicator)	-0.303	-0.413	-0.344	-0.203	-0.581	-0.558	-0.542	-0.609
	[0.871]	[0.786]	[0.854]	[0.913]	[0.754]	[0.765]	[0.772]	[0.745]

(Continued)

Table 9: Directors' tenure on the board and IPO performance (Continued)

	Dependent variable: First day return (%)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% outside directors	-4.833 [0.436]	-1.278 [0.761]	-3.022 [0.633]	-2.75 [0.665]	-4.862 [0.431]	-4.984 [0.422]	-5.691 [0.359]	-5.916 [0.340]
Log (boardsize)	-2.095 [0.485]	-1.629 [0.451]	-1.785 [0.553]	-1.705 [0.571]	-2.002 [0.504]	-2.197 [0.464]	-2.236 [0.458]	-2.504 [0.406]
Log (directors' yrs on bd)	2.488* [0.058]	1.828* [0.096]	3.754** [0.015]	2.649* [0.056]	2.847** [0.032]	2.047 [0.124]	2.204* [0.094]	1.945 [0.140]
Director ownership	-0.14 [0.939]	-0.445 [0.768]	-0.201 [0.913]	0.355 [0.849]	-0.475 [0.796]	-0.415 [0.823]	-0.128 [0.945]	-0.312 [0.868]
CEO chairman (indicator)	1.017 [0.452]	0.998 [0.369]	0.676 [0.617]	0.773 [0.566]	0.877 [0.514]	0.853 [0.527]	0.859 [0.525]	0.978 [0.470]
Female board (indicator)	0.785 [0.605]	0.611 [0.625]	0.933 [0.538]	0.944 [0.533]	0.786 [0.603]	0.823 [0.588]	0.893 [0.557]	0.955 [0.529]
Tech firm (indicator)	3.236** [0.031]	2.354* [0.057]	3.269** [0.029]	3.293** [0.028]	3.196** [0.033]	3.294** [0.028]	3.499** [0.020]	3.407** [0.023]
Std return	58.874 [0.237]	23.431 [0.567]	52.607 [0.291]	54.796 [0.272]	57.836 [0.244]	60.287 [0.228]	57.464 [0.250]	56.363 [0.260]
Fraction offered	-0.191*** [0.000]	-0.153*** [0.000]	-0.187*** [0.000]	-0.191*** [0.000]	-0.186*** [0.000]	-0.188*** [0.000]	-0.189*** [0.000]	-0.195*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.455 [0.960]	-2.404 [0.749]	-2.222 [0.807]	-1.2 [0.895]	-0.571 [0.949]	1.266 [0.889]	0.167 [0.985]	1.772 [0.846]
Observations	537	537	537	537	537	537	537	537
Adjusted R2	14%	13%	14%	14%	14%	13%	13%	13%

Table 10. Directors' expertise and advisory needs of IPO firms.

This table compares investment banker directors' advisory role in IPO firms with high and low advisory needs.

Panel A reports the univariate test results, which compares IPO underpricing between issuers with different levels of investment bankers on the board. The IPO underpricing is measured by *First day return*(%), computed as the ratio of the closing price of the stock on its first trading day less the offer price to its offer price.

Panel B reports OLS regression results using 537 IPO firms in the sample for the 2002–2008 period. The dependent variable is *First day return*(%). Directors' advisory contribution is measured by *% investment banker*, which is the percentage of outside directors on the board who had been investment bankers prior to or at the IPO event time. Definitions of all other variables are provided in the Appendix. Regressions include indicator variables for each IPO year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Univariate test

		% investment banker			Difference	
		Low	Medium	High	Low-High	t-stat(z-stat)
Firm Size						
Large	Mean	12.426	12.469	8.038	4.388**	2.30
	Median	(8.330)	(10.505)	(4.440)	(3.890**)	2.334
Small	Mean	9.611	11.679	10.837	-1.226	-0.56
	Median	(3.155)	(5.410)	(4.640)	(-1.485)	-0.563
Leverage						
High	Mean	9.755	10.104	6.156	3.599**	2.09
	Median	(5.310)	(6.105)	(3.220)	(2.090*)	1.542
Low	Mean	11.878	11.690	14.071	-2.193	-0.98
	Median	(7.175)	(5.410)	(10.045)	(-2.870)	-0.908
VC-backed						
Non VC-backed	Mean	8.966	10.257	5.247	3.719**	2.55
	Median	(5.810)	(7.500)	(2.570)	(3.240**)	2.339
VC-backed	Mean	13.541	13.049	15.850	-2.309	-0.83
	Median	(8.330)	(7.740)	(10.630)	(-2.300)	-1.055

Panel B: Multivariate test

	Firm size		Leverage		VC-backed	
	Large	Small	High	Low	Non VC-backed	VC-backed
	(1)	(2)	(3)	(4)	(5)	(6)
% investment banker	-18.521*** [0.002]	-5.268 [0.519]	-21.427*** [0.000]	-3.548 [0.695]	-16.434*** [0.001]	9.169 [0.400]
Log (proceeds)	3.536** [0.013]	8.364*** [0.000]	3.127** [0.020]	5.915*** [0.002]	2.345** [0.038]	8.151*** [0.001]
Log (sales)	-2.035** [0.046]	1.401 [0.102]	-0.612 [0.423]	0.495 [0.544]	-0.729 [0.212]	0.999 [0.333]
R&D	-11.253 [0.300]	-12.441** [0.034]	-21.671*** [0.005]	-15.139** [0.019]	-21.272*** [0.005]	-7.393 [0.283]
Log (firm age)	0.460 [0.516]	1.345 [0.358]	0.297 [0.686]	0.374 [0.764]	0.512 [0.399]	0.542 [0.792]
VC-backed (indicator)	12.073*** [0.000]	2.106 [0.444]	7.958*** [0.000]	8.939*** [0.001]		
Reputable underwriter (indicator)	-2.374 [0.402]	0.209 [0.934]	2.284 [0.352]	-2.460 [0.383]	0.198 [0.922]	0.409 [0.905]
% outside directors	0.711 [0.933]	-7.278 [0.434]	-1.673 [0.837]	-6.485 [0.488]	2.695 [0.693]	-11.837 [0.298]
Log (boardsize)	-1.985 [0.606]	0.284 [0.952]	-0.769 [0.832]	-2.719 [0.596]	-3.269 [0.319]	-1.095 [0.845]
Director ownership	-1.468 [0.480]	2.140 [0.530]	1.857 [0.377]	-1.472 [0.668]	0.558 [0.753]	-2.102 [0.628]
CEO chairman (indicator)	2.805 [0.111]	-0.973 [0.639]	5.006*** [0.005]	-2.211 [0.292]	1.613 [0.287]	1.284 [0.595]
Female board (indicator)	1.279 [0.525]	0.077 [0.973]	4.037** [0.044]	-0.864 [0.700]	1.091 [0.535]	0.971 [0.705]
Tech firm (indicator)	-2.681 [0.215]	5.319** [0.018]	-3.122 [0.125]	7.183*** [0.002]	1.951 [0.309]	4.180* [0.082]
Std return	110.472 [0.239]	58.614 [0.347]	35.640 [0.492]	87.973 [0.429]	70.537 [0.315]	56.792 [0.439]
Fraction offered	-0.141 *** [0.003]	-0.328*** [0.000]	-0.147*** [0.003]	-0.232*** [0.003]	-0.141 *** [0.001]	-0.393*** [0.002]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.374 [0.513]	-17.865 [0.236]	0.886 [0.934]	-4.491 [0.773]	10.073 [0.269]	-16.857 [0.421]
Observations	267	263	265	265	296	234
Adjusted R^2	18%	18%	16%	14%	8%	17%

Appendix. Variable Definitions

This appendix provides a detailed description of the variables used in the tables.

<i>Variable</i>	<i>Definition</i>
<i>Director's background</i>	
Investment banker	Indicator variable that equals to 1 if the director had been an investment banker prior to or at the IPO event time and 0 otherwise.
Commercial banker	Indicator variable that equals to 1 if the director had been a commercial banker prior to or at the IPO event time and 0 otherwise.
Venture capitalist	Indicator variable that equals to 1 if the director had been an executive in venture capital firm(s) or private equity firm(s) prior to or at the IPO event time and 0 otherwise.
Other finance executive	Indicator variable that equals to 1 if the director had been a CFO, treasurer, accountant or vice president of finance prior to or at the IPO event time and 0 otherwise.
Public director	Indicator variable that equals to 1 if the director was holding public directorship(s) prior to or at the IPO event time and 0 otherwise.
Incumbent public director	Indicator variable that equals to 1 if the director was holding public directorship(s) at the IPO event time and 0 otherwise.
Public firm CEO	Indicator variable that equals to 1 if the director had been CEO of public firm(s) prior to or at the IPO event time and 0 otherwise.
Lawyer	Indicator variable that equals to 1 if the director had been a lawyer prior to or at the IPO event time and 0 otherwise.
JD	Indicator variable that equals to 1 if the director held a Juris Doctor (JD) degree at the IPO event time and 0 otherwise.
Governor	Indicator variable that equals to 1 if the director had been a governor in federal or state government prior to or at the IPO event time and 0 otherwise.
Professor	Indicator variable that equals to 1 if the director had been a professor prior to or at the IPO event time and 0 otherwise.
PhD	Indicator variable that equals to 1 if the director held a PhD degree (Juris Doctor not included) at the IPO event time and 0 otherwise.
MBA	Indicator variable that equals to 1 if the director held an MBA degree at the IPO event time and 0 otherwise.
Female	Indicator variable that equals to 1 if the director is female and 0 otherwise.
Age	Age of the director at the IPO event time.
Director ownership	Firm's shares owned by the director normalized by the total number of shares outstanding.
<i>Board Characteristics</i>	
% investment banker	Percentage of outside directors on the board who had been investment bankers prior to or at the IPO event time. To be considered to have investment banking experience, the director has to have work experience as an investment banker or be an executive of the investment banks listed in the Carter-Manaster IPO underwriter reputation rankings from Jay Ritter's dataset (Loughran and Ritter, 2004).
% incumbent investment banker	Percentage of outside directors on the board who were investment bankers at the IPO event time.
% former investment banker	Percentage of outside directors on the board who had been investment bankers prior to the IPO event time, but retired at the IPO event time.
% affiliated investment banker	Percentage of outside directors on the board who had been investment bankers and had been working for the underwriter of the IPO firm prior to or at the IPO event time.
% unaffiliated investment banker	Percentage of outside directors on the board who had been investment bankers but had not been working for the underwriter of the IPO firm prior to or at the IPO event time.
% short tenure investment banker	Percentage of outside directors on the board who had been investment bankers prior to or at the IPO event time, and became directors of the IPO firms in the IPO year.

(Continued)

Appendix. Variable Definitions (Continued)

<i>Variable</i>	<i>Definition</i>
% long tenure investment banker	Percentage of outside directors on the board who had been investment bankers prior to or at the IPO event time, and were directors of the IPO firms for at least one year prior to the IPO year.
% commercial banker	Percentage of outside directors on the board who had been commercial bankers prior to or at the IPO event time.
% venture capitalist	Percentage of outside directors on the board who had been venture capitalists prior to or at the IPO event time.
% other finance executive	Percentage of outside directors on the board who had been CFO, treasurer, accountant, or vice president of finance prior to or at the IPO event time.
% public director	Percentage of outside directors on the board holding public directorship(s) prior to or at the IPO event time.
% incumbent public director	Percentage of outside directors on the board holding public directorship(s) at the IPO event time.
% former public director	Percentage of outside directors on the board holding public directorship(s) prior to the IPO event time, but not holding any public directorship at the IPO event time.
% short tenure public director	Percentage of outside directors on the board who had held public directorship(s) prior to or at the IPO event time, and became directors of the IPO firms in the IPO year.
% long tenure public director	Percentage of outside directors on the board who had held public directorship(s) prior to or at the IPO event time, and had been directors of the IPO firms for at least one year prior to the IPO year.
% public firm CEO	Percentage of outside directors on the board who had been CEOs of public firm(s) prior to or at the IPO event time.
% incumbent public firm CEO	Percentage of outside directors on the board who were CEOs of public firm(s) at the IPO event time.
% former public firm CEO	Percentage of outside directors on the board who had been CEOs of public firm(s) prior to the IPO event time, but retired at the IPO event time.
% successful former public firm CEO	Percentage of outside directors on the board who had been CEOs of public firm(s) prior to the IPO event time, but retired at the IPO event time. Also, the public firm where the director had served as CEO had not been delisted and the director held one or more public directorship(s) at the IPO event time.
% unsuccessful former public firm CEO	Percentage of outside directors on the board who had been CEOs of public firm(s) prior to the IPO event time, but retired at the IPO event time. Also, the public firm where the director served as CEO had been delisted or the director held no public directorship at the IPO event time.
% short tenure public firm CEO	Percentage of outside directors on the board who had been CEOs of public firm(s) prior to or at the IPO event time, and became directors of the IPO firms in the IPO year.
% long tenure public firm CEO	Percentage of outside directors on the board who had been CEOs of public firm(s) prior to or at the IPO event time, and had been directors of the IPO firms for at least one year prior to the IPO year.
% lawyer	Percentage of outside directors on the board who had been lawyers prior to or at the IPO event time.
% short tenure venture capitalist	Percentage of outside directors on the board who had been lawyers prior to or at the IPO event time, and became directors of the IPO firms in the IPO year.
% long tenure venture capitalist	Percentage of outside directors on the board who had been lawyers prior to or at the IPO event time, and had been directors of the IPO firms for at least one year prior to the IPO year.
% JD	Percentage of outside directors on the board holding a Juris Doctor degree at the IPO event time.
% governor	Percentage of outside directors on the board who had been governors in federal or state government prior to or at the IPO event time.
% professor	Percentage of outside directors on the board who had been professors in the university prior to or at the IPO event time.
% finance experience	Sum of % investment banker, % commercial bankers, % venture capitalist, and % other finance executive.
% law experience	Sum of % lawyer and % JD.
% public firm experience	Sum of % public director and % public firm CEO.

(Continued)

Appendix. Variable Definitions (Continued)

<i>Variable</i>	<i>Definition</i>
% other experience	Sum of % professor and % governor.
% outside director	Percentage of outside directors on the board. Outside directors are directors who do not have any executive role in the firm.
Board size	Number of directors on the board.
Board ownership	Firm's shares owned by all the directors normalized by the total number of shares outstanding.
CEO chairman	Indicator variable that equals to 1 if the CEO is the chairman of the board and 0 otherwise.
CEOs' yrs on bd	All the CEO directors' total years on the board at the IPO event time normalized by total number of directors on the board. CEO directors are those who had been CEOs of public firm(s) prior to or at the IPO event time.
Directors' yrs on bd	All the directors' total years on the board at the IPO event time normalized by total number of directors on the board.
Female board	Indicator variable that equals to '1' if there is at least one female director on the board and 0 otherwise.
Investment bankers' yrs on bd	All the investment banker directors' total years on the board at the IPO event time normalized by total number of directors on the board. Investment banker directors are those who had been investment bankers prior to or at the IPO event time.
Venture capitalists' yrs on bd	All the lawyer directors' total years on the board at the IPO event time normalized by total number of directors on the board. Lawyer directors are those who had been lawyers prior to or at the IPO event time.
Public directors' yrs on bd	All the public directors' total years on the board at the IPO event time normalized by total number of directors on the board. Public directors are those who held public directorship(s) prior to or at the IPO event time.
<i>Deal & Firm Characteristics</i>	
Firm age	Number of years since the firm's incorporation.
First day return	The ratio of the closing price of the stock on its first trading day less the offer price to its offer price.
Fraction offered	The number of shares in the offering divided by the total shares outstanding after the IPO.
IPO valuation	The number of shares outstanding after the offering times the offer price (in \$millions) divided by sales in the IPO year.
Proceeds	The number of shares issued in the offering times the offer price (in \$millions).
R&D	R&D expenditures normalized by book value of total assets.
Reputable underwriter	Indicator variable that equals to 1 if the lead underwriter has a ranking of 8 or 9 on a 9-point scale based on Jay Ritter's underwriter rankings (Loughran and Ritter, 2004) and 0 otherwise.
State PE firm number	Total number of private equity firms in a certain state-year, scaled by the total market capitalization of all the financial firms in the same state-year.
State public firm number	The size weighted public firm number in a certain state-year, using the state public firm total market capitalization as the weight.
Std return	The standard deviation of the IPO stocks' raw returns using a time-series of 255 trading days commencing 6 trading days after the offer.
Tech firm	Indicator variable that equals to 1 if the IPO firm is from high-tech industries defined by Loughran and Ritter (2004) and 0 otherwise.
Underwriting fee	Percentage of total underwriting fee in IPO proceeds. It is computed as: $100 \times (\text{total underwriting fee} / \text{IPO proceeds})$.
VC-backed	Indicator variable that equals to 1 if the firm is backed by venture capitalists and 0 otherwise.

Essay Three:

The Time Effect of Corporate Diversification

Abstract

We focus on corporate diversification, documenting a worsening effect over time. Diversified firms not only demonstrate a diversification discount; the discount also becomes larger over time after diversification. At a given point of time, mature diversified firms with larger diversification age are likely to perform worse than juvenile diversified firms. CEO incentives and information asymmetry partly explain the diversification time effect, but this time effect still holds after taking into consideration R&D expenditure, number of segments, firm age, CEO and board characteristics, other unobserved firm characteristics and self-selection bias. In addition, the time effect is not driven by poor corporate governance in mature diversified firms. However, mature diversified firms perform better and show a diversification premium during a financial crisis, which sheds some light on why firms choose to stay diversified.

JEL Classification: G32, G34

Keywords: Diversification; Diversification age; Mature diversified firms; Board of directors; CEO turnover; Financial crisis

1. Introduction

Corporate diversification has received wide attention in finance research over the past decades. Several studies (Lang and Stulz, 1994; Berger and Ofek, 1995; Servaes, 1996) suggest that diversified firms trade at an average discount of about 8 percent relative to a portfolio of comparable stand-alone firms. Later studies, for example, Graham, Lemmon, and Wolf (2002) and Campa and Kedia (2002), argue that diversified firms had been poor performers prior to diversifying and thus the diversification discount cannot be evidence of value destruction due to diversification. However, Lamont and Polk (2002) show that exogenous changes in diversity due to changes in industry investment are negatively related to changes in firm value, even after taking into consideration endogenous problems in diversification discounts.

Most of the studies reporting a diversification discount document cross-sectional comparisons of diversified firms and single-segment firms. However, few studies have focused on dynamic changes in diversified firms' performance after they diversify. If diversification destroys firm value, then do the diversified firms perform worse and worse after diversification? Does the diversification discount increase with the firms' diversification age?

This research shows that diversification has a worsening effect over time. Diversified firms not only exhibit a diversification discount to stand-alone firms, but this discount becomes larger and larger over time after diversification. Using segment data from 1999 to 2008, we demonstrate that, at a given point of time, mature diversified firms with larger diversification age (years the firm has been diversified) tend to bear larger diversification discounts than juvenile diversified firms with smaller diversification age. This result is robust when we control for year fixed effect

and industry fixed effect. We also take into consideration several factors that may bias our results. After controlling for firm age, number of segments in a firm (segment number), proxies for agency concern and information asymmetry, and subjecting different subsamples to robustness tests, we find that this diversification time effect still holds.

Ahn (2009) argues that unsuccessful diversified firms, those with higher diversification discount, are more likely to choose to refocus their corporate strategy after diversification. Thus, our empirical results are not likely to be caused by a biased sample. When we consider a sample consisting of only juvenile diversified firms, there is also a strong and significant diversification time effect. This result indicates that diversified firms bear larger and larger diversification discount over time after diversification until some choose to refocus while the others stay diversified.

We investigate the reasons for the diversification time effect and also its implications. First, we analyze the agency explanation. A sizable literature suggests that managers in firms with greater free cash flow are more likely to diversify to increase firm size and to benefit from the power and prestige of managing a larger firm at the expense of shareholders (Jensen, 1986; Stulz, 1990; Denis, Denis, and Sarin, 1997a). Managers also want to diversify because they have large, undiversified positions in their own firms and diversification can reduce the idiosyncratic risk they face as a result of those positions (May, 1995; Aggarwal and Samwick, 2003). If agency concern is the main reason why firms choose to diversify, then diversification can be seen as a value-destroying managerial decision that leads to a diversification discount for diversified firms. We do find that CEOs of mature diversified firms have lower ownership of the firm and are less

likely to be the founder, indicating that agency problems are more severe in mature diversified firms than their juvenile counterparts. However, in firms with higher CEO ownership, the diversification time effect still holds and mature diversified firms with higher CEO ownership show an even larger diversification discount.

Anderson et al. (2000) empirically show that CEOs in diversified firms have lower stock ownership, but diversified firms have more outside directors. They suggest that diversified firms use alternative governance mechanisms as substitutes for low CEO stock ownership. Consistent with their argument, we find that mature diversified firms have more outside directors, both in proportion and in number. Thus, the lower excess values in mature diversified firms are not likely to be caused by poor corporate governance.

Information asymmetry is another important factor we consider. Myerson (1982) and Harris, Kriebel, and Raviv (1982) argue that information asymmetry arises in diversified firms between central management and divisional managers, especially the divisional managers in newly acquired divisions. We find that mature diversified firms are larger in size, have significantly higher R&D expenditure and also more segments than juvenile diversified firms, indicating that information asymmetry between headquarters and divisions in mature diversified firms would be larger.

A firm's board of directors not only plays an important monitoring role, which helps mitigate the agency problems in diversified firms, but it also serves the valuable function of providing advice to a firm's management. Coles, Daniel and Naveen (2008) show that firms tend to design the board structure according to the firms' advisory needs. Larger boards and boards with more

outside directors potentially bring more experience and knowledge and offer better advice (Dalton et al., 1999) . Since both CEO-incentive and information asymmetry problems are more severe in mature diversified firms, we expect the boards of directors in mature diversified firms to play a significant role in assisting a firm's management to address the potential problems. Our multivariate regression results provide positive evidence that, in firms with larger boards and more outside directors, the diversification time effect is reduced.

Other corporate governance measures are also taken into consideration. We investigate the diversification time effect and the likelihood of CEO turnover. If the larger diversification discount in mature diversified firms is driven by poor corporate governance and entrenched CEOs, then we would expect CEO turnover, especially forced CEO turnover, to be less likely to happen in mature diversified firms. However, empirical test results do not support this expectation. They show that forced CEO turnover to stock performance sensitivity is higher, instead of lower, in mature diversified firms, indicating that corporate governance could hardly explain the diversification time effect.

If diversification keeps destroying firm value and the discount becomes larger and larger over diversification age, why do firms choose to remain diversified? Diversification offers several benefits. An important one is the creation of an internal capital market for managers who are unable to credibly signal to the external capital market the value of a project or investment policy (Stulz, 1990; Stein, 1997; Fluck and Lynch, 1999; Hadlock, Ryngaert and Thomas, 2001). Another obvious benefit is increased debt capacity (Lewellen, 1971), which creates firm value by increasing interest tax shields. These benefits make diversification more valuable when an

exogenous economic shock occurs, because in a crisis it is more difficult to borrow money from the outside and the market will be more pessimistic. A recent study by Kuppuswamy and Villalonga (2010) supports this view by providing evidence that diversified firms increased in value relative to focused firms during the ongoing global financial crisis.

In our study, we show that mature diversified firms have a great advantage over juvenile ones in a financial crisis. The mature diversified firms' excess value is 10.3 percentage points larger than that of the juvenile diversified firms during the crisis period. In other words, when there is an exogenous financial shock to the market, mature diversified firms enjoy a diversification premium, instead of bearing a discount. That would be the initial target of diversification: to diversify the risk that a firm may be confronted with in a recession.

We contribute to the existing diversification literature in the following ways. First, we show that corporate diversification is a dynamic process with diversification discount increasing with diversification age, and provide new evidence to confirm that diversification destroys firm value. This diversification time effect suggests that the cross-sectional diversification discounts documented in previous literature are likely to be driven by mature diversified firms. Second, consistent with the main explanation of diversification, we indicate that both CEO incentives and information asymmetry partly explain the diversification time effect. This time effect is not likely to be driven by poor corporate governance in mature diversified firms, but good corporate governance, such as more outside directors on board, can work as a substitute mechanism to mitigate the CEO-incentive or information asymmetry problems in diversified firms. Third, consistent with Kuppuswamy and Villalonga (2010), we confirm that diversification is

advantageous when there is an exogenous shock. In a financial crisis, mature diversified firms show greater advantage over single-segment firms, which sheds some light on why these firms choose to stay diversified in the face of an ever increasing diversification discount.

Several other research studies look at the long-run performance of diversified firms through longitudinal investigations of diversification. This paper differs from theirs in the following way. Hyland and Diltz (2002) and Villalonga (2004) document significant diversification discount up to five years after the occurrence of a diversification event. However they focus on comparing excess value before and after diversification. Our research, on the other hand, focuses on the gradual change in diversification discount after a diversification event on the basis that firms are likely to diversify step by step. For example, they may expand to more segments and increase R&D expenditure over time, which leads to more and more information asymmetry problems. Thus their diversification may show gradual value-destroying characteristics. Hyland (2008) investigates the long-run performance of diversifying firms, tracking firms for up to five years past their diversification year. He documents evidence that value is destroyed for small firms that diversify but enhanced for larger firms that diversify. Again, his study does not address gradual change over time. Ahn (2009) studies the dynamics of the diversification discount. His focus is on the time-series pattern of diversification discount over the decades since the 1980s, but not on the changes over event time.

The remainder of the paper is organized as follows. In Section 2, we review the literature and develop our main empirical predictions. In Section 3, we describe the data, key variable construction, and sample characteristics. Section 4 provides the main results and in section 5 we

use a group of additional tests to confirm the robustness of the diversification time effect. In Section 6, we investigate several issues in mature and juvenile diversified firms: agency problems, information asymmetry and the likelihood of (forced) CEO turnover. Section 7 shows mature diversified firms having an advantage over juvenile diversified firms and stand-alone firms in a financial crisis. Section 8 concludes.

2. Related Literature and Hypothesis Development

Prior literature (Lang and Stulz, 1994; Berger and Ofek, 1995; Servaes, 1996) suggests that diversified firms trade at an average discount of about 8 percent relative to a portfolio of comparable stand-alone firms. Besides, Comment and Jarrell (1995), John and Ofek (1995), and Bengtsson (2000), among others, report evidence of value gains from corporate refocusing strategies. Daley, Mehrotra and Sivakumar (1997) find that spun-off segments experience improved performance, especially if they are unrelated.

On the other hand, other studies argue that there is no diversification discount and that the diversification discount found in the above studies is mainly caused by endogeneity bias. Graham, Lemmon, and Wolf (2002) and Campa and Kedia (2002), for example, argue that diversified firms were poor performers prior to diversifying and thus the diversification discount cannot be evidence of value destruction due to diversification.⁴⁰ However, Lamont and Polk (2002) show that the exogenous changes in diversity due to changes in industry investment are negatively

⁴⁰ Other studies even report a diversification premium. For example, Villalonga (2004) argues that the measurement in previous studies is systematically biased in favor of finding a diversification discount and he finds a diversification premium using the establishment-level data from the Business Information Tracking Series database. Similarly, Hyland and Diltz (2002) document positive announcement impacts around diversification announcements and argue that firms that diversify are discounted before they ever diversify.

related to changes in firm value, even after taking into consideration endogenous problems in the diversification discount.

The diversification discount has been widely discussed in the literature, and one question that is presented is why a large number of firms still choose to diversify if diversification destroys value. Agency is one explanation. If agency is the main reason why firms choose to diversify, then diversification can be seen as a value-destroying managerial decision that leads to a diversification discount for diversified firms.

The link between firm diversification and corporate governance has also been explored in previous literature. For example, Anderson et al. (2000) empirically show that CEOs in diversified firms have lower stock ownership and lower pay-for-performance sensitivities but that such firms have more outside directors. They suggest that diversified firms use alternative governance mechanisms as substitutes for lower pay-for-performance sensitivities and CEO stock ownership. Singh, Mathur, and Gleason (2004) also investigate the governance and diversification issue but their results show little direct evidence regarding the relationship among ownership structure, corporate governance, and corporate diversification.

Information asymmetry cost is another explanation for the diversification discount. Myerson (1982) and Harris, Kriebel, and Raviv (1982) argue that information asymmetry arises in diversified firms between central management and divisional managers, especially the divisional managers in newly acquired divisions. Ding and Kang (2010) indicate that whether diversified firms trade at discount or premium depends on the information asymmetry between headquarters and divisional managers, as this affects their resource allocation efficiency.

Finally there are several potential benefits from corporate diversification. One is that managers may create an internal capital market in order to resolve the information asymmetry between inside managers and outside investors, when managers are unable to credibly signal to the external capital market the value of a project or investment policy and when the external capital market fails to allocate resources in an efficient manner (Stulz, 1990; Stein, 1997; Fluck and Lynch, 1999; Billett and Mauer, 2003; Hadlock, Ryngaert and Thomas, 2001). The second benefit is increased debt capacity (Lewellen, 1971), which creates firm value by increasing interest tax shields. Thus optimally diversified firms are predicted to have higher leverage and lower tax payments (Berger and Ofek, 1995).

The above review suggests that firms' performance worsen after diversification, and this may be due to several factors. Schoar (2002) uses plant-level data to investigate the effects of corporate diversification on productivity and shows that firms that diversify experience a net reduction in productivity. When there is an increase in firms' diversification, management focus tends to shift towards new segments at the expense of existing divisions, leading to an overall productivity decline (Schoar, 2002). If diversified firms choose to diversify into more segments over time, then every time a firm increases diversification, there should be further productivity decline. Thus we would expect diversified firms to have worse performance over time.

Second, agency problems may get worse after diversification and increase with diversification age. Previous literature indicates that managers in firms with more free cash flow are more likely to diversify to increase firm size and to benefit from the power and prestige of managing a larger firm at the expense of shareholders (Jensen, 1986; Stulz, 1990; Denis, Denis, and Sarin, 1997a). If

firms choose to diversify due to agency problems in the first place and if corporate governance is not improved, we have reasons to expect shareholder-manager conflicts become worse for this firm and managers perform more actively to benefit themselves at the shareholders' expense over time.

Third, information asymmetry may get worse and worse over time after diversification if firms choose to diversify using a step by step strategy (for example, expanding to more segments over time).

These arguments lead to our first hypothesis:

Worsening diversification hypothesis: *Diversified firms perform worse dynamically after diversification and the diversification discount increases with their diversification age.*

On the other hand, diversified firms may perform better and better over time if the diversification decision is not due to agency problems and if the firms' managers perform actively to reduce the information asymmetry between headquarters and divisions after diversification. When a firm chooses to diversify into new industries, it may also need time to learn, and its managers will need time to adjust their investment or resource-allocation strategy to an optimal level.

In a recent study, Ding and Kang (2010) show that the extent of information asymmetry is reflected through the transparency of a firm's information environment, or the strength and effectiveness of internal auditing of managerial behavior. In other words, corporate governance

plays an important role in reducing the information asymmetry in their model. If diversified firms seek efficient corporate governance to reduce cost of diversification (agency cost and information asymmetry), the benefits of diversification (e.g., increased debt capacity) may dominate dynamically over time. The above arguments lead to our second hypothesis:

***Learning diversification hypothesis:** Diversified firms perform better dynamically after diversification and the diversification discount decreases with their diversification age.*

3. Data, Variable Construction and Summary Statistics

3.1. Data and variable construction

The Compustat Industry Segment (CIS) database reports segment information for all active Compustat firms other than utility subsidiaries. The database contains information by segment on net sales, earnings before interest and tax (EBIT), depreciation, capital expenditures, and total assets. It also has the number of reported segments for the firm.

Following prior studies of the diversification discount (Lang and Stulz, 1994; Berger and Ofek, 1995), we obtain data for all active and inactive firms in the CIS database from 1990 to 2008. To avoid distorted valuation multiples for firms with sales or assets near zero, we require firms to have sales of at least \$10 million. We eliminate firm-years that show a missing or non-positive asset, sales or market value. We also eliminate firm-years that have financial segments (SIC code between 6000 and 6999). All segments within a firm that share a common four-digit SIC code are aggregated into a common business segment. To be included in the final sample, data on the diversified corporations and single-segment firms must be available on both

the CIS and Compustat databases. These criteria yield a total of 75,225 firm-years from 10,794 firms during 1990–2008. Of the firm-years, 17,537 are diversified firm-years and 57,688 are single-segment.

The key treatment variable in this study is firm's diversification age. A diversified firm has diversification age 1 in the first year of transforming from single-segment firm to multi-segment firm (diversified), and diversification age increases by 1 each year as long as the firm remains diversified. All the single-segment firms' diversification ages are 0. Since accurate segment data are not available prior to 1990, we start counting diversification age from 1990. For the 857 diversified firms in 1990, there is no information on the exact year they became diversified. Thus we assume the diversification age of these firms to be 1 in 1990 for simplicity. While this method may lead to inaccuracy in the 857 firms' true diversification age, robustness tests on subsamples that exclude these firm-years confirm that this does not affect our results and conclusions. In order to ensure enough variation in firms' diversification age, we refine our sample period from 1999 to 2008 for further testing. The result is a total 36,187 firm-years (26,820 single-segment and 9,367 diversified firm-year observations) from 7,249 firms during 1999–2008.

The diversification discount measure used in this study is firms' excess value. Following Berger and Ofek (1995), we compute two different measures of excess value based on asset or sales multipliers as the natural logarithm of the ratio of a firm's actual value to its imputed value. A firm's imputed value is the sum of its segments' imputed values, which are obtained by multiplying a segment's annual sales or assets by the median market-to-sales or market-to-assets multiplier of single-segment firms in the same industry. Following Villalonga (2004), we use the

full sample of firms to calculate the excess values described above.

Data on CEO characteristics are obtained from ExecuComp, Corporate Library, IRRC or firms' annual reports and proxy statements. CEO ownership is measured as the firm's shares owned by the CEO normalized by the total number of shares outstanding. Board characteristics data are obtained from the Capital IQ (CIQ) database.

CEO turnover data are obtained from the ExecuComp database, and to identify forced CEO turnovers, we follow the method used in Parrino (1997) and extract related news from Factiva. To control for the prior year's stock return in the CEO turnover test, we use the prior 12-month buy and hold return. All the stock return data are from CRSP and other accounting data are from Compustat.

3.2. Summary statistics

Table 1 Panel A presents summary statistics for the sample's 26,820 single-segment and 9,367 diversified firm-year observations during 1999–2008. In the last six columns, we compare firm characteristics of the single-segment firms with the diversified firms.

The diversified firms are larger in size, with significantly larger sales, total assets and market valuation than the single-segment firms. Specifically, the mean total assets and market valuation for the diversified firms are \$4,968 and \$6,134 million respectively, while the mean total assets and market valuation for the single-segment firms are only \$1,313 and \$2,229 million.

The diversified firms are also more leveraged than the single-segment firms, significant at the 1% level. This is consistent with the theory that diversification increases debt capacity and

reduces tax payments (Lewellen, 1971; Berger and Ofek, 1995). The diversified firms also have less cash, less capital expenditure, higher EBIT and are more likely to pay dividends. The mean R&D expenditure in the diversified firms is \$71.86 million, significantly higher than the \$27.44 million mean in the single-segment firms, suggesting that diversified firms are likely to have more information asymmetry than single-segment firms.

The excess value in the diversified firms is lower than in the single-segment firms, and the difference is significant at 1% level when the excess value is calculated based on the sales multiplier, which is more accurate because the segment data in our sample have more missing data on segment assets than on segment sales.

In our sample of diversified firms, the mean segment number is 2.59 and the median is 2. The mean diversification age is 7.29 years and the median is 6 years. Based on the sample median diversification age, we further divide the diversified firms into mature diversified firms (diversification age greater than the sample median) and juvenile diversified firms (diversification age equal to or less than the sample median).

Table 1 Panel B compares the summary statistics for the sample's 4,511 mature diversified firm-year observations and 4,856 juvenile diversified firm-year observations. The size of the mature diversified firms is nearly double the size of the juvenile diversified firms, with \$6,552 million mean total assets and \$8,183 million mean market valuation for the mature ones, and only \$3,496 million mean total assets and \$4,231 million mean market valuation for the juvenile counterparts. The mature diversified firms also have more segments, with a mean of 2.81 segments for the mature diversified firms versus 2.39 for the juvenile diversified firms. These

statistics indicate that diversified firms may choose to diversify step by step and they expand their business into more industries (become more diversified) as their diversification age increases.

Consistently, the mature diversified firms also have significantly higher R&D expenditure, with a mean of \$98.62 million, while the mean for the juvenile diversified firms is only \$47 million. This is not surprising because diversified firms may put more R&D capital into the new segments they diversify into.

Mature diversified firms are less leveraged than juvenile diversified firms. The mean and median leverage for the mature diversified firms are 26.24% and 24.79% respectively, while the mean and median are 29.04% and 26.92% respectively for the juvenile diversified firms, and the difference is significant at the 1% level. The lower leverage in mature diversified firms does not necessarily indicate less debt capacity. Instead, it may imply that mature firms have more unused debt capacity to meet future capital needs, such as when an exogenous economic shock affects the market.

The excess value for the mature diversified firms is lower than for the juvenile diversified firms, and the difference is significant at the 1% level when the excess value is calculated based on the sales multiplier. On average, diversification age is 11.67 for the mature firms and 3.22 for the juvenile firms. The mature diversified firms also have less cash, lower capital expenditure, higher EBIT and are more likely to pay dividends than the juvenile diversified firms.

4. Diversification Time Effect

4.1. Diversification discount and diversification age

To test how the diversification discount changes with firms' diversification age, we perform

ordinary least squares (OLS) regressions that use excess value (based on sales or asset multipliers) as the dependent variables and diversification age as key independent variables of interest. We estimate the following OLS regression:

$$\begin{aligned} \text{Excess value} = & \\ & \alpha + \beta_1 \text{Diversified (indicator)} + \beta_2 \text{Diversification age} + \beta_3 \text{Ln(total asset)} + \\ & \beta_4 \text{Leverage} + \beta_5 \text{Cash} + \beta_6 \text{Capex} + \beta_7 \text{EBIT} + \beta_8 \text{R\&D} + \beta_9 \text{Dividend} + \\ & \beta_{10} \text{Foreign inc} + \text{Year FE} + \text{Industry FE} + \varepsilon, \quad (1) \end{aligned}$$

The dependent variable, excess value, is computed as the natural logarithm of the ratio of a firm's actual value to its imputed value. A firm's imputed value is the sum of its segments' imputed values, which are obtained by multiplying a segment's annual sales or assets by the median market-to-sales or market-to-assets multiplier of single-segment firms in the same industry. Following Berger and Ofek (1995), the industry median multipliers are based on the narrowest SIC grouping that includes at least five single-segment firms with sufficient data for computing the multipliers.

To measure the diversification discount, we control using a dummy variable, *Diversified*, which takes the value of 1 if the firm has more than one segment in that year. The key treatment variable in the regression is firms' diversification age. The dummy variable, *Diversified*, is used to measure the difference in excess value between diversified firms and single-segment firms that cannot be explained by differences in firm characteristics and industry and year effects, while the variable *Diversification age* measures how the diversified firms' excess value change over time after diversification.

Following previous literature on corporate diversification, we control for the following

variables: firm size measured as the natural logarithm of total assets ($\ln(\text{total assets})$), *Leverage* (ratio of total debt to total assets), cash normalized by total asset ($\text{Cash} / \text{Total assets}$), capital expenditure (*Capex*), *EBIT*, R&D expenditures (*R&D*), dividend payment measured as an indicator which takes the value of 1 if the firm pays dividend in that year and 0 otherwise (*Dividend*), and foreign incorporation measure which takes the value of 1 if the firm is incorporated abroad (not in the U.S.) and 0 otherwise (*Foreign inc*). Finally, we include *Industry FE* (fixed effects) to control for unobservable industry-specific heterogeneity and *Year FE* to account for time trends.

The results are reported in Table 2. Columns (1)–(4) report the results of using excess value based on the sales multiplier as the dependent variable, and columns (5)–(8) use excess value based on the asset multiplier as the dependent variable. In columns (1) and (4), consistent with prior literature, we find that the coefficient estimates on *Diversified* is negative and significant, suggesting that there is a significant diversification discount. The coefficient estimate of -0.201 on *Diversified* in regression (1) suggests that there is 20.1% value loss in the diversified firms. Using the average leverage of 27.69% in the diversified firms, and assuming no effect on debt value, we calculate the value loss to equity holders as about 27.8%.

In regression (2), we control for *Diversification age* instead of the *Diversified* indicator. The coefficient estimate of -0.022 on *Diversification age* suggests that one year increase in diversification age is associated with 2.2% value loss. When we control for the *Diversified* indicator and *Diversification age* in the same regression (regression (3)), and control for both year fixed effect and industry fixed effect in regression (4), we find both treatment variables,

Diversified and *Diversification age* to be negative and significant at the 1% level. The coefficient estimates of -0.111 on *Diversified* and -0.013 on *Diversification age* suggest that there is 11.1% value loss from diversification and there is an additional 1.3% value loss associated with staying diversified for one more year. In regression (4), the coefficient estimate of -0.016 on *Diversification age* suggests that one year increase in diversification age is associated with 1.6% value loss in diversified firms. Compared with a typical juvenile diversified firm with median diversification age of 3, a typical mature diversified firm with median diversification age of 11 would have 12.8% ($1.6\% \times 8$) more value loss. When we use the asset multiplier to calculate the excess value in regressions (5)–(8), we find the diversification discount and time effect to be smaller. However the coefficient estimate on *Diversification age* is still significant even after we control for industry fixed effect in regression (8).

Overall, these results support the worsening diversification hypothesis that diversified firms perform dynamically worse over time after diversification, with diversification discount increasing with diversification age.

4.2. Diversification discount in juvenile and mature diversified firms

In this subsection, we break down our diversified firms into juvenile and mature diversified firms. Juvenile diversified firms are those whose diversification age are below or equal to the sample median (6 years) and mature diversified firms are those whose diversification age are above the sample median. We use an indicator *Mature* to measure the difference in excess value between mature and juvenile diversified firms. We re-estimate equation (1) by replacing

Diversification age with the dummy variable *Mature*.

Table 3 presents the regression results. In regression (1), we use the full sample and control for the indicator variables *Diversified* and *Mature*. The negative and significant coefficients of -0.152 on *Diversified* and -0.140 on *Mature* suggest that the diversified firms are associated with 15.2% value loss compared with the single-segment firms, with the mature diversified firms having 14% more value loss than the single-segment firms. In regression (2), we use the subsample of diversified firms to study the difference between mature and juvenile diversified firms. We find the coefficient on *Mature* to be -0.103 and significant at the 1% level, indicating that there is a 10.3% value loss for the mature diversified firms as cost of staying diversified. In regression (3), we re-define our indicator *Mature*, and use the 75th percentile point of diversification age to separate mature and juvenile firms, i.e., mature diversified firms should have a diversification age of more than 10. Again, we find a negative and significant coefficient on *Mature*, indicating that even for diversified firms with very large diversification age, diversification discounts are still increasing with age. In regressions (4)–(5), we re-estimate the same regression in (1)–(3) but use excess value based on asset multipliers. We find similar results, although the diversification time effect is not as strong as when we use excess value based on sales multipliers. These results further support the worsening diversification hypothesis.

5. Robustness Tests

In the last section, we show a strong time effect for corporate diversification, with diversification discount increasing with diversification age. However, there are still several

concerns that may lead our results to be spurious. We perform robustness tests to address these concerns.

5.1. Firm age

Borghesi, Houston and Naranjo (2007) argue that a significant portion of the diversification discount arises from benchmark comparisons of value ratios of mature firms with those of very young firms that are more likely to have high value multiples. They indicate that firm age may be a useful proxy for growth opportunities that are likely to further affect market multiples of individual firms. Therefore the estimated diversification value is likely to vary over time with changes in the average age of publicly traded firms. Therefore, diversification age may be simply another measure of firm age and does not reflect the time of firms' diversification, but the opportunity the firms have in the market. To address this concern, we add firm age as a control into our regression.

In Table 4 columns (1) and (2), we run regressions similar to those employed in Tables 2 and 3, but add firm age as a control.⁴¹ We still find a negative and significant coefficient estimate on *Diversification age* (regression (1)) and on the indicator variable *Mature* (regression (2)). After controlling for firm age, diversified firms still experience 0.6% value loss for each additional year they remain diversified, and there is 6.4% more value loss for the mature diversified firms than

⁴¹ In diversified firms, firm age might be highly correlated with diversification age. However, there is little correlation between the two variables in single-segment firms, because for single-segment firms, the firm age increases year by year, while diversification age always stays at 0. Actually, even in diversified firms, the correlation coefficient between firm age and diversification age is 0.504, slightly over 0.5. This may be due to the fact that some firms choose to diversify in their early years so that, cross-sectionally, these firms may have high diversification age but low firm age. The correlation coefficient between firm age and diversification age in the full sample is 0.457. To check the multicollinearity, we perform the variance inflation factor (VIF) test. The mean VIF values are 2.08 and 2.05 for regressions (1) and (2) in Table 4, respectively, suggesting that there is no serious multicollinearity problem.

the juvenile ones in our sample.

5.2. Number of segments

Since the mature diversified firms in the sample tend to have more segments than the juvenile diversified firms, it is likely that mature diversified firms are more diversified than their juvenile counterparts and have more diversification discount. Thus, diversification age may be a reflection of the extent of diversification.

In Table 4 columns (3) and (4) we further control segment number (the number of segments in a firm) to address this concern. After controlling for segment number, we still find negative and significant coefficient estimates on *Diversification age* and the *Mature* dummy.

5.3. Subsample of firms with accurate diversification age

The diversification age may not be accurate for some firms in our sample. Since most of the segment data are only accurate and available after 1990, we start counting diversification age from that year. However, for the 857 diversified firms in the year 1990, we have no information on the exact year they became diversified. Consequently, we assign diversification age of 1 to these cases. To address potential problems from this assignment, we run regressions on a subsample that includes only firms with accurate diversification age (all the firm-year observations of the 857 diversified firms in 1990 are excluded). The subsample includes 33,079 firm-year observations from 6,752 firms.

In Table 4 regressions (5) and (6), which uses the subsample, we find that the coefficient estimates on *Diversification age* and the *Mature* dummy are still negative and significant at the 1%

level. There is 1.8 % additional value loss in staying diversified for one more year (regression (5)), and 13.1% additional value loss for the mature diversified firms (regression (6)) in the subsample regression.

5.4. Subsample of firms with available data as early as the year 1990

There are potential sample selection concerns in our main regressions. For example, some of the firms come into our sample in the later period, so that the diversification age would not be high for these firms. To address this concern, we choose a subsample of firms with segment data available as early as the year 1990. This criterion generates a subsample of 3,330 firms with 10,104 firm-year observations. The diversified firms in this subsample comprise either firms that have been diversified since 1990 or that were single-segment firms in 1990 but diversified later.

In Table 4 regressions (7) and (8), using this subsample, we show that the diversification time effect still holds. There is 1.1% additional value loss in staying diversified for one more year (regression (7)), and 9.2% additional value loss for mature diversified firms (regression (8)) in the subsample regression.

5.6. Firm fixed effect estimation

Unobservable firm characteristics may simultaneously affect firms' decision to stay diversified and firms' performance measured by excess value, leading the results in previous regressions to be biased. In this subsection, we further introduce firm fixed effect to control for unobservable firm characteristics.

Specifically, to add firm fixed effects to see whether firms experience a time varying

discount after diversification, we use a subsample of 774 firms that transitioned from single-segment to diversified firms (5,287 firm-year observations) and 774 control non-diversifying single-segment firms during our sample period. Since firm fixed effects reduced the inter-firm variability in the data, firm characteristics with no inter-firm variability, e.g., *Foreign inc*, need to be dropped when firm fixed effects are controlled.

Table 5 regressions (1) and (2) report the results. We find that our results in Table 3 are robust even after controlling for unobservable firm characteristics. There is a 1.2% value loss in staying diversified for one more year (regression (1)) and this time effect is significant at the 5% level. The mature diversified firms experience a marginal significant 7.2% additional value loss compared to their juvenile counterparts. The signs and significance of the coefficients on other variables remain practically identical to the OLS estimation in Table 2 and Table 3.

5.7. Heckman's two-stage self-selection model

Prior literature indicates a self-selection concern associated with diversified firms (Campa and Kedia, 2002; Villalonga, 2004). It is plausible that a firm that experiences a positive shock to its growth opportunities may choose to refocus. Therefore the firms that remain diversified longer will be the ones with poorer growth opportunities and lower values. In this subsection, we employ Heckman's self-selection model to address this concern.

The selection equation of the Heckman two-stage self-selection estimation procedure (Heckman, 1979) or a firm's propensity to diversify is given by following equation:

$$\begin{aligned}
Diversified = & \alpha + \beta_1 IndQ + \beta_2 DivSales + \beta_3 Ln(total\ asset) \\
& + \beta_4 Leverage + \beta_5 Cash + \beta_6 Capex + \beta_7 EBIT + \beta_8 R\&D + \beta_9 Dividend \\
& + \beta_{10} Foreign\ inc + Year\ FE + Industry\ FE + \varepsilon, \quad (2)
\end{aligned}$$

where two variables *IndQ* and *DivSales* are used as instruments (Campa and Kedia, 2002; Villalonga, 2004) to meet the exclusion restriction and we include as control variables those used in Eq. (1). *IndQ* is defined as the industry average Tobin's Q and *DivSales* is defined as the fraction of industry sales accounted for by diversified firms, which represents industry diversification attractiveness. The selection equation is estimated by maximum likelihood as an independent Probit model. Based on the parameter estimates we generate a vector of inverse Mills (*Lambda*) and re-estimate equation (1) with inverse Mills (*Lambda*) as an additional control.

Table 5 regressions (3) and (4) report the second stage results. We find that after controlling for potential self-selection bias, the diversification time effect still holds. The coefficients on *Diversification age* and the *Mature* indicator are -0.013 and -0.122 respectively and are both significant at the 1% level. We further find that the variable of inverse Mills ratio (*Lambda*) is significantly and positively associated with firms' excess value, suggesting significant evidence of self-selection.

Overall, the results from the robustness tests suggest that the worsening diversification time effect is robust after taking into consideration firm age, segment number, firm fixed effect and self-selection bias. Consistent with the worsening diversification hypothesis, the diversified firms not only bear a diversification discount as a whole, but also bear additional diversification

discount as a cost of remaining diversified a greater number of years.

6. Explanation and Implication of Diversification Time Effect

6.1. Diversification time effect and CEO characteristics: CEO incentives

In the finance literature, agency is considered one of most important explanations for the diversification discount. Several studies (Jensen, 1986; Stulz, 1990; Denis, Denis, and Sarin, 1997a) argue that managers in firms with more free cash flow are more likely to diversify to increase firm size and to benefit from the power and prestige of managing a larger firm at the expense of shareholders. Anderson et al. (2000) also show that CEOs in diversified firms have lower stock ownership and lower pay-for-performance sensitivities, indicating that agency problems are indeed more severe in diversified firms.

If agency is also the main reason for the diversification time effect, we would expect agency problems to increase with firms' diversification age and for CEOs to be likely to be more entrenched in their positions in mature diversified firms. We use three CEO characteristics for further analysis: *CEO ownership* (firm's shares owned by the CEO normalized by the total number of shares outstanding), *Founder CEO* (an indicator variable that takes the value of 1 if CEO is the founder of the firm and 0 otherwise) and *CEO chairman* (an indicator variable that takes the value of 1 if CEO is the chairman of the board and 0 otherwise). CEO characteristics are either from the CIQ database or manually collected from firms' proxy statements. After merging the CEO characteristics data with our sample, we get a subsample of 13,944 firm-year observations from 2,881 firms. We expect CEOs in mature diversified firms to have lower CEO ownership, to be less likely to be the founder, and to be more likely to be the chairman of the

board of directors.

In Table 6 Panel A, we present the summary statistics for the mature diversified firms and juvenile diversified firms. We find that CEOs in the mature diversified firms have significantly lower ownership and are also less likely to be the founder than CEOs in the juvenile diversified firms, which is consistent with our expectation that agency problems are more severe in mature diversified firms. However there is no evidence to show that CEOs in mature diversified firms are more entrenched in the firms. The difference in CEO-chairman duality is not significant between mature and juvenile diversified firms.

In Table 6 Panel B, we run further tests using multivariate regressions. We control for *CEO ownership*, *Founder CEO* and *CEO chairman* respectively and interact each variable with the diversification time effect measure (*Diversification age* or the *Mature* indicator). We expect that in mature diversified firms, where agency problems are more serious, higher CEO ownership would lead to an increase in firms' excess value. However, the empirical results do not support this expectation. We find that in mature firms, higher CEO ownership is associated with even greater value loss (regressions (1) and (2)). In regressions (3)–(6), we do not find any significant coefficient estimate for the interaction term of *Founder CEO* (*CEO chairman*) and diversification time effect measure (*Diversification age* or the *Mature* indicator).

Most important, after controlling for these CEO characteristics, we still find coefficient estimates on *Diversification age* to be negative and significant in all dimensions. There is 0.8%–0.9% additional value loss for each year that the diversified firms stay diversified.

These results suggest that although there is evidence indicating that CEOs in mature

diversified firms have fewer incentives (lower CEO ownership and fewer founder CEOs), the diversification time effect is not likely to be driven by the increasing agency problems in diversified firms. After taking into account several CEO incentive proxies, we still find diversified firms bearing additional cost to stay diversified.

6.2. Diversification time effect and board characteristics: Information asymmetry and board advising

Information asymmetry is another important factor that could account for the diversification discount. Information asymmetry arises in diversified firms between central management and divisional managers, especially the divisional managers in newly acquired divisions (Myerson, 1982; Harris, Kriebel, and Raviv, 1982). In a recent study, Ding and Kang (2010) indicate in their model that diversification per se does not cause a firm to trade at a discount or premium, and whether the diversified firms trade at a discount or premium depends on the information asymmetry between headquarters and divisional managers, as this affects their resource allocation efficiency.

In the summary statistics for mature and juvenile diversified firms in Table 1 Panel B, we show that the mature diversified firms have significantly more segments and more R&D expenditure than their juvenile counterparts. Diversified firms tend to complete their diversification step by step, thus firms become more diversified as their diversification age increases. Therefore it would make sense for the information asymmetry to increase with

diversification age, leading to greater value loss.⁴² If this is the case, do mature diversified firms employ more strategies to mitigate information asymmetry? We try to use board characteristics, such as board size and the number and ratio of outside directors to shed some light on this question.

A board of directors performs two primary functions: monitoring and advising management. Recent studies show that firms tend to design the board structure according to their advisory needs (Coles, Daniel and Naveen, 2008). According to Dalton et al. (1999), larger boards and boards with more outside directors potentially bring more experience and knowledge and offer better advice. Thus we would expect mature diversified firms to have larger boards and more outside directors to help management mitigate information asymmetry problems.

In Table 7 Panel A, we provide strong evidence that mature diversified firms have significantly larger boards, more outside directors on their boards, and higher ratio of outside directors than their juvenile diversified counterparts, indicating that mature diversified firms have more advisory needs.

In Table 7 Panel B, we run multivariate regressions to further investigate the role of the board of directors in diversified firms. We control for board size, number of outside directors, and

⁴² Information asymmetry may be associated with misallocation of resources across segments, which is an important source of value loss in diversified firms. For example, Meyer, Milgrom, and Roberts (1992) argue that cross-subsidization results in unprofitable lines of business, creating greater value losses in diversified firms. Also, Berger and Ofek (1995) provide empirical evidence to show that diversified firms with poor performance segments tend to have larger diversification discounts than diversified firms without such segments. Consistent with Berger and Ofek (1995), in an untabulated test, we find that diversified firms with negative operating profit segments suffer from larger diversification discount, and this effect is stronger in high diversification age firms, indicating that the misallocation of resources is more serious in firms with high diversification age.

ratio of outside directors respectively and interact these board characteristics with firms' diversification time effect measure (*Diversification age* and the *Mature* indicator). In regressions (1) and (2), we find that for the mature diversified firms, larger boards are associated with higher excess value, but this effect is not significant. In regressions (3) and (4), we find that for the mature diversified firms, more outside board directors are significantly associated with higher firm excess value. And in regressions (5) and (6), we show that for the mature diversified firms, higher outside director ratios is associated with higher firm excess value. These results suggest that outside directors, but not the board size, play an important role in reducing information asymmetry and increasing firms' excess value in mature diversified firms.

Again, after controlling for all these board characteristics, we still find coefficient estimates on *Diversification age* to be negative and significant in all dimensions. The coefficient estimates suggest that there is 2.8%–3.6% additional value loss for each year that diversified firms stay diversified.

Overall, information asymmetry can partly explain the diversification time effect. We find that mature diversified firms have more information asymmetry than juvenile firms. Accordingly, mature diversified firms have boards with larger board size, more outside directors and higher ratio of outside directors. Our results are also consistent with the board advising argument in the sense that boards with more outside directors bring more experience and offer better advice for mature diversified firms.

6.3. Diversification time effect and likelihood of CEO turnover

The literature documents a link between firm diversification and corporate governance.

Anderson et al. (2000) empirically show that CEOs in diversified firms have lower stock ownership and lower pay-for-performance sensitivities, but diversified firms have more outside directors. They suggest that diversified firms use alternative governance mechanisms as substitutes for low pay-for-performance sensitivities and CEO stock ownership. Singh, Mathur, and Gleason (2004) also investigate the governance and diversification issue but their results show little direct evidence regarding the relation among ownership structure, corporate governance, and corporate diversification. In recent studies, Ding and Kang (2010) show in their model that the extent of the information asymmetry mentioned above is reflected through the transparency of a firm's information environment, or the strength and effectiveness of internal auditing of managerial behavior. In other words, corporate governance plays an important role in reducing the information asymmetry in their model.

In the previous section, we show that in mature diversified firms, CEOs have fewer incentives (lower CEO ownership and lower founder CEOs) and there is more information asymmetry (more business segments and more R&D expenditure) compared to juvenile diversified firms. We also find mature diversified firms to have larger boards and more outside directors to help management reduce potential information asymmetry problems. In this section, we try to investigate the difference in top management turnover between mature and juvenile diversified firms. If mature diversified firms have more agency problems and CEOs in mature firms are more entrenched in their positions, then we expect CEO turnover to be less likely. However, since we observe lower CEO ownership in mature firms and there is no evidence to show that CEOs are more entrenched in their positions in mature firms, we would expect mature

diversified firms to implement better corporate governance mechanisms to mitigate agency problems and information asymmetry, which would increase the likelihood of forced CEO turnover.

The CEO turnover data are originally obtained from the ExecuComp database. To identify forced CEO turnover, we follow the method used by Denis, Denis and Sarin (1997b) and Parrino (1997) and go through the news in Factiva from one year before the event date to three months after. A CEO turnover is considered to be forced (non-routine) if it satisfies the following requirements: 1) no announcement indicating CEO turnover three months before the event; 2) negative news, scandal(s), or lawsuit(s) against the firm within one year before the event; 3) the old CEO is under 65; 4) stock price drops during the year before the event.

We first conduct CEO turnover logit regression to investigate whether there is any difference in likelihood of CEO turnover and CEO turnover to stock performance sensitivity in mature diversified firms. The dependent variable is *CEO turnover*, an indicator variable that takes the value of 1 if a CEO turnover event occurs in a given year and 0 otherwise. Table 8 columns (1)–(3) present the results. We find that stock returns over the previous 12 months are negatively associated with the likelihood of CEO turnover, and significant at the 1% level. However there is no evidence to show that diversified firms (*Diversified*) or high diversification age firms (*Diversification age* and the *Mature* indicator) are significantly associated with likelihood of CEO turnover. The negative coefficient estimates on the interaction term of *stock return* with the diversification time effect measure (*Diversification age* or *Mature* indicator) suggest that mature diversified firms have higher CEO turnover to stock performance sensitivity, but this relationship

is not significant.

In Table 8 columns (4)–(6), we perform forced CEO turnover logit regression. The dependent variable is *Forced CEO turnover*, an indicator variable that takes the value of 1 if a forced CEO turnover event occurs in a given year and 0 otherwise. Again we find *stock return* is significant and negatively associated with the likelihood of forced CEO turnover. We also find negative and significant coefficient estimates on the interaction term of *stock return* with the diversification time effect measure (*Diversification age* or the *Mature* indicator), indicating that mature diversified firms have significantly higher forced CEO turnover to stock performance sensitivity.

Overall, these results support the view that mature diversified firms implement better corporate governance mechanisms to reduce CEO-incentive problems and information asymmetry.

7. Mature Diversified Firms in a Financial Crisis

Since we document a robust diversification time effect in prior sections, one question that arises is why a large number of firms still choose to stay diversified if diversification destroys value and they incur additional cost in remaining diversified. There must be some less evident advantages to diversification.

It is argued that managers can benefit from being able to create an internal capital market for managers who are unable to credibly signal to the external capital market the value of a project or investment policy (Stulz, 1990; Stein, 1997; Fluck and Lynch, 1999; Hadlock, Ryngaert and

Thomas, 2001). Diversification also increases debt capacity (Lewellen, 1971), which creates firm value by increasing interest tax shields. These benefits make diversification more valuable when there is an exogenous economic shock and it becomes more difficult to borrow money from the outside and the market becomes more pessimistic. A recent study by Kuppuswamy and Villalonga (2010) shows that diversified firms increased in value relative to focused firms during the ongoing global financial crisis.

Inspired by the prior wisdom, we use the 2008 financial crisis as an exogenous shock to investigate the difference in firm value between mature and juvenile diversified firms. Instead of using annual data, we use quarterly data. The segment data for each firm-quarter observation is the annual segment data in the nearest fiscal year, thus the diversification age calculation is based on the data in the nearest fiscal year. Other accounting data are obtained from firms' most recent quarterly data from the Compustat database. Excess value is based on the most recent quarterly market valuation while sales or asset multipliers are based on sales or assets in the most recent four quarters. We restrict our sample period to 2006 to 2009.

The bankruptcy and collapse of Lehman Brothers in September 2008 is widely considered to have triggered the worst global financial crisis since the 1970s. We thus define an indicator variable, *Crisis*, which takes the value of 1 if the firm-quarter observation is in the last quarter of 2008 or onwards and 0 otherwise. The indicator variable measures how the financial crisis affects firms' excess value, while the interaction term of *Crisis* with the diversification time effect measure (*Diversification age* or the *Mature* indicator) indicates how the excess value of mature diversified firms would be affected in a financial crisis.

Table 9 reports the regression results. In regression (1), we find that the *Crisis* indicator is associated with negative excess value, but the relationship is not significant. In regression (2), we find *Crisis* significantly associated with 2.5% excess value loss, but the positive and significant coefficient estimate on the interaction of *Crisis* with *Diversification age* suggests that high diversification age firms tend to have higher excess value than other firms during the financial crisis. Similarly, in regression (3), we find the mature diversified firms outperforming the juvenile and single-segment firms during the financial crisis. The positive and significant coefficient estimate on the interaction term of *Crisis* with *Mature* indicates that there is a 10.3% gain in excess value for the mature diversified firms during the financial crisis. In regressions (4)–(6), we use the excess value based on asset multipliers as the dependent variable and find similar results as in regressions (1)–(3). The excess value gain based on asset multipliers is about 7.1% for the mature diversified firms during the crisis and significant at the 1% level.

The above results shed some light on why firms choose to stay diversified even if they bear additional cost in doing so. The value loss from diversification and the diversification time effect is compensated by the premium of diversification and the diversification time effect when there is an exogenous economic shock affecting the market.

8. Summary and Conclusion

This paper investigates how the diversification discount changes with diversification age and documents a significant diversification time effect. At a given point of time, mature diversified firms show a greater diversification discount than juvenile diversified firms, indicating that

diversified firms bear additional costs in remaining diversified. This worsening effect over time still holds even after taking into consideration R&D expenditure, segment number, firm age, unobservable firm characteristics (firm fixed effect), and self-selection bias and after subjecting different subsamples to robustness tests.

CEO incentives and information asymmetry partly explain the worsening diversification time effect. Our results show that CEOs in mature diversified firms have fewer incentives (lower CEO ownership and fewer founder CEOs) and there is more information asymmetry (more segments and more R&D expenditure) in mature diversified firms than in their juvenile counterparts. However, the diversification time effect still holds after controlling for proxies of CEO incentives and information asymmetry. In addition, the time effect is unlikely to be driven by poorer corporate governance in mature diversified firms. Instead, we find stronger boards with more outside directors and better advising capacity in mature diversified firms. We also find that, in mature diversified firms, CEOs are less likely to be entrenched in their positions. Forced CEO turnover to stock performance sensitivity are also significantly higher in such firms.

We also provide new evidence that show the benefit of diversification and staying diversified: mature diversified firms are seen to enjoy a diversification premium during a financial crisis. This finding sheds light on why firms choose to diversify and stay diversified even though they incur additional costs doing so.

Due to data constraints, our study does not investigate other potentially important issues regarding corporate governance and firms' diversification time effect. For example, do directors with expertise in other industries, especially in the industries of newly acquired segments, provide

more advice to management to reduce agency problems and information asymmetry in mature diversified firms? For the CEO turnover case, are the new CEOs more likely to have employment experience in other industries so that information asymmetry could be reduced? Do institutional investors play any role in helping to reduce information asymmetry in mature diversified firms? These issues represent useful areas for future research.

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Table 1. Summary statistics

The sample consists of 36,187 firm-year observations during the 1999–2008 period. Panel A reports the summary statistics for 26,820 single-segment firm-year observations and 9,367 diversified firm-year observations. Panel B reports the summary statistics for mature and juvenile diversified firms. Mature diversified firms are those whose diversification age are above the sample median, while juvenile diversified firms are those whose diversification age are no more than the sample median. *Excess value based on sales (asset) multipliers* is the logarithm of the ratio of a firm's actual market value to its imputed value. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Summary statistics for single-segment firms and diversified firms

	Full Sample of Private Firms		Single-segment Firms		Diversified Firms		Test of difference: p-value	
	Mean	Median	Mean	Median	Mean	Median	t-test	Wilcoxon Z-test
Market valuation (\$million)	3240	332	2229	259	6134	749	0.000***	0.000***
Total assets (\$million)	2259	237	1313	177	4968	680	0.000***	0.000***
Sales (\$million)	2028	210	1130	148	4560	666	0.000***	0.000***
Leverage	24.59%	19.02%	23.51%	15.59%	27.69%	25.77%	0.000***	0.000***
Cash	0.130	0.071	0.149	0.088	0.076	0.042	0.000***	0.000***
Capex	0.112	0.036	0.123	0.036	0.079	0.036	0.000***	0.205
EBIT	-0.056	0.054	-0.093	0.045	0.050	0.072	0.000***	0.000***
R&D	38.942	0	27.444	0	71.861	0	0.000***	0.468
Dividend (indicator)	0.262	0	0.19	0	0.469	0	0.000***	0.000***
Foreign inc (indicator)	0.126	0	0.125	0	0.131	0	0.095*	0.046**
Number of segments	1.412	1	1	1	2.592	2	0.000***	0.000***
Firm age	16.98	12	14.38	11	24.42	19	0.000***	0.000***
Excess value based on sales multipliers	-0.227	-0.158	-0.185	-0.109	-0.346	-0.287	0.000***	0.000***
Excess value based on asset multipliers	-0.043	-0.034	-0.042	-0.026	-0.048	-0.061	0.448	0.213
Diversification age	1.886	0	0	0	7.287	6	0.000***	0.000***
# of observations	36187		26820		9367			

Panel B: Summary statistics for mature diversified firms and juvenile diversified firms

	Juvenile Diversified Firms (divage<=6)		Mature Diversified Firms (divage>6)		Test of Difference: p-value	
	Mean	Median	Mean	Median	t-test	Wilcoxon Z-test
Market valuation (\$million)	4231	455	8183	1242	0.000***	0.000***
Total assets (\$million)	3496	413	6552	1153	0.000***	0.000***
Sales (\$million)	2811	369	6525	1134	0.000***	0.000***
Leverage	29.04%	26.92%	26.24%	24.79%	0.000***	0.000***
Cash	0.084	0.045	0.067	0.039	0.000***	0.000***
Capex	0.088	0.037	0.069	0.036	0.000***	0.442
EBIT	0.024	0.061	0.077	0.081	0.000***	0.000***
R&D	47.002	0	98.620	0.214	0.000***	0.000***
Dividend (indicator)	0.356	0	0.590	1	0.000***	0.000***
Foreign inc (indicator)	0.139	0	0.123	0	0.016**	0.008***
Firm age	17.77	12	31.57	32	0.000***	0.000***
Number of segments	2.391	2	2.807	2	0.000***	0.000***
Excess value based on sales multipliers	-0.315	-0.286	-0.379	-0.289	0.001***	0.030**
Excess value based on asset multipliers	-0.041	-0.063	-0.056	-0.058	0.275	0.270
Diversification age	3.219	3	11.666	11	0.000***	0.000***
# of observations	4856		4511			

Table 2. Time effect of diversification

The sample consists of 26,820 single-segment and 9,367 diversified firm-year observations during the 1999–2008 period. The dependent variable in columns 1–4 is the firms' excess value based on sales multipliers and the dependent variable in columns 5–8 is the firms' excess value based on asset multipliers. *Excess value based on sales (asset) multipliers* is the logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying the segment's annual sales (total assets) by the median market-to-sales (market-to-assets) multiplier of single-segment firms in the same industry. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent Variable: Excess value based on sales multipliers				Dependent Variable: Excess value based on asset multipliers			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Diversified (indicator)	-0.201*** [0.000]		-0.111*** [0.000]	-0.107*** [0.000]	-0.023* [0.084]		0.003 [0.848]	0.011 [0.542]
Diversification age		-0.022*** [0.000]	-0.013*** [0.000]	-0.016*** [0.000]		-0.004** [0.019]	-0.004* [0.068]	-0.004* [0.062]
Ln (Total assets)	0.139*** [0.000]	0.140*** [0.000]	0.140*** [0.000]	0.149*** [0.000]	0.032*** [0.000]	0.032*** [0.000]	0.032*** [0.000]	0.032*** [0.000]
Leverage	0.162*** [0.000]	0.150*** [0.000]	0.156*** [0.000]	0.208*** [0.000]	0.189*** [0.000]	0.188*** [0.000]	0.188*** [0.000]	0.195*** [0.000]
Cash	1.165*** [0.000]	1.174*** [0.000]	1.160*** [0.000]	1.365*** [0.000]	0.955*** [0.000]	0.953*** [0.000]	0.953*** [0.000]	1.007*** [0.000]
Capex	0.722*** [0.000]	0.725*** [0.000]	0.718*** [0.000]	1.045*** [0.000]	0.194*** [0.000]	0.193*** [0.000]	0.193*** [0.000]	0.233*** [0.000]
EBIT	-0.108*** [0.000]	-0.112*** [0.000]	-0.110*** [0.000]	-0.169*** [0.000]	0.193*** [0.000]	0.193*** [0.000]	0.193*** [0.000]	0.187*** [0.000]

(Continued)

Table 2. Time effect of diversification (Continued)

	Dependent Variable: Excess value based on sales multipliers				Dependent Variable: Excess value based on asset multipliers			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R&D	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.004]	0.000 [0.466]	0.000 [0.447]	0.000 [0.447]	0.000 [0.237]
Dividend (indicator)	0.017 [0.437]	0.025 [0.252]	0.027 [0.222]	0.003 [0.875]	0.093*** [0.000]	0.096*** [0.000]	0.096*** [0.000]	0.095*** [0.000]
Foreign inc	-0.069** [0.014]	-0.077*** [0.006]	-0.075*** [0.008]	-0.041 [0.143]	-0.128*** [0.000]	-0.129*** [0.000]	-0.129*** [0.000]	-0.135*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	No	No	No	Yes	No	No	No	Yes
Constant	-1.240*** [0.000]	-1.241*** [0.000]	-1.239*** [0.000]	-1.376*** [0.000]	-0.418*** [0.000]	-0.417*** [0.000]	-0.418*** [0.000]	-0.494*** [0.000]
Observations	35,643	35,643	35,643	35,643	35,642	35,642	35,642	35,642
Adjusted R^2	14%	14%	14%	20%	7%	7%	7%	9%

Table 3. Comparison of mature and juvenile diversified firms

The sample consists of 9,367 diversified firm-year observations during the 1999–2008 period. The dependent variable in columns 1–3 is the firms' excess value based on sales multipliers and the dependent variable in columns 4–6 is the firms' excess value based on asset multipliers. *Excess value based on sales (asset) multipliers* is the logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying a segment's annual sales (total assets) by the median market-to-sales (market-to-assets) multiplier of single-segment firms in the same industry. Mature diversified firms are diversified firms whose diversification age are above the sample median (6 years) in columns 1, 2, 4, and 5 and above the sample's 75th percentile point (10 years) in columns 3 and 6. In columns 1 and 4, the full sample of single-segment firms and diversified firms are used; in columns 2, 3, 5, and 6, the sample of diversified firms is used. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent Variable: Excess value based on sales multipliers			Dependent Variable: Excess value based on asset multipliers		
	Mature =1 if diversification age > 6		Mature =1 if diversification age > 10	Mature =1 if diversification age > 6		Mature =1 if diversification age > 10
	(1)	(2)	(3)	(4)	(5)	(6)
Diversified	-0.152*** [0.000]			0.004 [0.782]		
Mature (indicator)	-0.140*** [0.000]	-0.103*** [0.000]	-0.089** [0.010]	-0.043** [0.022]	-0.034* [0.093]	-0.022 [0.352]
Ln (Total assets)	0.149*** [0.000]	0.083*** [0.000]	0.082*** [0.000]	0.032*** [0.000]	0.012* [0.080]	0.012* [0.092]
Leverage	0.210*** [0.000]	0.465*** [0.000]	0.469*** [0.000]	0.196*** [0.000]	0.175*** [0.001]	0.178*** [0.001]
Cash	1.365*** [0.000]	1.014*** [0.000]	1.025*** [0.000]	1.007*** [0.000]	0.993*** [0.000]	0.999*** [0.000]
Capex	1.046*** [0.000]	1.604*** [0.000]	1.611*** [0.000]	0.233*** [0.000]	0.359*** [0.000]	0.362*** [0.000]

(Continued)

Table 3. Comparison of mature and juvenile diversified firms (Continued)

	Dependent Variable: Excess value based on sales multipliers			Dependent Variable: Excess value based on asset multipliers		
	Mature =1 if diversification age > 6	Mature =1 if diversification age > 10		Mature =1 if diversification age > 6	Mature =1 if diversification age > 10	
	(1)	(2)	(3)	(4)	(5)	(6)
EBIT	-0.168*** [0.000]	0.182* [0.053]	0.181* [0.054]	0.187*** [0.000]	0.342*** [0.000]	0.342*** [0.000]
R&D	-0.000*** [0.003]	0.000 [0.232]	0.000 [0.245]	0.000 [0.235]	0.000 [0.691]	0.000 [0.686]
Dividend (indicator)	0.001 [0.969]	0.063* [0.064]	0.060* [0.074]	0.095*** [0.000]	0.112*** [0.000]	0.111*** [0.000]
Foreign inc	-0.039 [0.165]	-0.014 [0.778]	-0.014 [0.775]	-0.135*** [0.000]	-0.134*** [0.000]	-0.133*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.378*** [0.000]	-1.232*** [0.000]	-1.256*** [0.000]	-0.494*** [0.000]	-0.449*** [0.000]	-0.459*** [0.000]
Observations	35,643	9,182	9,182	35,642	9,181	9,181
Adjusted R^2	20%	19%	19%	9%	10%	10%

Table 4. Robustness test of diversification time effect

The sample consists of 26,820 single-segment and 9,367 diversified firm-year observations during the 1999–2008 period. The dependent variable is the firms' excess value based on the sales multiplier. *Excess value based on sales multipliers* is the logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying a segment's annual sales by the median market-to-sales multiplier of single-segment firms in the same industry. *Mature* is an indicator variable that takes the value of 1 if the firm's diversification age is above the sample median and 0 otherwise. *Firm age* is counted based on the initial year the firm has accounting data in the Compustat database. In columns 1–4, the full sample of single-segment and diversified firms is used; columns 5–6 represent the full sample excluding diversified firms in the year 1990; in columns 7–8, firms available as early as the year 1990 are used. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent Variable: Excess value based on sales multipliers							
	Full Sample				Subsample excluding diversified firms in 1990		Sample of firms available as early as 1990	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Diversified (indicator)	-0.131*** [0.000]	-0.145*** [0.000]	-0.027 [0.425]	-0.060* [0.056]	-0.102*** [0.001]	-0.147*** [0.000]	-0.044 [0.317]	-0.103*** [0.002]
Diversification age	-0.006** [0.045]		-0.013*** [0.000]		-0.018*** [0.000]		-0.011*** [0.007]	
Mature (indicator)		-0.064** [0.020]		-0.115*** [0.000]		-0.131*** [0.000]		-0.092** [0.030]
Firm age	-0.008*** [0.000]	-0.008*** [0.000]						
Number of segments			-0.065*** [0.000]	-0.068*** [0.000]				

(Continued)

Table 4. Robustness test of diversification time effect (Continued)

Dependent Variable: Excess value based on sales multipliers								
	Full Sample				Subsample excluding diversified firms in 1990		Sample of firms available as early as 1990	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln (Total assets)	0.155*** [0.000]	0.155*** [0.000]	0.151*** [0.000]	0.150*** [0.000]	0.154*** [0.000]	0.154*** [0.000]	0.111*** [0.000]	0.111*** [0.000]
Leverage	0.207*** [0.000]	0.208*** [0.000]	0.208*** [0.000]	0.210*** [0.000]	0.195*** [0.000]	0.195*** [0.000]	0.354*** [0.000]	0.355*** [0.000]
Cash	1.326*** [0.000]	1.326*** [0.000]	1.368*** [0.000]	1.369*** [0.000]	1.345*** [0.000]	1.346*** [0.000]	1.408*** [0.000]	1.411*** [0.000]
Capex	1.007*** [0.000]	1.007*** [0.000]	1.040*** [0.000]	1.040*** [0.000]	0.988*** [0.000]	0.990*** [0.000]	1.201*** [0.000]	1.206*** [0.000]
EBIT	-0.161*** [0.000]	-0.160*** [0.000]	-0.171*** [0.000]	-0.170*** [0.000]	-0.176*** [0.000]	-0.176*** [0.000]	1.693*** [0.000]	1.693*** [0.000]
R&D	-0.000** [0.012]	-0.000** [0.011]	-0.000*** [0.004]	-0.000*** [0.003]	-0.000*** [0.001]	-0.000*** [0.000]	-0.000 [0.735]	-0.000 [0.725]
Dividend (indicator)	0.063*** [0.004]	0.063*** [0.004]	0.006 [0.769]	0.004 [0.836]	-0.002 [0.933]	-0.003 [0.893]	0.080** [0.013]	0.079** [0.014]

(Continued)

Table 4. Robustness test of diversification time effect (Continued)

	Dependent Variable: Excess value based on sales multipliers							
	Full Sample				Subsample excluding diversified firms in 1990		Sample of firms available as early as 1990	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Foreign inc	-0.110*** [0.000]	-0.110*** [0.000]	-0.036 [0.200]	-0.034 [0.225]	-0.045 [0.115]	-0.045 [0.117]	0.004 [0.956]	0.005 [0.948]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.274*** [0.000]	-1.274*** [0.000]	-1.319*** [0.000]	-1.319*** [0.000]	-1.388*** [0.000]	-1.391*** [0.000]	-1.292*** [0.000]	-1.298*** [0.000]
Observations	35,643	35,643	35,643	35,643	32,610	32,610	9,909	9,909
Adjusted R^2	21%	21%	20%	20%	20%	20%	30%	30%

Table 5. Firm fixed effect estimation and self-selection model estimation

In columns 1–2, we report the diversification time effect estimation after controlling for firm fixed effect. The sample consists of 774 firms that transitioned from single-segment to diversified firms (5,287 firm-year observations) and 774 control non-diversifying single-segment firms during the 1999–2008 period. Regressions in columns 1–2 include year and firm fixed effects. In columns 3–4, we employ Heckman’s two-stage procedure to address the self-selection bias. The sample consists of 26,820 single-segment and 9,367 diversified firm-year observations during the 1999–2008 period. In the first step, a Probit model is used to estimate firms’ diversification decision and compute the inverse Mills ratio (*Lambda*). Instrumental variables are the industry average Tobin’s Q and the fraction of industry sales accounted for by diversified firms. In the second stage, the inverse Mills ratio (*Lambda*) is added into the model in Table 2. Regressions in columns 3–4 include indicator variables for each Fama-French (1997) 48 industry and year. The *Diversified* indicator equals to 1 if a firm is diversified in that year and 0 otherwise. *Mature* is an indicator variable that takes the value of 1 if the firm’s diversification age is above the sample median and 0 otherwise. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent Variable: Excess value based on sales multipliers			
	Firm Fixed Effect		Self-selection	
	(1)	(2)	(3)	(4)
Diversified (indicator)	-0.058*	-0.091***	-0.716***	-0.780***
	[0.072]	[0.000]	[0.000]	[0.000]
Diversification age	-0.012**		-0.013***	
	[0.027]		[0.000]	
Mature (indicator)		-0.072*		-0.122***
		[0.096]		[0.000]
Ln (Total assets)	0.164***	0.164***	0.171***	0.171***
	[0.000]	[0.000]	[0.000]	[0.000]
Leverage	0.247***	0.247***	0.228***	0.230***
	[0.000]	[0.001]	[0.000]	[0.000]
Cash	1.133***	1.133***	1.198***	1.191***
	[0.000]	[0.000]	[0.000]	[0.000]
Capex	0.766***	0.765***	0.903***	0.898***
	[0.000]	[0.000]	[0.000]	[0.000]
EBIT	-0.083	-0.083	-0.174***	-0.174***
	[0.112]	[0.112]	[0.000]	[0.000]
R&D	-0.000	-0.000	-0.000***	-0.000***
	[0.270]	[0.273]	[0.000]	[0.000]
Dividend (indicator)	0.062*	0.063*	0.084***	0.085***
	[0.076]	[0.073]	[0.000]	[0.000]
Foreign inc			-0.062***	-0.061***
			[0.000]	[0.000]

(Continued)

Table 5. Firm fixed effect estimation and self-selection model estimation (Continued)

	Dependent Variable: Excess value based on sales multipliers			
	Firm Fixed Effect		Self-selection	
	(1)	(2)	(3)	(4)
Lambda			0.349*** [0.000]	0.364*** [0.000]
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	No	No	Yes	Yes
Firm fixed effect	Yes	Yes	No	No
Constant	-1.544*** [0.000]	-1.546*** [0.000]	-1.319*** [0.000]	-1.319*** [0.000]
Observations	10,597	35,643	35,643	35,643
Adjusted R^2	9%	9%	20%	20%

Table 6. Diversification time effect and CEO characteristics: CEO incentives

The sample consists of 9,732 single-segment and 4,212 diversified firm-year observations during the 1999–2008 period. Panel A reports the difference in test results for CEO characteristics between mature and juvenile diversified firms. Panel B reports the OLS regression results. The dependent variable is the firms' excess value based on sales multipliers. *Excess value based on sales multipliers* is the logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying a segment's annual sales by the median market-to-sales multiplier of single-segment firms in the same industry. *Mature* is an indicator variable that takes the value of 1 if the firm's diversification age is above the sample median and 0 otherwise. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Difference test between mature and juvenile diversified firms

	Juvenile Diversified firms (divage<=median)		Mature Diversified firms (divage>median)		Test of Difference: p-value	
	Mean	Median	Mean	Median	t-test	Wilcoxon Z-test
CEO ownership	0.046	0.008	0.031	0.004	0.000***	0.000***
Founder CEO	0.139	0	0.049	0	0.000***	0.000***
CEO chairman	0.733	1	0.747	1	0.313	0.157
Excess value based on sales multipliers	-0.208	-0.180	-0.304	-0.196	0.001***	0.004***
Excess value based on asset multipliers	0.070	0.027	0.031	0.012	0.027**	0.052*
# of observations	2220		1992			

Panel B: Multivariate test

	Dependent Variable: Excess value based on sales multipliers					
	(1)	(2)	(3)	(4)	(5)	(6)
Diversified (indicator)	-0.108*** [0.005]	-0.188*** [0.000]	-0.143*** [0.000]	-0.192*** [0.000]	-0.148*** [0.000]	-0.192*** [0.000]
Diversification age (a)	-0.008** [0.031]		-0.009** [0.015]		-0.008* [0.078]	
Mature (indicator) (b)		-0.003 [0.945]		-0.060* [0.089]		-0.082 [0.135]
CEO ownership (c)	-0.180 [0.317]	-0.295* [0.081]				
Founder CEO (indicator) (d)			0.082*** [0.007]	0.077*** [0.010]		
CEO chairman (indicator) (e)					0.006 [0.802]	0.000 [0.986]
(a) x (c)	-0.425*** [0.008]					
(b) x (c)		-14.210* [0.056]				
(a) x (d)			-0.013 [0.158]			
(b) x (d)				-0.183 [0.163]		
(a) x (e)					-0.002 [0.677]	
(b) x (e)						0.011 [0.847]
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.694*** [0.000]	-0.695*** [0.000]	-0.775*** [0.000]	-0.771*** [0.000]	-0.762*** [0.000]	-0.755*** [0.000]
Observations	13,692	13,692	13,692	13,778	13,778	13,778
Adjusted R^2	21%	21%	21%	21%	21%	21%

Table 7. Diversification time effect and board characteristics: Information asymmetry and board advising

The sample consists of 9,732 single-segment and 4,212 diversified firm-year observations during the 1999–2008 period. Panel A reports the difference in test results for board characteristics between mature and juvenile diversified firms. Panel B reports the OLS regression results. The dependent variable is the firms' excess value based on the sales multiplier. *Excess value based on sales multipliers* is the logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying the segment's annual sales by the median market-to-sales multiplier of single-segment firms in the same industry. *Mature* is an indicator variable that takes the value of 1 if the firm's diversification age is above the sample median and 0 otherwise. *Board size* is the total number of directors on a board. *Ratio of outside directors* is the total number of outside directors divided by the total number of directors. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Difference test between mature and juvenile diversified firms

	Juvenile Diversified Firms (divage<=median)		Mature Diversified Firms (divage>median)		Test of Difference: p-value	
	Mean	Median	Mean	Median	t-test	Wilcoxon Z-test
Board size	8.793	9	9.530	9	0.000***	0.000***
Number of outside directors	6.742	6	7.627	8	0.000***	0.000***
Ratio of outside directors	0.754	0.800	0.793	0.846	0.000***	0.000***
Excess value based on sales multipliers	-0.208	-0.180	-0.304	-0.196	0.001***	0.004***
Excess value based on asset multipliers	0.070	0.027	0.031	0.012	0.027**	0.052*
# of observations	2220		1992			

Panel B: Multivariate test

	Dependent Variable: Excess value based on sales multipliers					
	(1)	(2)	(3)	(4)	(5)	(6)
Diversified (indicator)	-0.156*** [0.000]	-0.205*** [0.000]	-0.178*** [0.000]	-0.210*** [0.000]	-0.161*** [0.000]	-0.210*** [0.000]
Diversification age (a)	-0.036** [0.041]		-0.028*** [0.007]		-0.029** [0.024]	
Mature (indicator) (b)		-0.346 [0.149]		-0.231 [0.116]		-0.209 [0.148]
Ln (Board size) (c)	-0.221*** [0.000]	-0.209*** [0.000]				
Ln (number of outside directors) (d)			-0.150*** [0.000]	-0.137*** [0.000]		
Ratio of outside directors (e)					-0.230** [0.028]	-0.190* [0.057]
(a) x (c)	0.012 [0.120]					
(b) x (c)		0.122 [0.255]				
(a) x (d)			0.011** [0.047]			
(b) x (d)				0.080 [0.263]		
(a) x (e)					0.024* [0.100]	
(b) x (e)						0.166 [0.342]
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.373** [0.043]	-0.401** [0.027]	-0.537*** [0.001]	-0.563*** [0.001]	-0.565*** [0.001]	-0.598*** [0.001]
Observations	13,778	13,778	13,750	13,750	13,778	13,778
Adjusted R^2	20%	20%	20%	20%	20%	20%

Table 8. Diversification time effect and likelihood of CEO turnover

The sample consists of 22,013 single-segment and 8,241 diversified firm-year observations during the 1999–2008 period. Data on CEO turnover is manually collected following the Parrino (1997) method. There are a total of 1,150 CEO turnover events and 294 forced CEO turnover events during the sample period. The dependent variable for columns 1–3 is an indicator that takes the value of 1 if a CEO turnover event occurs in a given year and 0 otherwise. The dependent variable for columns 4–6 is an indicator that takes the value of 1 if a forced CEO turnover event occurs in a given year and 0 otherwise. *Stock return* is the cumulative buy and hold monthly stock return in the prior fiscal year. *Mature* is an indicator variable that takes the value of 1 if the firm's diversification age is above the sample median and 0 otherwise. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	CEO Turnover: Logit			Forced CEO Turnover: Logit		
	(1)	(2)	(3)	(5)	(5)	(6)
Diversified (indicator)	0.041 [0.717]	0.042 [0.705]	0.036 [0.699]	-0.021 [0.922]	-0.055 [0.800]	0.007 [0.968]
Diversification age (a)	0.003 [0.760]	0.005 [0.657]		0.000 [0.987]	0.01 [0.671]	
Mature (indicator) (b)			0.097 [0.437]			0.214 [0.363]
Stock return (c)	-0.145*** [0.002]	-0.135*** [0.007]	-0.140*** [0.004]	-0.550*** [0.000]	-0.459*** [0.000]	-0.494*** [0.000]
(a) x (c)		-0.022 [0.502]			-0.149** [0.040]	
(b) x (c)			-0.394 [0.579]			-3.826** [0.022]
Ln (Total assets)	0.567*** [0.000]	0.567*** [0.000]	0.567*** [0.000]	0.464*** [0.000]	0.463*** [0.000]	0.464*** [0.000]
Leverage	-0.734*** [0.000]	-0.737*** [0.000]	-0.735*** [0.000]	-0.127 [0.694]	-0.132 [0.684]	-0.132 [0.684]
Cash	0.723** [0.019]	0.724** [0.019]	0.724** [0.019]	0.349 [0.537]	0.365 [0.520]	0.357 [0.529]
Capex	-0.263 [0.367]	-0.264 [0.366]	-0.262 [0.370]	-0.169 [0.740]	-0.177 [0.728]	-0.175 [0.732]
EBIT	0.215* [0.064]	0.216* [0.064]	0.217* [0.063]	-0.266* [0.087]	-0.274* [0.078]	-0.272* [0.080]
R&D	-0.000*** [0.004]	-0.000*** [0.004]	-0.000*** [0.004]	0 [0.664]	0 [0.678]	0 [0.682]

(Continued)

Table 8: Diversification time effect and likelihood of CEO turnover (Continued)

	CEO Turnover: Logit			Forced CEO Turnover: Logit		
	(1)	(2)	(3)	(5)	(5)	(6)
Dividend (indicator)	0.208*** [0.009]	0.208*** [0.009]	0.205*** [0.009]	0.071 [0.647]	0.078 [0.615]	0.074 [0.634]
Foreign inc	-3.213*** [0.000]	-3.213*** [0.000]	-3.213*** [0.000]	-2.453*** [0.000]	-2.460*** [0.000]	-2.468*** [0.000]
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,625	29,625	29,625	29,383	29,383	29,383
Pseudo R^2	16%	16%	16%	11%	11%	11%

Table 9. Diversification time effect in financial crisis

The sample consists of 32,352 single-segment and 11,664 diversified firm-quarter observations during the 2006–2009 period. The segment data are based on the segment data in the prior fiscal year. The accounting data are quarterly data from the Compustat database. The dependent variable in columns 1–3 is the firms' excess value based on sales multipliers and the dependent variable in columns 4–6 is the firms' excess value based on asset multipliers. *Excess value based on sales (asset) multipliers* is the logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying a segment's annual sales (total assets) by the median market-to-sales (market-to-assets) multiplier of single-segment firms in the same industry. *Mature* is an indicator variable that takes the value of 1 if the firm's diversification age is above the sample median and 0 otherwise. *Crisis* is an indicator variable that takes the value of 1 if the data is in the 4th quarter of 2008 or in the year 2009, and 0 otherwise. Regressions include indicator variables for each Fama-French (1997) 48 industry and year. All continuous variables are winsorized at the 1st and 99th percentiles. *P*-values based on robust standard error clustered at the firm level are reported in brackets. Superscripts ***, **, * correspond to statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dependent Variable: Excess value based on sales multipliers			Dependent Variable: Excess value based on asset multipliers		
	(1)	(2)	(3)	(4)	(5)	(6)
Diversified	-0.150*** [0.000]	-0.082* [0.084]	-0.150*** [0.000]	0.003 [0.891]	-0.004 [0.895]	0.003 [0.898]
Diversification age (a)		-0.016*** [0.000]			-0.001 [0.737]	
Mature (indicator) (b)	-0.144*** [0.001]		-0.176*** [0.000]	-0.006 [0.840]		-0.028 [0.367]
Crisis (indicator) (c)	-0.008 [0.401]	-0.025** [0.018]	-0.022** [0.035]	-0.013* [0.057]	-0.026*** [0.001]	-0.023*** [0.003]
(a) x (c)		0.007*** [0.001]			0.005*** [0.001]	
(b) x (c)			0.103*** [0.002]			0.071*** [0.002]
Ln (Total assets)	0.104*** [0.000]	0.105*** [0.000]	0.104*** [0.000]	0.002 [0.665]	0.002 [0.687]	0.002 [0.654]
Leverage	0.312*** [0.000]	0.310*** [0.000]	0.312*** [0.000]	0.288*** [0.000]	0.289*** [0.000]	0.288*** [0.000]
Cash	1.103*** [0.000]	1.102*** [0.000]	1.105*** [0.000]	0.943*** [0.000]	0.944*** [0.000]	0.944*** [0.000]
Capex	1.237*** [0.000]	1.234*** [0.000]	1.235*** [0.000]	0.314*** [0.000]	0.314*** [0.000]	0.313*** [0.000]
EBIT	-0.124*** [0.003]	-0.126*** [0.003]	-0.124*** [0.003]	0.202*** [0.000]	0.202*** [0.000]	0.202*** [0.000]

(Continued)

Table 9: Diversification time effect in financial crisis (Continued)

	Dependent Variable: Excess value based on sales multipliers			Dependent Variable: Excess value based on asset multipliers		
	(1)	(2)	(3)	(4)	(5)	(6)
R&D	-0.000*	-0.000*	-0.000*	0.000**	0.000**	0.000**
	[0.053]	[0.060]	[0.052]	[0.048]	[0.049]	[0.047]
Dividend (indicator)	0.056**	0.061**	0.056**	0.146***	0.145***	0.146***
	[0.042]	[0.028]	[0.043]	[0.000]	[0.000]	[0.000]
Foreign inc	-0.007	-0.007	-0.006	-0.045	-0.045	-0.045
	[0.878]	[0.860]	[0.886]	[0.144]	[0.149]	[0.146]
Year & industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.251***	-1.249***	-1.249***	-0.278***	-0.276***	-0.276***
	[0.000]	[0.000]	[0.000]	[0.002]	[0.003]	[0.003]
Observations	42,485	42,485	42,485	42,473	42,473	42,473
Adjusted R^2	17%	17%	17%	9%	9%	9%

Appendix. Variable definitions This appendix provides a description of the variables used in the tables.

<i>Variable</i>	<i>Definition</i>
Board size	The total number of directors on a board of directors.
Cash	Income before extraordinary items plus depreciation and amortization normalized by book value of total assets.
Capex	Capital expenditure normalized by book value of total assets.
CEO chairman	Indicator that equals 1 if the CEO is the chairman of the board and 0 otherwise.
CEO ownership	Firm's shares owned by the CEO normalized by the total number of shares outstanding.
CEO turnover	Indicator that equals 1 if a CEO turnover event occurs in a given year and 0 otherwise.
Crisis	Indicator that equals 1 if the data is in the 4th quarter of 2008 or in the year 2009, and 0 otherwise.
Diversification age	Number of years since the firm's diversification.
Diversified	Indicator that equals 1 if the firm operates multiple segments and 0 otherwise.
DivSales	The fraction of industry sales accounted for by diversified firms.
Dividend	Indicator that equals 1 if the firm pays dividends and 0 otherwise.
EBIT	Earnings before interest and taxes normalized by sales.
Excess value based on asset multipliers	The logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying the segment's total assets by the median market-to-assets multiplier of single-segment firms in the same industry.
Excess value based on sales multipliers	The logarithm of the ratio of a firm's actual market value to its imputed value. A firm's imputed value is computed as the sum of its segments' imputed values, which are obtained by multiplying the segment's annual sales by the median market-to-sales multiplier of single-segment firms in the same industry.
Firm age	Number of years since the firm's incorporation.
Forced CEO turnover	Indicator that equals 1 if a forced CEO turnover event occurs in a given year and 0 otherwise.
Foreign inc	Indicator that equals 1 if the firm is incorporated abroad (not in the U.S.) and 0 otherwise.
Founder CEO	Indicator that equals 1 if the CEO is the founder or a member of the group that founded the company and 0 otherwise.
IndQ	The industry average Tobin's Q. Tobin's Q is defined as the sum of market value of common shares and book value of total debt divided by the book value of total assets.
Leverage	Total debt normalized by the book value of total assets.
Mature	Indicator that equals 1 if the firm's diversification age is above the sample median and 0 otherwise.
Number of segments	Number of segments in a firm.
Proportion of outside directors	Proportion of outside directors on the board. Outside directors are directors who do not have any executive role in the firm.
Ratio of outside directors	The total number of outside directors divided by the total number of directors.
R&D	R&D expenditure normalized by the book value of total assets.
Sales	Sales of a firm in millions.
Stock return	The cumulative buy and hold monthly stock return in the prior fiscal year.