Heterogeneous Value Creation of Doctoral Independent Directors during Mergers and Acquisitions: Evidence from Target Shareholder Gains

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Using manually collected biographical information on independent directors in target firms, we analyze the role of directors with doctoral degrees in mergers and acquisitions between 2005 and 2014. We first observe that doctoral independent directors serve on the boards of about 68% of target firms. We find that the market differently responds to the existence of doctoral independent directors with two distinct disciplines during the M&A announcements. While doctoral directors with business-related backgrounds are negatively associated with shareholder wealth, those with technology-related backgrounds tend to increase shareholder wealth. Interestingly, our empirical results show that doctoral independent directors with business-related degrees improve shareholder wealth in targets with higher advisory needs. We also find that low monitoring intensive targets, which have greater monitoring needs than high monitoring intensive targets, benefit only from independent directors with technology-related degrees. Overall, our findings imply that doctoral independent directors can provide better advisory and monitoring service when their expertise is relevant to the firm's need.

JEL Classification: G30, G34

Keywords: Doctoral Directors, Board Advising, Board Monitoring, Target Shareholder Gains, Mergers and Acquisitions

1. Introduction

Board of directors can play advisory and monitoring role to fulfil their fiduciary duties in mergers and acquisitions. Cotter, Shivdasani, and Zenner (1997) report that board independence is positively associated with target shareholder gains and premiums during takeover attempts through tender offer. In contrast, directors of target firms may also have conflict of interest in management buyouts such as seeking their jobs at the acquiring firm. Boone and Mulherin (2014) suggest that target firms can form a special committee of disinterested and independent directors to address this issue.[1]

This study examines whether a dimension of boardroom diversity, the educational level of directors, can create value for target shareholders around the announcement of mergers and acquisitions. In particular, we use the presence and the relative size of doctoral independent directors on the board as a proxy for the expertise of board of directors. The extant literature on diversity in the boardroom suggests that the education of directors affect corporate decision making (e.g., Anderson, Reeb, Upadhyay, and Zhao, 2011; Mahadeo, Soobaroyen, and Hanuman, 2012; Dalziel, Gentry, and Bowerman, 2011).

Recent studies focus on the existence and the relative size of professor-directors on the board and find that firms with professor-directors have higher corporate social responsibility performance ratings (Cho, Jung, Kwak, Lee, and Yoo, 2015), improve innovation outputs (Jung, Podolski, Rhee, and Yoo, 2015), and have higher firm performance (Francis, Hasan, Wu, 2015).

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[1] In the case of Dell Inc. buyout in 2013, Michael Dell, the founder of the company, proposed a buyout deal, collaborating with Silver Lake Partners or the private equity firm. Because of Michael Dell's obvious conflict of interest, the board of Dell Inc. formed a special committee of four independent and disinterested directors. The special committee also hired an investment bank and had the bank carry out an auction to seek competing bids higher than the Michael Dell's bid.

These studies suggest that professor-directors contribute to firm performance because they have higher reputation, transfer knowledge, and enhance the board's diversity. Adopting the rationale of this line of research, we examine the role of independent directors with doctoral degrees, which extends the scope of investigation in that doctoral directors are superset of professor directors. However, these doctoral directors can contribute to the firm performance rather by providing expertise and transferring knowledge than by offering reputation.

We argue that the quality of board monitoring and advising varies with the expertise of directors. To account for these variations, we consider the heterogeneity in the field of study of doctoral directors following prior literature (White, Woidtke, Black, and Schweitzer 2014; Cho et al 2015; Francis, Hasan, and Wu, 2015; Jung et al, 2015). Specifically, we classified doctoral independent directors as follows: *Business* directors with doctoral degrees in business, economics, and law and *Technology* directors with degrees in science, engineering, and medicine.

We also hypothesize that the quality of doctoral directors' advising and monitoring depends on whether their expertise has relevance to the firm's needs. *Business* directors in target firms may play a better advising role in strategic business decisions such as mergers and acquisitions because they can understand the financial statements and give an accurate assessment of the value of target firms to managers, supporting and improving the bargaining power. *Technology* directors with specialized knowledge, on the other hand, may not provide valuable advice to managers and instead focus on monitoring roles.

Using manually-collected biographical information on directors in 772 target firms during 2005-2014, we first look at the prevalence of doctoral directors. About 68 percent of target firms have at least one doctoral director. This high frequency of doctoral directors hints that firms find some merits to elect a doctoral director in their slate of board members. We then examine the overall influence of doctoral independent directors on three-day cumulative abnormal returns (CARs) and one week premiums around the announcement. We find that *Business* directors decrease CARs, while *Technology* directors enhance CARs. In addition, their influence of *Business* directors on CARs statistically and significantly differs from that of *Technology* directors.

Our test results, however, suggest that the presence of each doctoral director is neither always beneficial nor always harmful to shareholders. Specifically, we first use firm complexity as a proxy for target firms' advisory needs following Coles, Daniel, and Naveen (2008) and Linck, Netter, and Yang (2008) and find that *Business* directors significantly enhance CARs, but *Technology* directors destroy CARs as target firms' advisory needs increase. In addition, we find that *Technology* directors significantly improve shareholder wealth as targets' monitoring needs, as measured by monitoring intensity on the board (Faleye, Hoitash, and Hoitash, 2011), increase and as needs for specific knowledge, as measured by R&D intensity, rise. The influence of *Business* directors is insignificantly associated with the monitoring needs. These findings strongly support our conjecture that doctoral independent directors can provide better advisory and monitoring service when their expertise matches with the firm's need.

We perform robustness checks to provide additional evidence to support our hypothesis. We first test again whether each group of doctoral independent directors in target firms has different orientation towards monitoring and advising roles using individual characteristics of doctoral directors instead of firm operating environment. Social ties between CEO and independent directors are thought to weaken board monitoring by making independent directors more friendly (Hwang and Kim, 2009) and at the same time enhance the quality of advising by improving mutual understanding and information flow (Westphal, 1999; Adams and Ferreira, 2007). We measure employment ties as a proxy for CEO-doctoral director social ties following prior literature (Fracassi and Tate, 2012) and compare the influence of doctoral directors with CEO tie with that of doctoral directors without CEO tie.

As expected, we find that *Business* directors with CEO tie are positively associated with CARs while *Business* directors without CEO tie are associated with decrease in CARs. It indicates that social ties enable *Business* directors to provide advising more efficiently. In addition, we find that *Technology* directors significantly increase CARs only when they are not tied with CEO, suggesting social ties weaken the efficiency of *Technology* directors' monitoring. These findings further confirm our conjecture that the orientation of doctoral directors' roles in mergers and acquisitions depends on their expertise.

Another important concern is potential endogeneity. We estimate a two-stage least square model using the supply ratio of doctoral graduates in each academic field as an instrument variable to account for the characteristic that could affect the presence of doctoral independent directors on the board. The results in our baseline regressions are robust when we use the instrumented variable in the second stage regressions, indicating that the relations between the presence and relative size of doctoral directors and target shareholder wealth are not driven by the potential endogeneity problem.

Our paper makes several contributions to the existing literature. First, this study complements existing finance and corporate governance literature by showing that board composition is an important determinant of target shareholder wealth. Most of the literature on takeover targets focuses on the wealth effects of anti-takeover provisions (e.g., Goktan and Kieschnick, 2012; Bates, Becher, Lemmon, 2008). To the best of our knowledge, our study is the first to examine the role of doctoral directors of target firms and their impacts on target shareholder wealth in mergers and acquisitions. Second, our analysis shows that the influence of doctoral independent directors is heterogeneous. We identify the circumstances under which board advising and monitoring of doctoral directors of specific types are valuable. The results also support the theoretical analysis of Adams and Ferreira (2007) by showing the value creation by efficient board advising. Finally, our paper extends the literature on diversity in the boardroom by providing strong evidence that target firms' shareholder wealth is affected by the expertise of doctoral directors. Especially, this study extends the literature on the effects of educational background of board of directors on firm performance, the underexplored area compared to other types of diversity such as age and gender (Mahadeo, Soobaroyen, and Hanuman, 2012).

The reminder of this paper is organized as follows. Section 2 describes the data and explain how we construct the variables employed in this study. Section 3 presents the main findings and some robustness checks. Finally, we conclude in Section 4.

2. Data and summary statistics

2.1. The data

The original sample includes the M&A announcements of U.S public targets on Securities Data Company's (SDC Platinum) Mergers and Acquisitions database during the years 2005 to 2014. Motivated by Masulis, Wang, and Xie (2007) and Bates, Becher, and Lemmon (2008), we impose the following requirements: (a) the acquisition is completed and the transaction value exceeds $1 million; (b) the transaction is identified by SDC as merger, acquisition of majority interest, or tender offer; (c) the bidder must own less than 50% of the target's share before the transaction and 100% afterward; (d) the target has accounting data available from Compustat annual files and daily stock return data (from 200 days to 60 days before the announcement date (day 0)) from Center for Research in Security Prices (CRSP); and (e) the target is not a financial institution with SIC code between 6000 and 6999. This initial screening results in 906 transactions.

Our initial data on corporate governance comes from ISS database (formerly known as RiskMetrics). Although ISS offers comprehensive coverage of firms, it covers only firms that comprise the S&P 1,500 and other major US corporations. Considering that target firms tend to be small, ISS database does not covers the majority of target firms in SDC database. We find that only about 30% of 906 transactions are merged with ISS database. To fill this gap, we supplement the missing governance information by manually searching DEF 14A proxy statements, 10-K annual reports, and S&P Capital IQ database.

DEF 14A forms, published by firms prior to their annual proxy meeting, contain considerable detail on board composition and detailed profiles of each board member. Specifically, 'Election of Directors' section gives information on existing board members, including the number of directors, the biographies of directors and officers, and the independence of directors. We double check the board information from 10-K filings when specific information from DEF 14A is unclear or we require additional information. We exclude transactions when governance information is not available in this process. Therefore, missing data items reduce our final sample size to 772 observations.

2.2. Main variables of interests

We hand collect each independent director's detailed educational information such as degrees and academic disciplines by searching through SEC filings (e.g., *DEF 14A*s and *10-K*s), the press websites (e.g., *Businessweek* and *Forbes*), and other search engines (e.g., *Zoominfo* and

FindTheCompany). We include some professional doctoral degrees such as Doctor of Jurisprudence (J.D.) and Doctor of Medicine (M.D.) in our sample. These two disciplines take up the largest part of our doctoral independent directors.

To allow for heterogeneity in academic disciplines, we classify doctoral independent directors into two groups based on the area of study following prior literature: *Business* – independent directors with doctoral degrees in business-related areas such as business, law, and economics; and *Technology* – independent directors with technology-related degrees such as science, engineering and medicine.

Next, we convert our director-firm information into firm level to conduct our main analysis. Our dummy variables, *Business* and *Technology*, capture the presence of doctoral independent directors and equal one if a firm has at least one independent director with a doctoral degree in each category. To measure the relative size of doctoral independent directors on the board, we create continuous variables, *% Business* and *% Technology*, that equal the number of doctoral independent directors with degrees in each category divided by the total number of independent directors in the boardroom. We exclude a target firm only if all directors' educational information in the firm is entirely missing. Including target firms with incomplete educational information, however, may lead to underestimating the existence and fraction of doctoral independent directors. Thus, all the regressions in this study include a continuous variable, *Edu_missing*, which equals the number of independent directors with missing educational information divided by the total number of independent directors on the board, to control for the underestimation.

2.3. Measures of shareholder wealth and other controls

2.3.1. Announcement returns and takeover premiums

Effective board advising and monitoring may benefit target shareholders either by increasing bargaining power or by assisting managers in making decisions in favor of the shareholders. In this study, we use two proxies for measuring target shareholder gains. First, we measure target announcement effects by market-adjusted cumulative abnormal returns (CARs) around announcements. Using the daily CRSP value-weighted market index returns, we obtain market model estimates during the estimation window from 245 days to 41 days before announcements. We calculate the three-day CARs as the excess return over the market model-adjusted CRSP index returns from one day before to one day after announcement dates obtained from SDC. Second, as an alternative to CARs, we also investigate the takeover premiums paid to target firms using the one week premiums reported from SDC.

2.3.2. Target characteristics

Firm Size has been found to affect target performance. Prior literature shows that acquirers tend to pay lower premiums for large targets since the likelihood of a target being acquired decreases as its size increases. For example, Gorton, Kahl, and Rosen (2009) suggest that large targets tend to have weaker acquirer competition. We use the natural logarithm of total assets as a proxy for firm size. *Firm Profitability* is negatively correlated with target shareholder gains since less profitable targets are more likely to be acquired. We include return on assets (*ROA*) to control for the target firm profitability. In Israel (1991), the gains to acquiring firms decrease as the target debtholders' proportion of the gains increases, suggesting that higher financial leverage in the target can deter takeovers. We control for *Leverage* defined as a ratio of a firm's total liabilities to total assets. Servaes (1991) finds that *Tobin's Q* is negatively related to target returns. Consequently, we include the target's *Tobin's Q* measured as the ratio of the market value of total assets to the book value of total assets.

To account for target board characteristics related to advising and monitoring roles, we include governance factors that might significantly influence target shareholder gains. Yermack (1996) finds that board size is negatively associated with Tobin's Q, suggesting that smaller boards can monitor the firm more effectively. Thus, we include *Board Size* measured as the log of the total number of directors on the board. Cotter, Shivdasani, and Zenner (1997) find that independent directors can enhance target shareholder wealth by inducing managers to negotiate takeover premiums more effectively. The variable *Board Independence* represents the fraction of independent directors to total directors on the board. Last, two CEO characteristics, *CEO Duality*, which represents the practice of one person serving both as a firm's CEO and the chairman of its board at the same time, and *CEO Age*, which equals the log of age, are also included.

2.3.3. Deal characteristics

Our sample includes private acquirer. Bargeron, Schlingemann, Stulz, and Zutter (2008) show that target firms receive higher takeover premiums from public acquirers than from private acquirers. Consequently, we include a dummy variable *Private Acquirer* indicating that the acquirer is a private firm. Huang and Walkling (1987) and Comment and Schwert (1995) demonstrate that cash payment method is more beneficial for target shareholders than the method of stock payment. To account for this variation, we include a dummy variable, *Cash Only*. We also include *Deal Size* to control for the size of deal and a dummy variable, *Tender Offer*, following prior literature.

2.4. Summary statistics

[Insert Table 1 Here]

Panel A of Table 1 reports information on the doctoral independent directors in our sample. Our sample shows that a significant portion of target firms have at least one doctoral independent directors on the board. We also find that the proportion of target firms with at least one doctoral independent director is on average 67.7% in our sample. Allowing for difference in major, 47.9% of target firms have at least one *Business* independent directors and 32% of target firms have at least one *Technology* independent directors. *Others* independent directors serve only on 6.5% of boards. This indicate that independent directors with business and technology-related degrees have a dominant proportion of our doctoral independent directors. Panel A also shows that target firms, on average, have 20.8% of independent directors with doctoral degrees on the board. 11.5%, 8.3%, and 1.1% of independent directors on the board have business-related, technology-related, and other degrees, respectively.

Panel B in Table 1 summarizes target, board, and deal characteristics for our sample. The target characteristics are measured at the end of the fiscal year immediately prior the announcement. The mean (median) value of Tobin's Q is 1.859 (1.520) while the mean (median) of ROA is -0.038 (0.026). The mean value of target firm size (6.03), measured as the log of total assets, is smaller than other studies such as Bates, Becher, and Lemmon (2008) suggesting that our sample includes target firms smaller than S&P 1500 firms. With respect to board characteristics, we find that the average board size is 7.83, with a median of 8.00. The average board independence is 0.75. The proportion of targets' CEOs serving as the chairman of the board is observed in 46.1%. 22.5% of target firms are acquired by private firms. Finally, about 59.1% of acquirers pay all cash.

3. Empirical findings: Doctoral directors and shareholder gains

3.1. Univariate analysis

In this section, we make an initial assessment of our hypotheses by comparing the wealth effect of doctoral independent directors across subsamples. As discussed before, we use three-day CARs computed around the announcement and one week premiums as the main measure of shareholder gains around the announcement. Table 2 presents the results. Each panel provides the statistical significance of differences in means (medians) between target firms with and without doctoral independent directors by conducting t-tests (Wilcoxon Rank Sum tests).

In Panel A, we separate the deals in which independent directors have at least one doctoral independent directors (*With Business* and *With Technology*) from those without such directors (*Without Business* and *Without Technology*). For the entire sample, the average CARs for target firms with *Business* directors is 0.259%, whereas for those without such directors it is 0.368%. The difference in CARs between two groups, is also statistically significant at the 1% level. The median of announcement returns when *Business* directors exist are also smaller than when no *Business* directors are present, but the difference is not statistically significant. The mean (median) value is lower when *Business* directors exist, but the differences are insignificant. Overall, the findings indicate that *Business* directors destroy target shareholder wealth around the announcement.

We find that the existence of *Technology* directors on the board affects in the other direction. The mean and median values of CARs with *Technology* directors are 0.357% and 0.261%, respectively, compared with 0.259% and 0.212% of those without. The differences in mean and median values are significant at 1% level. The mean (median) of one week premiums for targets with *Technology* directors is 0.460% (0.342%), significantly higher than the corresponding value for those without. The results are consistent with *Technology* directors, on average, play better monitoring or advising roles.

Our second conjecture is that doctoral independent directors may provide better advising as advising needs increase and better monitoring as monitoring becomes more valuable. The findings in Panel A do not explain the reason why the two groups of doctoral independent directors differentially influence shareholder gains around the announcement. Following Coles, Daniel, and Naveen (2008) and Linck, Netter, and Yang (2008), we use firm complexity as a proxy for advising needs. We first compute a factor score (principal component analysis) based on the number of business segments, firm size, and leverage. We then define complex target firms as those with above the median factor score.

In Panel B, we further sort target firms based on firm complexity. The mean (median) of CARs and one week premiums for complex targets with *Business* directors is insignificantly different from those with no such directors. The complex targets with *Business* directors have the lower mean of CARs and the higher median of CARs and mean (median) of one week premiums than those without *Business* directors. Interestingly, for simple targets with low advising needs, firms with *Business* directors have the mean (median) of CARs is 0.288% (0.243%), significantly lower than the corresponding value of simple targets without *Business* directors, 0.385% (0.277%). The mean (median) of one week premiums for simple targets with *Business* directors is 0.350% (0.310%), compared with 0.472% (0.321%) for those with no such directors. The difference in the mean of premiums is statistically different from zero, while the difference in median value is insignificant. The results suggest that the value-destroying effect of *Business* directors is driven by the subsample of simple target firms.

The fact that the variation in the influence of *Business* directors on shareholder gains depends on firm complexity is consistent with our conjecture. Doctoral independent directors with business-related degrees can provide target firm with high quality advising and monitoring by accurately assessing financial statements and the value of target firms. Although the costs of monitoring may increase as complexity increase, the benefits from the high quality advising of *Business* directors may outweigh the costs as target firms become more complex. The findings in Panel B suggest that the advising and monitoring roles of *Business* directors are more valuable for target firms with high complexity, especially when the targets confront strategic financial decisions such as mergers and acquisitions.

Panel B also shows that the mean (median) CARs of complex target firms with *Technology* directors on their board is 0.251% (0.203%), compared with 0.233% (0.196%) for complex targets without such directors. The differences in CARs are not significant. The mean (median) value of one week premiums is 0.424% (0.326%), compared with 0.350% (0.278%) of those without. The differences in one week premiums are statistically different from zero. The results suggests that the monitoring and advising roles of *Technology* directors appear to be beneficial in targets with high complexity.

The mean (median) values of both CARs and one week premiums for simple targets are significantly greater when *Technology* directors are present on the board. For example, mean (median) of CARs simple targets with *Technology* directors is 0.438% (0.310%), significantly greater than those without such directors at 1% level. In addition, the differences in CARs and one week premiums for simple targets are greater and more significant than those for complex targets. The findings suggests that the positive wealth effect of *Technology* directors are mainly driven by simple target firms with low advising needs.

These results provide two implications. First, *Technology* directors with specialized and non-business-related knowledge may not provide complex targets with valuable monitoring and advising, but their roles become more important as targets become simpler. Second, *Technology* directors without business-related knowledge may become more monitoring-oriented when confronting strategic financial decisions. Thus, their monitoring roles are less valuable for complex targets in which the costs of monitoring is higher. However, their monitoring is more important in simple targets with the lower costs of monitoring.

Findings in Panel A and B imply that doctoral independent directors are more likely to be advising-oriented when their expertise is relevant to the firm's needs, while they tend to be more monitoring-oriented when their expertise deviates from the firm's needs. This is consistent with Jung, Podolski, Rhee, and Yoo's (2015) findings that academic directors with science backgrounds play a strong advisory role in corporate innovation, but those with business background have no impact on corporate innovation.

To further confirm that *Business* directors and *Technology* directors are more likely to be advising-oriented and monitoring-oriented in mergers and acquisitions, respectively, we sort our targets based on monitoring needs. Faleye, Hoitash, and Hoitash (2011) find that firms have higher monitoring quality and lower advising quality as the proportion of independent directors serving on at least two of three monitoring committees (audit, compensation, and nominating) increases. We define the monitoring-intensive targets as those in which the proportion of monitoring-intensive directors is above the median value. We argue that targets without the monitoring-intensive boards may have greater monitoring needs. In contrast, board monitoring may be less valuable for targets who already have monitoring-intensive boards.

In panel C, we find that targets without the intensive-monitoring board have lower CARs and premiums when they have *Business* directors than when they have no such directors, but only the difference in the mean of CARs is significantly different from zero. The mean of CARs for targets with monitoring-intensive boards and *Business* directors is 0.250%, compared with

0.319% of those with monitoring-intensive boards and without *Business* directors, suggesting that *Business* directors, whose roles in mergers and acquisitions are oriented towards advising, may not provide targets with high monitoring needs with valuable monitoring. The presence of *Business* directors is also not value-enhancing for targets with low monitoring needs, but the differences in CARs and premiums are not statistically different from zero.

Interestingly, the mean (median) of CARs and premiums for targets without the monitoring-intensive board is significantly greater when the targets have at least one *Technology* directors on their board. The differences in CARs and premiums are statistically significant. Although targets with *Technology* directors have greater mean (median) value of CARs and premiums even when they have low monitoring needs, the difference are insignificant with the exception of the mean of CARs. In addition, the differences are generally greater for targets with high monitoring needs. For example, the mean (median) differences in CARs is 0.109% (0.065%) for targets with high monitoring needs, compared with 0.093% (0.011%) of those with low monitoring needs. The results suggest that the monitoring role of *Technology* directors become more important as monitoring-intensity on the board decrease (monitoring needs increase).

The results in Table 2 suggest that *Business* and *Technology* directors have heterogeneous influences on shareholder gains around the announcement, and their expertise is connected with board advising and monitoring roles depending on the firm's needs. Overall, *Business* directors destroy shareholder wealth, while *Technology* directors benefit target shareholders in mergers and acquisitions, one of the most strategic corporate decisions. However, *Business* directors create value for targets with high complexity, probably by better assessing their firms and provide management with better advising. *Technology* directors do not provide management with better advising for targets with high advising needs, but their positive influence exists when target firms have high monitoring needs.

3.2. Multivariate tests

The wealth effect of doctoral independent directors may be influenced by certain firm characteristics such as advising and monitoring needs, as measured by firm complexity and board monitoring intensity, respectively. Hence, in our multivariate regression models, we control for such characteristics that may influence the role of doctoral independent directors. In addition, we examine additional tests to confirm that *Business* and *Technology* independent directors in target firms have different orientations towards board roles in mergers and acquisitions.

3.2.1. Baseline regressions: Do doctoral independent directors enhance target shareholder gains?

We begin our multivariate analysis with the following OLS regression model to determine target shareholder gains around the announcement as a function of the presence of *Business* and *Technology* independent directors, target firm characteristics, target board structure, and deal characteristics:

$$\text{Target Shareholer Wealth} = \beta_0 + \beta_1\text{Business (or Technoloy)} + \beta_2\text{Firm Size} + \beta_3\text{ROA} + \beta_4\text{Leverage} + \beta_5\text{Tobin's Q} + \beta_6\text{Board Size} + \beta_7\text{Board Independence} + \beta_8\text{CEO Duality} + \beta_9\text{CEO Age} + \beta_{10}\text{Private Acquirer} + \beta_{11}\text{Deal Value} + \beta_{12}\text{Tender Offer} + \beta_{13}\text{Cash Only} + \beta_{14}\text{Edu}_{\text{missing}} + \text{Year Dummies} + \varepsilon.$$

Control variables for target firm and governance characteristics are measured in the fiscal year immediately prior to the announcement. We include year dummies to capture unknown year fixed effects. For the statistical significance, we use standard errors clustered by 2-digit SIC industry to correct for correlation of residuals within industries following Petersen (2009) and report t-statistics based on the robust standard errors in the parentheses.

Model 1 and 2 of Table 3 examines the influence of the presence of *Business* and *Technology* independent directors on three-day CARs, while Model 4 and 5 use one week premiums as a dependent variable. We model the effect of each doctoral independent directors with indicator variables equal to one if targets have at least one of each doctoral independent directors and zero otherwise. Model 1 and 2 shows that on average, the presence of *Business* directors is associated with significantly lower CARs, while *Technology* directors are related to significantly higher CARs. The negative and significant coefficient on *Business* (t=-2.086) suggests that CARs are 3.9% lower for targets with *Business* directors on the board. In contrast, the significantly positive coefficient on *Technology* directors (t=2.765) implies that the presence of *Technology* directors on the board enhance CARs by 7.1%. The results are consistent with Table 2. Model 4 and 5 show that the coefficients associated with the presence of doctoral independent directors are insignificantly different from zero. However, overall effect of *Business* and *Technology* directors on premiums is substantial, as is the effect on CARs.

To determine whether the influences of *Business* and *Technology* directors on target shareholder gains are significantly different, we conduct F-tests in model 3 and 6. Since many target firms have both *Business* and *Technology* directors, our dummy variables are not mutually exclusive. Hence, instead of including two dummies, we include two continuous variables, *%Business* and *%Technology*, measured as the number of *Business* and *Technology* directors divided by the total number of independent directors on the board. The coefficient on *%Business* is not significantly different from zero, but the coefficient on *%Technology* is significantly positive at 1% level. The economic magnitude of the coefficient on *%Technology* is about 0.246, indicating that a unit increase in the proportion of *Technology* directors is associated with an increase of CARs by 24.6%. The F-test suggests that the coefficient on *%Business* is significantly different from the coefficient on *%Technology* (p=0.002), suggesting that the two groups of doctoral directors have significantly different influences on target shareholder wealth. Consistent with the results in model 4 and 5, the coefficients on *%Business* and *%Technology* in model 6 are statistically insignificant. The F-test shows that the differences between the two groups are not statistically different from zero. Overall, we find evidence consistent with our univariate tests in Panel A of Table 2. Our results on control variables are consistent with prior literature.

3.2.1. Do doctoral independent directors enhance target shareholder gains as advising needs increase?

[Insert Table 4 Here]

To provide evidence concerning whether the influences of doctoral directors vary with targets' advising needs, we include *High Complexity* (HC), an indicator variable that equals one if firm complexity is above the median score, and its interaction terms with the presence and the relative size of doctoral directors on the board. We exclude *Firm Size* and *Leverage* from all specifications since we compute firm complexity based on these variables. Table 4 reports the results. χ_1, χ_3, χ_5, and χ_7 capture the effect of doctoral independent directors on shareholder gains for simple targets. χ_2, χ_4, χ_6, and χ_8 are the incremental effect of doctoral independent directors on shareholder gains for complex targets, while $\chi_1+\chi_2$, $\chi_3+\chi_4$, $\chi_5+\chi_6$, and $\chi_7+\chi_8$ capture the total effect of doctoral independent directors on shareholder wealth for complex targets.

In model 1 and 4, we find that the coefficient on χ_1 is significantly negative (χ_1=-0.090; t=-2.509 in model 1 and χ_1=-0.100; t=-2.846 in model 4), implying that simple targets with

Business directors have lower CARs and premiums than those without such directors. The coefficient on χ_2 is significantly positive (χ_1=0.096; *t*=2.341 in model 1 and χ_1=0.137; *t*=4.647 in model 4), suggesting that the influence of *Business* directors on both CARs and premiums becomes more positive as firm complexity increase. The F-test suggests that the effect of *Business* directors on shareholder wealth for complex firm ($\chi_1+\chi_2$) is insignificant (*p*=0.703 in model 1 and *p*=0.208 in model 4). These results are consistent with our conjecture that targets with high advising needs benefit from having *Business* directors.

Model 2 shows that the coefficient on χ_3 is significantly positive at 1% level (χ_2=0.108; *t*=3.052), implying that the presence of *Technology* directors on the board increases CARs by 10.8% for simple target firms. The coefficient on χ_4 (-0.094; *t*=-2.131) suggests that the role of *Technology* directors becomes more detrimental to shareholder gains as firm complexity increases. In model 5, the coefficients on χ_3 and χ_4 imply that the influence of *Technology* directors on premiums for simple targets is insignificant (*t*=0.458) and the incremental effect of *Technology* directors for complex firms is also not statistically different from zero (*t*=0.168). The F-tests implies that the presence of *Technology* directors does not have significant influence on both CARs and premiums for complex targets. The results demonstrate that the advisory role of *Technology* directors is not beneficial to complex targets.

Model 3 and 6 of Table 4 include the relative size of *Business* and *Technology* directors as in Table 3 to compare the influences of the two groups. We find that a unit increase in the proportion of *Business* directors decreases CARs by 22.4% (*t*=-1.861 in model 3) and premiums by 31.3% (*t*=-2.197) for simple target firms. Although the higher proportion of *Business* directors have more beneficial effects as complexity increase, F-tests suggest that the relative size of *Business* directors is insignificantly associated with CARs and premiums for complex targets. The increase in the relative size of *Technology* directors is positively related to CARs for simple targets (χ_7=0.306; t=3.471), but it destroy shareholder wealth as targets become more complex. Consistent with the results in model 5, the coefficients on χ_7, χ_8, and $\chi_7+\chi_8$ in model 6 are all insignificant.

Additional F-tests suggest that the coefficients on χ_5 and χ_7 are significantly different (p<0.001), suggesting that *Business* and *Technology* directors affect CARs in the other directions for simple target firms. The difference for complex target firms, however, in not statistically significant. These results implies that the significant difference between *Business* and *Technology* directors in Table 3 is driven by simple targets.

Overall, the results in Table 4 provide evidence that the expertise of *Business* directors creates value for target shareholders, especially when general advisory needs are high, while *Technology* directors with specialized and non-business-related knowledge do not provide valuable advising in mergers and acquisitions, especially for target firms with high advising needs.

3.2.2. Do doctoral independent directors enhance target shareholder gains as monitoring needs increase?

[Insert Table 5 Here]

In this paper, we argue that the roles of doctoral independent directors vary according to whether their expertise is associated with target firms' needs. Hence, in this section, we test whether *Technology* directors, who do not have expertise in business decision making and do not provide valuable advising for targets with high advising requirements, concentrate on monitoring roles instead of advising roles. To test this, we include *High Monitoring Intensity*

(HM), a dummy variable that takes one if the proportion of monitoring-intensive independent directors to the total number of independent directors, is above the median. As discussed earlier, we argue that targets without monitoring-intensive boards have greater needs for board monitoring.

The results are presented in Table 5. In model 1 and 4, the coefficients on λ_1 are significantly negative, implying that, in targets with high monitoring requirements, having *Business* directors destroy shareholder wealth. The coefficients on the interaction of *Business* directors and HM (λ_2) are insignificant. The overall effects of *Business* directors on CARs and premiums ($\lambda_1+\lambda_2$) are insignificant. We interpret these results as consistent with directors with business expertise focus on advising roles in mergers and acquisitions, but their monitoring roles do not create value for targets, especially when the targets have high monitoring needs. In contrast, Model 2 and 5 report that the existence of *Technology* directors on the board (λ_3) significantly increase CARs (t=3.332) and premiums (t=1.826) for targets with high monitoring needs. In Model 2, the incremental effect of the presence of *Technology* directors (λ_3) on CARs is insignificant. In Model 5, however, the coefficient on the presence of *Technology* directors is significantly negative at 10% level (t=-1.904), indicating that one week premiums are more negatively associated with the presence of *Technology* directors in targets with low monitoring needs compared with those with high monitoring needs. The sum of the coefficients on *Technology* directors and the interaction term is insignificant (p=0.960).

In Model 3 and 6, we replace the presence of doctoral independent directors with the relative size of doctoral independent directors on the board. The coefficient on the fraction of *Business* directors is significantly negative (λ_5=-0.165; t=-1.791 in Model 3 and λ_5=-0.221; t=-1.834 in Model 6), suggesting that the announcement period CARs and one week premiums to shareholders in targets with high monitoring needs are lower when the relative size of *Business* directors on the board is greater. The coefficients on the interaction (λ_6) terms are positive but statistically insignificant. Shareholders in targets with high monitoring requirements earn higher CARs around the announcement when they have the higher proportion of *Technology* directors on the board (λ_7=0.189; t=1.858 in Model 3), but premiums are independent of the relative size of *Technology* directors (λ_7=0.033; t=0.164 in Model 6). The interaction terms (λ_8) again suggest that the incremental effect of the relative size of *Technology* directors on target abnormal returns and premiums are not significantly different from zero. Finally, F-tests suggest that the effect of *Business* directors on the announcement period CARs is significantly different from that of *Technology* directors for only targets with high monitoring needs.

Overall, Table 5 demonstrates our conjecture that *Technology* directors with expertise in non-business fields are more likely to focus on monitoring roles. Their roles are beneficial especially for targets with high monitoring requirements. In contrast, *Business* directors with expertise in business field are more likely to concentrate on advisory roles and their presence on the board does not create value for targets with high monitoring needs. Hence, the difference in the wealth effects of two groups is more pronounced when target firms have higher needs for monitoring.

3.2.2. Firm-specific knowledge and value creation of doctoral independent directors

[Insert Table 6 Here]

Table 4 implies that the quality of *Technology* directors' advising declines as target firms become more complex, suggesting that their specific knowledge does not help solve complex and strategic business issues. However, we argue that *Technology* directors may provide managers with better advising in the environment where firm-specific knowledge is more important. We use R&D intensity, measured as R&D expenditure divided by total assets, as a proxy for needs for firm-specific knowledge following Coles, Daniel, and Naveen (2008). We include *High R&D Intensity* (HR), an indicator variable that equals one if a target firm has R&D intensity ratio greater than the median in a given year. Following prior literature, we assume that targets with missing R&D expenditure from Compustat have zero R&D expenditure and include R&D_missing, a dummy variable that takes one if missing value of R&D expenditure is replaced with zero, to control for possible underestimation.

Table 6 reports the results. The influences of *Business* (γ_1, γ_5) and *Technology* (γ_3, γ_7) directors for targets with low R&D intensity are not statistically significant in all specifications. In addition, the interaction terms in all specifications suggest that the incremental effects of doctoral independent directors for targets with higher needs of firm-specific knowledge are not significant.

Model 1 shows that the coefficient on $\gamma_1+\gamma_2$ is negative and statistically significant (-0.062; p=0.064), implying that targets with high R&D intensity earn 6.2% lower CARs when they have *Business* directors on the board. On the contrary, Model 2 suggests that R&D-intensive targets realize 9.2% higher CARs when they have *Technology* directors ($\gamma_3+\gamma_4$=0.092; p<0.001). In Model 3, the coefficient on $\gamma_7+\gamma_8$ is positive and significant ($\gamma_7+\gamma_8$=0.257; p=0.001), indicating that a unit increase in the relative size of *Technology* directors on the board increase CARs by 25.7% for R&D-intensive targets. Finally, Model 3 and 6 show that the influences of *Business* and *Technology* directors on shareholder gains are insignificant for targets with low R&D intensity, but *Technology* directors are associated with significantly higher CARs and premiums for R&D-intensive targets.

Overall, the results in Table 6 indicate that the quality of *Technology* directors' advising increases as target firms' needs for specific knowledge increases. These results further confirm our hypothesis that the influence of doctoral directors' expertise depends on firms' needs.

3.3. Robustness checks

3.3.1. Social network and the expertise of doctoral directors

[Insert Table 7 Here]

From Table 3 to 6, we find that the role of doctoral independent directors in mergers and acquisitions interrelates with their expertise and that a firm's operating environment is an important determinant of the quality of their roles. To provide additional evidence concerning the determinant of the quality of roles, we employ an individual characteristic of doctoral directors, CEO-independent social network, instead of the operating environment.

Social ties can be an important determinant of the independence of outside directors (Hwang and Kim, 2009). On the contrary, social connections can enhance mutual understanding and reduce information asymmetry between CEO and independent directors, thereby improving the advisory roles of boards (Westphal 1999; Adams and Ferreira 2007). We expect that *Business* directors with expertise in business-related field may provide better advising if they have social ties with CEOs. In contrast, we expect that social ties with CEO may lower the quality of Technology directors' role by weakening their monitoring functions. Following Fracassi and Tate (2012), we use employment ties between CEO and doctoral independent directors as a proxy for social ties.

We hand-collect the employment history of CEOs and doctoral independent directors from various sources. Our primary source is DEF 14A proxy statements and 10-K annual reports. If we are unable to find the information on educational background and employment from the primary sources, we rely on search engines such as *Zoominfo.com, Businessweek.com*, and *Forbes.com*. We classify doctoral independent directors as "socially connected to CEO" if they have worked for other companies as managers or directors at the same time. We first compute the proportion of *Business* and *Technology* directors connected to CEO and create two continuous variables, *%Tied_Business* and *%Tied_Technology*. Next, we measure the relative size of *Business* and *Technology* directors who are not connected to CEO and include the two variables, *%Non-tied_Business* and *%Non-tied_Technology*, for comparison. We include *Employ_missing* in all specifications to account for the proportion of independent directors with missing information on employment.

Table 7 provides the results. The results in Table 2 and Table 3 suggest that *Business* directors, in general, destroy shareholder gains, while *Technology* directors enhance shareholder wealth around the announcement. Model 1 of Table 7, however, shows that a unit increase of the relative size of *Business* directors connected to CEO increase CARs by 51.8% (t=1.806), while a unit increase of the relative size of non-connected *Business* directors is associated with 16.1% decrease in CARs (t=-1.991), suggesting that CEO-*Business* director social ties improve the quality of *Business* directors' advising. F-test suggest that the influence of tied *Business* directors is significantly different from that of non-tied *Business* directors (p=0.031). In Model 2, *Technology* directors significantly enhance shareholder wealth only when they are not socially connected to CEO (η_4=0.259; t=4.168), indicating that CEO-*Technology* directors social ties weakens *Technology* directors' monitoring functions. F-test shows that there is no significant difference between the influence of tied and non-tied *Technology* directors (p=0.976). The results in Model 3 are consistent with those in Model 1 and 2. The difference in the influence between tied *Business* directors and tied *Technology* directors is statistically insignificant (p=0.549), while the influence of non-tied *Business* directors is significantly different from that of non-tied *Technology* directors (*p*=0.001).

Overall, results presented in Table 7 indicate that *Business* directors socially connected to CEO create value for target shareholder by improving the quality of advisory roles, while *Technology* directors' monitoring role may be weakened by social ties. These results further support our conjecture that *Business* directors with expertise in business field are more likely to focus on advising role, whereas *Technology* directors with specific-knowledge are more likely to concentrate on monitoring role.

3.3.2. Instrumental variable approach

In this study, we include control variables and fixed effects to control for omitted variable bias. However, the potential problem of endogeneity is still present. We use an instrumental variable (IV) approach to address this issue. We argue that the supply ratio of doctoral students by major fields provides a unique instrument in determining the likelihood of doctoral directors serving on the board. Specifically, our conjecture is that a major field of study that produces more doctoral degree holders are likely to supply more doctoral graduates to the industry. In addition, the supply ratio is less likely associated with shareholder gains.

We assume that the relative size of producing doctoral degree holders by academic field remains stable and use the ratio on 2014 as a proxy for historical supply ratio. We first obtain the data on the number of doctor's degrees conferred by U.S. institutions in 2014 from U.S. Department of Education website. We then measure the *Supply Ratio* of each academic field by dividing the number of doctoral graduates in each field by the total number of doctoral graduates. In defining IV, we exclude a firm if it has a doctoral independent directors with a degree from a non-U.S. institution because the data from U.S. Department of Education covers only U.S institutions.

[Insert Table 8 Here]

The results are reported in Table 8. In the first stage, we regress the relative size of doctoral independent directors, *%Business* and *%Technology*, on the supply ratio, and the same control variables as those in Table 3. Model 1 and Model 4 reports the results of the first stage regressions where we use *%Business* and *%Technology* as dependent variables, respectively. We find that the supply ratio, our IV variable, is positively and significantly associated with the relative size of *Business* and *Technology* independent directors on the board, implying that doctoral degree holders graduated from the field of high supply ratio are more likely to serve on the board. The first stage F-statistics is 643.61 (in Model 1) and 56.15 (in Model 4), respectively, confirming the supply ratio as a valid instrument for *%Business* and *%Technology*.[2] Model 2 and Model 3 show results from the second stage regressions with three-day CARs and one week premiums as dependent variable, respectively. We find that the coefficients on fitted *%Business* are negative and significant at the 5% level in both specifications. Model 5 shows that the coefficient on fitted *%Technology* is positively and significantly related to CARs, but in Model 6, we find that fitted *%Technology* is insignificantly associated with premiums.

Overall, the results are consistent with those from Table 3, indicating that the relation between doctoral independent directors and shareholder gains are not driven by the potential endogeneity problem.

4. Summary and Conclusion

This paper examines how doctoral independent directors affect target shareholder wealth. We

[2] Cragg and Donald (1993) test also confirms that our instrument is relevant.

classify doctoral independent directors into two groups – *Business* directors with degrees in business, law, and economics and *Technology* directors with degrees in science, engineering, and medicine and find robust results indicating that *Business* directors are associated with higher announcement returns, while *Technology* directors are related to lower returns.

To identify how the role of each group of doctoral directors differs depending on their expertise during mergers and acquisitions, we conduct several tests with proxies for advisory and monitoring needs. We find that higher announcement returns and premiums are observed as advisory needs increase, whereas *Technology* directors seem to have a negative impact on announcement returns when the need for monitoring is higher. In addition, we observe that *Technology* directors enhance announcement returns when specific knowledge is more important. Finally, we find that the existence of social ties with CEO significantly improves the quality of *Business* directors' advising, but it significantly deteriorates the quality of *Technology* directors' monitoring. These results are consistent with our conjecture that the quality of doctoral directors' advising and monitoring depends on whether their expertise is relevant to the firm's need.

Overall, our findings highlight the importance of doctoral independent directors' role in mergers and acquisitions. The dual role of doctoral independent directors can mitigate agency conflicts between managers and targets shareholders by increasing shareholder wealth during the announcement depending on the situation.

References

Adams, R.B., Ferreira, D., 2007. A theory of friendly boards. Journal of Finance 62, 217–250.

Anderson, R.C., Reeb, D.M., Upadhyay, A., Zhao, W., 2011. The economics of director heterogeneity. Financial Management 40, 5-38.

Bargeron, L.L., Schlingemann, F.P., Stulz, R.M., Zutter, C.J., 2008. Why do private acquirers pay so little compared to public acquirers? Journal of Financial Economics 89, 375–390.

Bates, T.W., Becher, D.A., Lemmon, M.L., 2008. Board classification and managerial entrenchment: Evidence from the market for corporate control. Journal of Financial Economics 87, 656–677.

Cho, C.H., Jung, J.H., Kwak, B., Lee, J., Yoo, C-Y., 2015. Professors on the board: do they contribute to society outside the classroom? Journal of Business Ethics (Forthcoming)

Coles, J., Daniel, N., Naveen, L., 2008. Boards: does one size fit all? Journal of Financial Economics 87, 329–356.

Comment, R., Schwert, G.W., 1995. Poison or placebo? Evidence on the deterrence and wealth effects of modern antitakeover measures. Journal of Financial Economics 39, 3-43.

Cotter, J.F., Shivdasani, A., Zenner, M., 1997. Do independent director enhance target shareholder wealth during tender offers? Journal of Financial Economics 43, 195-218.

Cragg, J.G., Donald, S.G., 1993. Testing Identifiability and Specification in Instrumental Variable Models. Econometric Theory 9, 222-240.

Dalziel, T., Gentry, R.J., Bowerman, M., 2011. An integrated agency–resource dependence view of the influence of directors' human and relational capital on firms' R&D spending. Journal of Management Studies 48, 1467-6486.

Faleye, O., Hoitash, R., Hoitash, U., The costs of intense board monitoring. Journal of Financial Economics 101, 160–181.

Fracassi, C., Tate, G., 2012. External networking and internal firm governance, Journal of Finance 67, 153–194.

Francis, B., Hasan, I., Wu, Q., 2015. Professors in the boardroom and their impact on corporate governance and firm performance. Financial Management 44, 547 – 581.

Goktan, M.S., Kieschnick, R., 2012. A target's perspective on the effects of ATPs in takeovers after recognizing its choice in the process. Journal of Corporate Finance 18, 1088–1103.

Gorton, G., Kahl, M., Rosen, R.J., 2009. Eat or be eaten: A theory of mergers and firm size. Journal of Finance 64, 1291–1344.

Huang, Y-S., Walkling, R.A., Target abnormal returns associated with acquisition announcements: Payment, acquisition form, and managerial resistance. Journal of Financial Economics 19, 329-349.

Hwang, B-H., Kim, S., 2009. It pays to have friends. Journal of Financial Economics 93, 138–158.

Israel, R., 1991. Capital structure and the market for corporate control: The defensive role of debt financing. Journal of Finance 46, 1391–1409.

Linck, J.S., Netter, J.M., Yang, T., 2008. The determinants of board structure. Journal of Financial Economics 87, 308–328.

Jung, B., Podolski, E.J., Rhee, S.G., Yoo, C-Y., 2015. Do professors on the board facilitate corporate innovation? working paper.

Mahadeo, J.D., Soobaroyen, T., Hanuman, V.O., 2012. Board composition and financial performance: uncovering the effects of diversity in an emerging economy. Journal of Business Ethics 105, 375–388.

Maulis, R.W., Wang, C., Xie, F., 2007. Corporate governance and acquirer returns. Journal of Finance 62, 1851–1889.

Petersen, M.A., 2009. Estimating standard errors in finance panel data sets: comparing approaches. Review of Financial Studies 22, 435-480.

Servaes. H., 1991. Tobin's Q and the gains from takeovers. Journal of Finance 46, 409–419.

Westphal, J.D., 1999. Collaboration in the boardroom: behavioral and performance consequences of CEO-Board social ties. Academy of Management Journal 42, 7-24.

White, J.T., Woidtke, T., Black, H.A., Schweitzer, R.L., Appointments of academic directors. Journal of Corporate Finance 28, 135–151.

Yermack, D., 1996. Higher market valuation of companies with a small board of directors. Journal of Financial Economics 40, 185-211.

Table 1. Summary Statistics

The table summarizes the statistics for the variables used in this study. The sample consists of 772 U.S. mergers and acquisitions completed between 2005 and 2014. We report the mean, median, standard deviation, and 25th and 75th percentiles for each variable. Panel A shows summary statistics for doctoral independent directors on the board of target firms. To allow for heterogeneity in academic area, we classify doctoral independent directors into three categories: business – those who have degrees in business, law, and economics; technology - those who have degrees in science, engineering, and medicine; and others. *Dr.*, *Business*, *Technology,* and *Others* are dummy variables indicating the existence of each group on the board. *% Dr.*, *% Business*, *% Technology,* and *% Others* are continuous variables measured by dividing the number of independent directors with each major category by the total number of independent directors on the board. Panel B describes the characteristics of target firms and transactions. *Firm Size* is the natural logarithm of total assets. *ROA* represents income before extraordinary items divided by total assets. Leverage is the sum of long term debt and debt in current liabilities over total assets. *Tobin's Q* is measured as the market value of assets divided by the book value of assets. *Board Size* represents the number of total directors on the board. *Board Independence* is the proportion of independent board members on the board. *CEO Duality* indicates CEOs serving as the chairperson of board at the same time. *Private Acquirer* is a dummy variable indicating if a target is acquired by a private firm. All variables are measured as of the end of the fiscal year immediately prior to the announcement. A detailed description of each variable is included in Appendix.

Variable	Obs.	Mean	Median	SD	25th Percentile	75th Percentile
Panel A. Summary of Doctoral Independent Directors						
Dr.	772	0.677	1.000	0.468	0.000	1.000
Business	772	0.479	0.000	0.500	0.000	1.000
Technology	772	0.320	0.000	0.467	0.000	1.000
Others	772	0.065	0.000	0.246	0.000	0.000
% Dr.	772	0.208	0.200	0.192	0.000	0.333
% Business	772	0.115	0.000	0.142	0.000	0.200
% Technology	772	0.083	0.000	0.145	0.000	0.143
% Others	772	0.011	0.000	0.045	0.000	0.000
Panel B. Summary of Firm and Deal Characteristics						
Firm Characteristics						
Firm Size (ln)	772	6.043	5.953	1.723	4.751	7.247
ROA	772	-0.038	0.026	0.263	-0.039	0.067
Leverage	772	0.203	0.122	0.253	0.000	0.323
Tobin's Q	772	1.859	1.520	1.170	1.143	2.190
Governance Characteristics						
Board Size	772	7.830	8.000	1.958	7.000	9.000
Board Independence	772	0.750	0.778	0.126	0.667	0.857
CEO Duality	772	0.461	0.000	0.499	0.000	1.000
CEO Age (years)	772	54.554	54.000	8.074	49.000	60.000
Deal Characteristics						
Private Acquirer	772	0.225	0.000	0.418	0.000	0.000
Deal Value (ln)	772	6.406	6.389	1.756	5.233	7.665
Tender Offer	772	0.199	0.000	0.400	0.000	0.000
Cash Only	772	0.591	1.000	0.492	0.000	1.000

Table 2. Univariate Tests

The table reports the mean and median of target cumulative abnormal returns (CARs) and one week premiums for different subsamples. In Panel A, we separate the target firms in which at least one independent director has a doctoral degree in each category from those in which no such independent directors are present. We use a factor score computed based on the number of business segments, firm size, and leverage as a proxy for advising needs following Coles, Daniel, and Naveen (2008) and Linck, Netter, and Yang (2008). Complex targets are those with above the median factor score. Panel B examines targets with different advising needs. We measure the proportion of independent directors serving on at least two of three monitoring committees (audit, compensation, and nominating) as a proxy for monitoring needs (monitoring quality) following Faleye, Hoitash, and Hoitash (2011). Targets with above median of the proportion of monitoring-intensive directors are defined as those with low monitoring needs. In panel C, we investigate the role of doctoral independent directors in subsamples with different monitoring needs. Two sample t-tests (Wilcoxon Rank Sum tests) are conducted to test whether means (medians) of targets with doctoral independent directors are significantly different from those without such directors. ***, **, and * denote significance at the 10%, 5%, and 1% levels, respectively.

Variables	CAR (-1, +1)		One Week Premiums	
	Mean	Median	Mean	Median
Panel A. Do doctoral independent directors enhance target shareholder gains?				
With Business	0.259	0.223	0.321	0.229
Without Business	0.368	0.304	0.421	0.308
test of difference	2.58***	1.52	1.62	0.58
With Technology	0.357	0.261	0.460	0.342
Without Technology	0.259	0.212	0.364	0.286
test of difference	-3.84***	-2.92***	-2.76***	-3.59***
Panel B. Do doctoral independent directors enhance target shareholder gains as advising needs increase?				
Complex Targets (high advising needs)				
With Business	0.236	0.203	0.381	0.298
Without Business	0.241	0.187	0.358	0.287
test of difference	0.20	-0.14	-0.59	-0.50
With Technology	0.251	0.203	0.424	0.326
Without Technology	0.233	0.196	0.350	0.278
test of difference	-0.63	-0.22	-1.74*	-2.17**
Simple Targets (low advising needs)				
With Business	0.288	0.243	0.350	0.310
Without Business	0.385	0.277	0.472	0.321
test of difference	2.39**	1.67*	2.30**	1.17
With Technology	0.438	0.310	0.489	0.371
Without Technology	0.289	0.236	0.382	0.300
test of difference	-3.60***	-3.20***	-1.96**	-2.73***
Panel C. Do doctoral independent directors enhance target shareholder gains as monitoring needs increase?				
Targets without monitoring-intensive boards (high monitoring needs)				
With Business	0.250	0.213	0.370	0.300
Without Business	0.319	0.233	0.416	0.319

test of difference	2.25**	1.57	1.09	0.86
With Technology	0.349	0.263	0.467	0.356
Without Technology	0.240	0.198	0.344	0.278
test of difference	-3.51***	-2.92***	-2.84***	-3.75***
Targets with monitoring-intensive boards (low monitoring needs)				
With Business	0.271	0.238	0.365	0.306
Without Business	0.322	0.225	0.425	0.303
test of difference	1.31	0.42	1.16	0.16
With Technology	0.370	0.243	0.450	0.321
Without Technology	0.277	0.232	0.384	0.298
test of difference	-2.16**	-1.24	-1.15	-1.11

Table 3. Baseline Regressions: Doctoral Directors and the Wealth of Target Shareholders

The table contains the results of OLS regressions of target shareholder wealth on the presence and the relative size of doctoral independent directors and other control variables. The dependent variables are three-day cumulative abnormal returns and one week premiums. *Business* and *Technology* are dummy variables which equal one if a firm has at least one independent directors with a doctoral degrees in each field. *% Business* and *% Technology* are continuous variables measured by dividing the number of independent directors with each major category by the total number of independent directors on the board. All specifications control for year fixed effects. *t*-statistics based on standard errors clustered by 2-digit SIC code are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

		CAR (-1, +1)			One Week Premiums		
VARIABLES		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Business		-0.039**			-0.032		
		(-2.086)			(-1.369)		
Technology			0.071***			0.049	
			(2.765)			(1.325)	
%Business	β_1			-0.091			-0.141
				(-1.246)			(-1.460)
%Technology	β_2			0.246***			-0.008
				(3.459)			(-0.048)
Firm Size		-0.040	-0.040	-0.034	-0.117**	-0.117**	-0.116**
		(-1.376)	(-1.367)	(-1.128)	(-2.634)	(-2.673)	(-2.633)
ROA		-0.194***	-0.177***	-0.167***	-0.733***	-0.722***	-0.736***
		(-5.087)	(-4.644)	(-4.074)	(-5.091)	(-4.670)	(-4.523)
Leverage		0.119**	0.130**	0.127**	0.404**	0.412**	0.404**
		(2.218)	(2.189)	(2.210)	(2.642)	(2.571)	(2.576)
Tobin's Q		-0.019	-0.020	-0.019	-0.047**	-0.048**	-0.048**
		(-1.271)	(-1.273)	(-1.222)	(-2.034)	(-2.055)	(-2.049)
Board Size		0.013	-0.016	-0.008	-0.000	-0.022	-0.010
		(0.271)	(-0.351)	(-0.168)	(-0.002)	(-0.291)	(-0.132)
Board Independence		0.159**	0.102	0.117	0.072	0.028	0.060
		(2.027)	(1.330)	(1.466)	(0.626)	(0.251)	(0.562)
CEO Duality		-0.036	-0.034	-0.029	-0.012	-0.011	-0.012
		(-1.382)	(-1.323)	(-1.215)	(-0.411)	(-0.383)	(-0.417)
CEO Age		-0.020	-0.051	-0.057	-0.034	-0.055	-0.036
		(-0.268)	(-0.681)	(-0.773)	(-0.307)	(-0.499)	(-0.329)
Private Acquirer		-0.062**	-0.063**	-0.057*	-0.046*	-0.048*	-0.045
		(-2.042)	(-2.038)	(-1.835)	(-1.807)	(-1.722)	(-1.673)
Deal Value		0.015	0.014	0.009	0.099**	0.099**	0.099**
		(0.547)	(0.504)	(0.346)	(2.177)	(2.182)	(2.094)
Tender Offer		0.054	0.049	0.044	0.036	0.032	0.035
		(1.322)	(1.281)	(1.162)	(0.768)	(0.722)	(0.771)
Cash Only		0.112***	0.109***	0.111***	0.077*	0.075*	0.077*
		(4.159)	(4.173)	(4.192)	(1.874)	(1.810)	(1.838)
Edu_missing		-0.023	0.021	0.021	0.015	0.048	0.005
		(-0.406)	(0.330)	(0.324)	(0.115)	(0.388)	(0.049)
Constant		0.352	0.538*	0.535*	0.511	0.642	0.547
		(1.063)	(1.693)	(1.683)	(1.036)	(1.361)	(1.162)
F-test				$\beta_1=\beta_2$***			$\beta_1=\beta_2$
				(*p*=0.002)			(*p*=0.262)
Observations		750	750	750	737	737	737
Adjusted R-squared		0.126	0.132	0.134	0.247	0.248	0.247
Year Fixed Effect		Y	Y	Y	Y	Y	Y

Table 4. Does the impact of Doctoral Directors depend on Advisory Needs? – Evidence from Firm Complexity

The table contains the results of OLS regressions of target shareholder wealth on the presence and the relative size of doctoral independent directors and other control variables. We use a factor score computed based on the number of business segments, firm size, and leverage as a proxy for advising needs following Coles, Daniel, and Naveen (2008) and Linck, Netter, and Yang (2008). High Complexity (HC) is a dummy variable which takes one if a firm has a factor score above the median. The dependent variables are three-day cumulative abnormal returns and one week premiums. *Business* and *Technology* are dummy variables which equal one if a firm has at least one independent directors with a doctoral degrees in each field. *% Business* and *% Technology* are continuous variables measured by dividing the number of independent directors with each major category by the total number of independent directors on the board. All specifications control for year fixed effects. *t*-statistics based on standard errors clustered by 2-digit SIC code are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

VARIABLES		CAR (-1, +1)			One Week Premiums		
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Business	χ_1	-0.090**			-0.100***		
		(-2.509)			(-2.846)		
Business × HC	χ_2	0.096**			0.137***		
		(2.341)			(4.647)		
Technology	χ_3		0.108***			0.030	
			(3.052)			(0.458)	
Technology × HC	χ_4		-0.094**			0.015	
			(-2.131)			(0.168)	
%Business	χ_5			-0.224*			-0.313**
				(-1.861)			(-2.197)
%Business × HC	χ_6			0.244*			0.345**
				(1.892)			(2.464)
%Technology	χ_7			0.306***			-0.093
				(3.471)			(-0.405)
%Technology × HC	χ_8			-0.230**			0.255
				(-2.384)			(0.802)
High Complexity (HC)		-0.087**	-0.004	-0.041	-0.042	0.022	-0.037
		(-2.580)	(-0.157)	(-1.356)	(-1.242)	(0.524)	(-0.693)
ROA		-0.211***	-0.203***	-0.190***	-0.817***	-0.817***	-0.822***
		(-5.443)	(-5.520)	(-4.790)	(-7.011)	(-6.451)	(-6.373)
Tobin's Q		-0.007	-0.007	-0.008	0.002	0.002	0.000
		(-0.861)	(-0.982)	(-1.044)	(0.129)	(0.141)	(0.029)
Board Size		0.030	-0.006	0.008	0.008	-0.017	0.001
		(0.648)	(-0.135)	(0.162)	(0.107)	(-0.227)	(0.012)
Board Independence		0.133*	0.098	0.108	0.020	-0.006	0.011
		(1.844)	(1.315)	(1.438)	(0.207)	(-0.058)	(0.114)
CEO Duality		-0.041*	-0.033	-0.031	-0.029	-0.027	-0.030
		(-1.694)	(-1.522)	(-1.437)	(-1.090)	(-1.049)	(-1.195)
CEO Age		-0.007	-0.052	-0.053	-0.023	-0.048	-0.028
		(-0.092)	(-0.731)	(-0.711)	(-0.199)	(-0.420)	(-0.238)
Private Acquirer		-0.055*	-0.060*	-0.048	-0.047	-0.055*	-0.047
		(-1.800)	(-1.864)	(-1.526)	(-1.632)	(-1.780)	(-1.611)
Deal Value		-0.012	-0.011	-0.012	0.003	0.004	0.003
		(-1.288)	(-1.130)	(-1.246)	(0.132)	(0.168)	(0.155)
Tender Offer		0.056	0.050	0.046	0.045	0.043	0.043

	(1.472)	(1.421)	(1.288)	(1.084)	(1.054)	(0.992)
Cash Only	0.106***	0.107***	0.106***	0.070	0.069	0.065
	(4.395)	(4.477)	(4.351)	(1.412)	(1.390)	(1.375)
Edu_missing	-0.026	0.021	0.016	0.008	0.046	0.003
	(-0.422)	(0.318)	(0.227)	(0.062)	(0.362)	(0.021)
Constant	0.261	0.451	0.456	0.418	0.529	0.463
	(0.804)	(1.462)	(1.448)	(0.835)	(1.087)	(0.933)
F-test	$\chi_1+\chi_2$	$\chi_3+\chi_4$	$\chi_5+\chi_6$	$\chi_1+\chi_2$	$\chi_3+\chi_4$	$\chi_5+\chi_6$
	(*p*=0.703)	(*p*=0.630)	(*p*=0.709)	(*p*=0.208)	(*p*=0.190)	(*p*=0.766)
			$\chi_7+\chi_8$			$\chi_7+\chi_8$
			(*p*=0.284)			(*p*=0.187)
			$\chi_5= \chi_7$***			$\chi_5= \chi_7$
			(*p*<0.001)			(*p*=0.208)
			$\chi_5+\chi_6=\chi_7+\chi_8$			$\chi_5+\chi_6=\chi_7+\chi_8$
			(*p*=0.562)			(*p*=0.469)
Observations	750	750	750	737	737	737
Adjusted R-squared	0.127	0.130	0.133	0.211	0.206	0.208
Year Fixed Effect	Y	Y	Y	Y	Y	Y

Table 5. Does the impact of Doctoral Directors depend on Monitoring Needs? – Monitoring Intensity

The table contains the results of OLS regressions of target shareholder wealth on the presence and the relative size of doctoral independent directors and other control variables. We measure the proportion of independent directors serving on at least two of three monitoring committees (audit, compensation, and nominating) as a proxy for monitoring needs (monitoring quality) following Faleye, Hoitash, and Hoitash (2011). High Monitoring Intensity (HM) is a dummy variable indicating that a target firm has the proportion of monitoring-intensive directors above the median. The dependent variables are three-day cumulative abnormal returns and one week premiums. *Business* and *Technology* are dummy variables which equal one if a firm has at least one independent directors with a doctoral degrees in each field. *% Business* and *% Technology* are continuous variables measured by dividing the number of independent directors with each major category by the total number of independent directors on the board. All specifications control for year fixed effects. *t*-statistics based on standard errors clustered by 2-digit SIC code are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

VARIABLES		CAR (-1, +1)			One Week Premiums		
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Business	λ_1	-0.043**			-0.041*		
		(-2.209)			(-1.679)		
Business × HM	λ_2	0.010			0.020		
		(0.227)			(0.812)		
Technology	λ_3		0.090***			0.088*	
			(3.332)			(1.826)	
Technology × HM	λ_4		-0.043			-0.090*	
			(-0.844)			(-1.904)	
%Business	λ_5			-0.165*			-0.221*
				(-1.797)			(-1.834)
%Business × HM	λ_6			0.153			0.167
				(1.108)			(1.108)
%Technology	λ_7			0.189*			0.033
				(1.858)			(0.164)
%Technology × HM	λ_8			0.124			-0.085
				(0.443)			(-0.384)
High Monitoring Intensity (HM)		0.004	0.027*	-0.016	0.011	0.052*	0.007
		(0.109)	(1.721)	(-0.690)	(0.336)	(2.003)	(0.242)
Firm Size		-0.040	-0.040	-0.035	-0.118**	-0.119***	-0.117***
		(-1.392)	(-1.374)	(-1.200)	(-2.662)	(-2.716)	(-2.699)
ROA		-0.193***	-0.175***	-0.168***	-0.732***	-0.719***	-0.735***
		(-5.124)	(-4.588)	(-4.146)	(-5.163)	(-4.763)	(-4.538)
Leverage		0.119**	0.132**	0.130**	0.407***	0.416**	0.408**
		(2.290)	(2.254)	(2.382)	(2.684)	(2.589)	(2.607)
Tobin's Q		-0.019	-0.020	-0.019	-0.047*	-0.048**	-0.048*
		(-1.218)	(-1.210)	(-1.142)	(-1.972)	(-2.034)	(-2.006)
Board Size		0.019	-0.002	0.003	0.017	0.003	0.008
		(0.455)	(-0.050)	(0.080)	(0.243)	(0.037)	(0.122)
Board Independence		0.165*	0.110	0.130	0.086	0.042	0.076
		(1.987)	(1.355)	(1.533)	(0.755)	(0.373)	(0.705)
CEO Duality		-0.035	-0.032	-0.028	-0.010	-0.007	-0.008
		(-1.399)	(-1.259)	(-1.157)	(-0.352)	(-0.256)	(-0.295)
CEO Age		-0.022	-0.057	-0.065	-0.040	-0.069	-0.050
		(-0.304)	(-0.767)	(-0.916)	(-0.361)	(-0.633)	(-0.466)
Private Acquirer		-0.062**	-0.063**	-0.055*	-0.046*	-0.048*	-0.045
		(-2.047)	(-2.045)	(-1.724)	(-1.794)	(-1.704)	(-1.640)

Deal Value	0.015	0.013	0.011	0.100**	0.099**	0.099**
	(0.552)	(0.491)	(0.410)	(2.177)	(2.199)	(2.121)
Tender Offer	0.054	0.051	0.044	0.036	0.035	0.034
	(1.297)	(1.294)	(1.127)	(0.785)	(0.766)	(0.773)
Cash Only	0.111***	0.108***	0.112***	0.076*	0.073*	0.077*
	(4.151)	(4.133)	(4.184)	(1.880)	(1.754)	(1.853)
Edu_missing	-0.024	0.018	0.023	0.013	0.043	0.003
	(-0.422)	(0.291)	(0.351)	(0.107)	(0.357)	(0.031)
Constant	0.340	0.522	0.539	0.483	0.622	0.553
	(0.969)	(1.493)	(1.619)	(0.953)	(1.248)	(1.133)
F-test	$\lambda_1+\lambda_2$	$\lambda_3+\lambda_4$	$\lambda_5+\lambda_6$	$\lambda_1+\lambda_2$	$\lambda_3+\lambda_4$	$\lambda_5+\lambda_6$
	(p=0.350)	(p=0.308)	(p=0.908)	(p=0.470)	(p=0.960)	(p=0.650)
			$\lambda_7+\lambda_8$			$\lambda_7+\lambda_8$
			(p=0.133)			(p=0.787)
			$\lambda_5=\lambda_7$***			$\lambda_5=\lambda_7$
			(p=0.006)			(p=0.134)
			$\lambda_5+\lambda_6=\lambda_7+\lambda_8$			$\lambda_5+\lambda_6=\lambda_7+\lambda_8$
			(p=0.158)			(p=0.984)
Observations	750	750	750	737	737	737
Adjusted R-squared	0.124	0.130	0.132	0.245	0.249	0.245
Year Fixed Effect	Y	Y	Y	Y	Y	Y

Table 6. Does the impact of Doctoral Directors depend on the Needs for specific knowledge? – R&D Intensity

The table contains the results of OLS regressions of target shareholder wealth on the presence and the relative size of doctoral independent directors and other control variables. We use R&D intensity, measured by dividing R&D expenditure by total assets, as a proxy for needs for specific knowledge following Coles, Daniel, and Naveen (2008). High R&D Intensity (HR) is a dummy variable indicating that a target firm' R&D intensity is greater than the median value. The dependent variables are three-day cumulative abnormal returns and one week premiums. *Business* and *Technology* are dummy variables which equal one if a firm has at least one independent directors with a doctoral degrees in each field. *% Business* and *% Technology* are continuous variables measured by dividing the number of independent directors with each major category by the total number of independent directors on the board. All specifications control for year fixed effects. *t*-statistics based on standard errors clustered by 2-digit SIC code are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

VARIABLES		CAR (-1, +1)			One Week Premiums		
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Business	γ_1	-0.016			-0.007		
		(-0.695)			(-0.262)		
Business × HR	γ_2	-0.046			-0.048		
		(-1.088)			(-0.894)		
Technology	γ_3		0.037			0.017	
			(0.849)			(0.368)	
Technology × HR	γ_4		0.055			0.051	
			(1.476)			(1.226)	
%Business	γ_5			-0.030			-0.089
				(-0.358)			(-0.882)
%Business × HR	γ_6			-0.141			-0.111
				(-0.962)			(-0.595)
%Technology	γ_7			0.172			-0.043
				(1.148)			(-0.189)
%Technology × HR	γ_8			0.085			0.028
				(0.650)			(0.191)
High R&D Intensity (HR)		0.042	-0.005	0.017	0.033	-0.010	0.025
		(1.088)	(-0.197)	(0.519)	(0.594)	(-0.196)	(0.404)
Firm Size		-0.039	-0.039	-0.035	-0.116**	-0.115***	-0.114**
		(-1.326)	(-1.321)	(-1.159)	(-2.654)	(-2.688)	(-2.635)
ROA		-0.188***	-0.172***	-0.164***	-0.727***	-0.716***	-0.731***
		(-5.236)	(-4.686)	(-4.267)	(-5.053)	(-4.559)	(-4.551)
Leverage		0.125**	0.130**	0.126**	0.411**	0.414**	0.410**
		(2.263)	(2.129)	(2.079)	(2.636)	(2.522)	(2.592)
Tobin's Q		-0.019	-0.020	-0.019	-0.047**	-0.048**	-0.048**
		(-1.267)	(-1.271)	(-1.207)	(-2.018)	(-2.064)	(-2.034)
Board Size		0.013	-0.019	-0.005	0.001	-0.024	-0.006
		(0.294)	(-0.400)	(-0.106)	(0.012)	(-0.305)	(-0.083)
Board Independence		0.152*	0.110	0.123	0.063	0.035	0.059
		(1.834)	(1.447)	(1.579)	(0.526)	(0.305)	(0.533)
CEO Duality		-0.037	-0.032	-0.029	-0.012	-0.010	-0.012
		(-1.400)	(-1.252)	(-1.215)	(-0.429)	(-0.343)	(-0.437)
CEO Age		-0.014	-0.049	-0.053	-0.030	-0.054	-0.030
		(-0.188)	(-0.659)	(-0.713)	(-0.265)	(-0.486)	(-0.269)
Private Acquirer		-0.059*	-0.061**	-0.057*	-0.045*	-0.047*	-0.043*
		(-2.001)	(-2.072)	(-1.861)	(-1.786)	(-1.776)	(-1.726)

	(1)	(2)	(3)	(4)	(5)	(6)
Deal Value	0.014	0.013	0.010	0.098**	0.098**	0.097**
	(0.512)	(0.489)	(0.362)	(2.179)	(2.221)	(2.114)
Tender Offer	0.053	0.048	0.043	0.034	0.031	0.035
	(1.289)	(1.259)	(1.113)	(0.710)	(0.694)	(0.750)
Cash Only	0.109***	0.109***	0.110***	0.074*	0.075*	0.074*
	(4.039)	(4.101)	(4.187)	(1.799)	(1.782)	(1.815)
Edu_missing	-0.025	0.024	0.013	0.013	0.051	0.003
	(-0.446)	(0.379)	(0.200)	(0.101)	(0.402)	(0.028)
R&D_missing	0.009	0.007	0.008	-0.004	-0.005	-0.002
	(0.288)	(0.233)	(0.234)	(-0.086)	(-0.110)	(-0.049)
Constant	0.306	0.528	0.503	0.483	0.641	0.507
	(0.887)	(1.590)	(1.537)	(0.951)	(1.312)	(1.046)
F-test	$\gamma_1+\gamma_2$*	$\gamma_3+\gamma_4$***	$\gamma_5+\gamma_6$	$\gamma_1+\gamma_2$	$\gamma_3+\gamma_4$	$\gamma_5+\gamma_6$
	(p=0.064)	(p<0.001)	(p=0.148)	(p=0.206)	(p=0.104)	(p=0.239)
			$\gamma_7+\gamma_8$***			$\gamma_7+\gamma_8$
			(p=0.001)			(p=0.928)
			$\gamma_5=\gamma_7$			$\gamma_5=\gamma_7$
			(p=0.325)			(p=0.855)
			$\gamma_5+\gamma_6=\gamma_7+\gamma_8$***			$\gamma_5+\gamma_6=\gamma_7+\gamma_8$***
			(p<0.001)			(p=0.009)
Observations	750	750	750	737	737	737
Adjusted R-squared	0.124	0.129	0.130	0.245	0.246	0.243
Year Fixed Effect	Y	Y	Y	Y	Y	Y

Table 7. Employment Ties and the Impact of Doctoral Directors on Target Shareholder Wealth

The table contains the results of OLS regressions of target shareholder wealth on the presence of doctoral independent directors and other control variables. The dependent variables are three-day cumulative abnormal returns and one week premiums. *%Tied_Business and %Tied_Technology* are continuous variables that represent the proportion of *Business* and *Technology* directors tied to CEO. We also include *%Non-tied_Business* and *%Non-tied_Technology,* which are the relative size of *Business* and *Technology* directors who are not tied to CEO, for comparison. *Employ_missing* represents the proportion of independent directors with missing information on employment. All specifications control for year fixed effects. *t*-statistics based on standard errors clustered by 2-digit SIC code are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

VARIABLES		CAR (-1, +1)			One Week Premiums		
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
%Tied Business	η_1	0.518*		0.492*	0.135		0.122
		(1.806)		(1.810)	(0.433)		(0.433)
%Non-tied Business	η_2	-0.161*		-0.137*	-0.155*		-0.158
		(-1.991)		(-1.797)	(-1.718)		(-1.622)
%Tied Technology	η_3		0.242	0.214		0.686	0.672
			(0.418)	(0.369)		(1.146)	(1.113)
%Non-tied Technology	η_4		0.259***	0.242***		-0.041	-0.058
			(4.168)	(4.133)		(-0.288)	(-0.405)
Firm Size		-0.040	-0.036	-0.035	-0.114**	-0.116**	-0.114**
		(-1.342)	(-1.158)	(-1.109)	(-2.528)	(-2.573)	(-2.509)
ROA		-0.196***	-0.167***	-0.167***	-0.732***	-0.732***	-0.732***
		(-5.211)	(-4.109)	(-4.072)	(-5.036)	(-4.361)	(-4.360)
Leverage		0.122**	0.127**	0.130**	0.404**	0.401**	0.404**
		(2.186)	(2.150)	(2.205)	(2.612)	(2.491)	(2.505)
Tobin's Q		-0.019	-0.019	-0.019	-0.047**	-0.046*	-0.046*
		(-1.236)	(-1.146)	(-1.173)	(-2.014)	(-1.922)	(-1.949)
Board Size		-0.002	-0.012	-0.011	-0.005	-0.015	-0.013
		(-0.041)	(-0.265)	(-0.224)	(-0.063)	(-0.208)	(-0.179)
Board Independence		0.147*	0.115	0.119	0.062	0.058	0.061
		(1.771)	(1.376)	(1.379)	(0.526)	(0.571)	(0.596)
CEO Duality		-0.036	-0.029	-0.029	-0.014	-0.017	-0.015
		(-1.265)	(-1.099)	(-1.075)	(-0.464)	(-0.571)	(-0.519)
CEO Age		-0.023	-0.052	-0.055	-0.046	-0.049	-0.054
		(-0.308)	(-0.759)	(-0.792)	(-0.402)	(-0.454)	(-0.496)
Private Acquirer		-0.064**	-0.060*	-0.058*	-0.045*	-0.049	-0.045
		(-2.135)	(-1.889)	(-1.895)	(-1.790)	(-1.643)	(-1.622)
Deal Value		0.016	0.011	0.011	0.097**	0.099**	0.098**
		(0.567)	(0.397)	(0.389)	(2.107)	(2.087)	(2.055)
Tender Offer		0.053	0.045	0.044	0.035	0.034	0.032
		(1.295)	(1.199)	(1.161)	(0.751)	(0.802)	(0.734)
Cash Only		0.111***	0.111***	0.111***	0.076*	0.077*	0.076*
		(4.137)	(4.267)	(4.185)	(1.839)	(1.835)	(1.813)
Edu_missing		-0.018	0.031	0.028	0.015	0.027	0.013
		(-0.304)	(0.471)	(0.419)	(0.120)	(0.243)	(0.118)
Employ_missing		-0.069	-0.086	-0.096	0.143	0.151	0.139
		(-0.480)	(-0.595)	(-0.665)	(0.688)	(0.681)	(0.630)
Constant		0.394	0.516*	0.532*	0.572	0.585	0.613
		(1.174)	(1.710)	(1.705)	(1.139)	(1.276)	(1.310)
F-test		$\eta_1=\eta_2$**	$\eta_3=\eta_4$	$\eta_1=\eta_2$**	$\eta_1=\eta_2$	$\eta_3=\eta_4$	$\eta_1=\eta_2$
		(*p*=0.031)	(*p*=0.976)	(*p*=0.032)	(*p*=0.375)	(*p*=0.153)	(*p*=0.346)
				$\eta_3=\eta_4$			$\eta_3=\eta_4$

			(p=0.963)			(p=0.154)
			$\eta_1=\eta_3$			$\eta_1=\eta_3$
			(p=0.549)			(p=0.178)
			$\eta_2=\eta_4$***			$\eta_2=\eta_4$
			(p=0.001)			(p=0.377)
Observations	750	750	750	737	737	737
Adjusted R-squared	0.128	0.131	0.135	0.247	0.247	0.247
Year Fixed Effect	Y	Y	Y	Y	Y	Y

Table 8. Endogeneity Issue: Two Stage Least Square (2SLS) Regression of Doctoral Directors on Target Shareholder Wealth

This table reports robustness tests on the relation between doctoral independent directors and target shareholder wealth. In the first stage, we use *Business Supply* and *Technology Supply*, measured by the number of doctoral graduates in each field divided by the total number of doctoral graduates from U.S. institutions in 2014, as the instrument for *%Business* and *%Technology*, respectively. We obtain the data on the number of doctoral graduate by academic fields from U.S. Department of Education website. All specifications control for year fixed effects. *t*-statistics based on standard errors clustered by 2-digit SIC code are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

VARIABLES	1st Stage	2nd Stage		1st Stage	2nd Stage	
	Biz (%)	CAR (-1, +1)	1 Wk Premium	Tech (%)	CAR (-1, +1)	1 Wk Premium
%Business		-0.223**	-0.239**			
		(-2.441)	(-1.980)			
Business Supply	0.988***					
	(26.050)					
%Technology					0.423*	0.380
					(1.946)	(1.008)
Technology Supply				2.248***		
				(11.119)		
Firm Size	0.007	-0.026	-0.089**	-0.023***	-0.020	-0.084**
	(1.131)	(-0.891)	(-2.461)	(-2.685)	(-0.639)	(-2.382)
ROA	-0.022	-0.253***	-0.723***	-0.099*	-0.200***	-0.676***
	(-1.365)	(-6.080)	(-4.531)	(-1.751)	(-4.006)	(-3.438)
Leverage	0.012	0.152***	0.230***	-0.039*	0.164***	0.239***
	(0.644)	(3.592)	(3.558)	(-1.742)	(3.124)	(2.953)
Tobin's Q	-0.006*	-0.012	-0.040*	0.003	-0.011	-0.039*
	(-1.698)	(-0.793)	(-1.839)	(0.395)	(-0.687)	(-1.772)
Board Size	-0.052**	-0.012	0.016	0.022	-0.028	0.001
	(-2.202)	(-0.281)	(0.189)	(1.084)	(-0.657)	(0.015)
Board Independence	-0.081***	0.156**	0.044	0.081**	0.107	0.001
	(-2.591)	(2.001)	(0.372)	(2.436)	(1.576)	(0.007)
CEO Duality	0.002	-0.035	-0.007	-0.024***	-0.027	-0.000
	(0.302)	(-1.468)	(-0.252)	(-2.663)	(-1.133)	(-0.018)
CEO Age	-0.005	-0.011	-0.024	0.120***	-0.066	-0.072
	(-0.186)	(-0.151)	(-0.206)	(3.310)	(-0.912)	(-0.604)
Private Acquirer	0.010	-0.050*	-0.032	-0.023**	-0.048	-0.032
	(0.925)	(-1.870)	(-1.350)	(-2.076)	(-1.602)	(-1.147)
Deal Value	-0.005	0.003	0.077*	0.020**	-0.003	0.073*
	(-0.868)	(0.106)	(1.895)	(2.338)	(-0.104)	(1.722)
Tender Offer	-0.016*	0.044	0.036	0.025*	0.030	0.023
	(-1.803)	(1.153)	(0.799)	(1.862)	(0.824)	(0.578)
Cash Only	0.003	0.117***	0.076*	0.004	0.115***	0.074*
	(0.370)	(5.146)	(1.763)	(0.408)	(5.078)	(1.673)
Edu_missing	-0.086***	-0.004	0.004	-0.127***	0.098	0.100
	(-3.029)	(-0.054)	(0.030)	(-4.377)	(1.278)	(0.926)
Constant	0.224**	0.297	0.407	-0.494***	0.514*	0.591
	(2.003)	(0.927)	(0.785)	(-3.613)	(1.697)	(1.103)
Observations	728	728	728	728	728	728
Adjusted R-squared	-	0.147	0.217	-	0.129	0.203
Partial R-Squared	0.526	-	-	0.167	-	-

F-stat for 1st stage	643.67	-	-	56.15	-	-
Year Fixed Effect	Y	Y	Y	Y	Y	Y