Friendly Boards and Innovation

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Abstract

We examine how friendly boards affect firm innovation. Using CEO-director social connections as a measure of board friendliness, we find that firms with friendly boards create more patents and citations. The positive relation between friendly boards and innovation are more pronounced when firms' advisory needs are higher or when firms operate in innovative industries. Friendly boards are also associated with higher firm value, especially when firms have higher advisory needs or when innovation is an important source of firm value. Our results support the positive view on a friendly board perspective that directors serve as valuable advisors to CEOs.

Keywords*: Board of directors, Corporate innovation, Board advising, Social ties, Corporate governance, Firm value.*

JEL classification*: G34, O32.*

1. Introduction

Corporate boards are often criticized as being weak and too friendly with management (Bebchuk and Fried, 2004). Responding to this criticism, corporate governance reforms and new listing requirements have focused on raising board independence from management, with the belief that independent directors enhance board monitoring, thereby curtailing managerial agency problems. This exclusive emphasis on the boards' monitoring role is not without controversy, however. According to the 2004 *Corporate Director's Guidebook* of the American Bar Association, in addition to being monitors boards should also serve as advisors to management, bringing their experience and expertise to the firms' decision making process (Committee on Corporate Laws, 2004).

Recent academic studies (e.g. Song and Thakor, 2006 and Adams and Ferreira, 2007) also question the role of independent directors solely as monitors. According to their studies, *management-friendly* boards, despite being potentially less vigilant in monitoring management, may enhance firm value, because friendly boards can be more effective in advising management. In Adams and Ferreira (2007), outside directors rely on management for firm-specific information in order to play the role as a monitor of and an advisor to the management. However, a board that is *too* independent may use this information to intensely monitor the CEO and intervene in management decisions, thereby discouraging CEOs to share information. Thus, despite being potentially lax on monitoring the CEO, a management-friendly board may enhance firm value by creating an atmosphere conducive to information sharing from the CEO, and in turn provide better advising. Similarly, Holmstrom (2005) suggests that boards need to gain the trust of management for the latter to share their information.

To explore the potential benefits of boards' advisory function, this paper examines how friendly boards affect firm innovation. We hypothesize that a friendly board,[1] by enhancing information exchanges between management and directors, are more able to provide quality advising to the CEO, thereby resulting in more successful innovation activities (the "friendly-board hypothesis"). The corporate innovation process is a

[1] Throughout the paper, we use the words "friendly board" and "connected board" interchangeably. We also use the words "friendly director" and "connected director" interchangeably.

particularly apt setting to study boards' advisory function and whether board friendliness affects the effectiveness of such a function. Innovation is the main engine of firm growth, and it sets the future direction of a firm's strategy (Aghion, Van Reenen, and Zingales, 2013). Therefore, boards are expected to be deeply involved in helping CEOs identify, clarify, and evaluate innovation projects (Faleye, Hoitash, and Hoitash, 2013).[2] Since innovation typically involves the exploration of new and untested ideas, at every stage of the innovation process it is of critical importance for management and the board to talk things over, and for the board to provide timely feedback on the strategies for the next stage of development (Manso, 2011). As such, the innovation process requires considerable communication and coordination among the directors and management. Furthermore, innovation decisions generally require substantial firm-specific knowledge. Absent of sharing of such information by the management, outside directors would encounter a hard time obtaining the information on their own, thereby hampering their ability to provide quality advising.

It is worth noting that friendly boards, by being more passive in their role as monitors of management, may encourage CEOs to undertake more long-term risky innovation projects, and thereby improve firms' innovation performance (Hirshleifer and Thakor, 1992; Manso, 2011; Chemmanur and Tian, 2012).[3] Thus, the alternative channel through which the friendly boards facilitate firms' innovation activities may be their reduced monitoring. However, without detailed data on the workings of the boardroom, it is difficult to disentangle whether better innovation outcomes are due to enhanced quality advising or reduced monitoring.

[2] Several recent studies show that directors advise CEOs on important matters relating to innovation. For example, Klarner, Probst, and Useem (2013) perform in-depth case studies and interview with the executives and directors of four pharmaceutical companies. They find that boards provide advice on the innovation strategy by offering strategic suggestions or alternative approaches for exploring innovation. In particular, one of the directors they interviewed indicates that "there's a very active dialogue in which the committee directors suggest a novel approach for a disease area, share ideas about the academic literature in a specific field, and share their experiences about what might be fruitful areas of exploration." Faleye, Hoitash, and Hoitash (2013) show that firms with an advisory director (independent director who does not serve on any of the monitoring committees but serves on at least one advisory committee) innovate more. In addition, using samples of German and Indian firms, respectively, Balsmeier, Buchwald, and Stiebale (2014) find that outside directors on supervisory boards influence firms' innovative activities and Helmers, Patnam, and Rau (2015) find that board interlocks have significant positive effects on both R&D and patenting, suggesting that information can be transmitted via shared directors.

[3] The issue on whether reduced monitoring encourages CEOs to invest more in risky projects is still debatable. For example, using the passage of state antitakeover laws as an exogenous event, Atanassov (2013) finds that firms that are protected by the laws reduce their patenting activities, indicating that a reduction in career pressure does not lead CEOs to increase investment in risky innovation. On the other hand, Chemmanur and Tian (2012) show that firm-level anti-takeover provisions spur innovation and lead to increased firm value, especially among innovative firms.

Both effects are likely to be present as suggested by Klarner, Probst, and Useem (2013) who perform in-depth interviews of the directors and executives of four pharmaceutical firms to understand the impact of directors on the innovation process. Given the relative scarcity of evidence on advisory roles of friendly boards, our aim in the paper is more modest – that is, to provide evidence that friendly boards play an advisory role in the innovation process, whilst not eliminating the possibility that reduced monitoring might also partially cause the positive relation between friendly boards and innovation. Thus, our tests below focus on showing 1) whether friendly boards markedly influence innovation performance, and 2) if they do, whether a significant part of such influence can be attributable to friendly boards' advisory function, as predicted by the existing theories (e.g. Adams and Ferreira, 2007).

To test the friendly-board hypothesis, we construct proxies for board friendliness based on social connections, and consider a board to be friendly if there is at least one director who is socially connected to the CEO. We focus on social connections in which personal ties are most likely to develop, namely, those arising from common educational background and non-professional activities (Domhoff, 2009). This focus is inspired by several recent studies which suggest that personal ties between management and directors promote board friendliness (e.g., Westphal, 1999), and enhance CEO-director information sharing (Adams and Ferreira, 2007; Adams, 2009).[4]

We evaluate innovation performance by both the quantity and the quality of the patents created, which are measured, respectively, by the number of the successful patents filed and the forward citations accumulated by the patents. Patenting activities have been used as an important measure of the success of innovation activities in several other studies including Aghion, Van Reenen, and Zingales (2013), Acharya and Subramanian (2009), Hirshleifer, Low, and Teoh (2012), Seru (2014), and Tian and Wang (2014).

We find that after controlling for research and development (R&D) expenditures, firms with friendly boards have more patent and citation counts than firms without such boards. We also find that this positive

[4] Previous studies also show that social connections enhance information flow between mutual fund managers and corporate boards (Cohen, Frazzini, and Malloy, 2008), between sell-side equity analysts and senior officers of the firms (Cohen, Frazzini, and Malloy, 2010), between bankers and firms (Engelberg, Gao, and Parsons, 2012), and between CEOs and divisional managers (Duchin and Sosyura, 2013).

relation between friendly boards and innovation output hold across firms of varying sizes and of different board sizes. Moreover, this effect of board friendliness on corporate innovation activities increases with the extent of board friendliness. Specifically, in comparison to firms without friendly boards, those with friendly boards produce 7.5% and 10.4% more patents and citations when the CEO is socially connected with *only one* outside director,[5] but create 11.7% and 14.4% more patents and citations when the CEO is connected with one or more directors. Thus, the presence of multiple connected directors on the board strengthens the advisory role of the board in facilitating innovation activities. Since we control for R&D intensity in the regressions, these results are not simply due to increased spending on innovation, but rather reflect an improvement in the effectiveness of the innovation process.

We also find that the results are robust to using alternative measures of innovation outcomes and board friendliness, to varying the set of control variables in the regressions, and to employing alternative regression specification such as Tobit models and Negative Binomial models.

In addition, to alleviate potential endogeneity problems due to omitted firm/CEO characteristics and reverse causality, we perform various tests and find that our results remain robust. First, we control for various measures of CEO innovation ability and use several placebo tests that take into account unobservable CEO characteristics, and we find that our results do not change. We also confirm that the results are not due to connected directors being able to hire better quality CEOs since connected directors may have inside information about CEO ability. Second, to alleviate concerns that omitted firm characteristics may simultaneously affect board friendliness and innovation outcomes, we 1) perform a propensity score matching analysis; 2) include firm fixed effects in the regressions; 3) control for time-varying firm ability to innovate; and 4) control for recent firm performance. Our conclusions remain the same. Third, innovative firms may choose to stack their boards with friendly directors who are sympathetic to the CEO's investment ideas. To the extent that innovation opportunities do not remain constant, the

[5] Given that the average numbers of patents and citations for firms without friendly boards are, respectively, 6.28 and 38.10, the presence of one connected outside director on the board is associated with increases in patents and citations by 0.47 and 3.96, respectively.

reverse causality explanation predicts that the effect of friendly boards on innovation performance comes mainly from newly-appointed connected directors. However, we find that both newly-appointed and seasoned connected directors matter. Finally, we use two-stage least squares (2SLS) regressions to further address the reverse causality and unobservable omitted variable biases. We use the average number of connections between the CEOs of other local firms and the directors of these other local firms as our instrumental variable (IV). When constructing the IV, following Chang et al. (2015), we consider only the CEO-director connections of other local firms that are not in the same industry as the focal firm and also not in innovative industries. The 2SLS regressions yield similar results as the OLS regressions.

Overall, these results are consistent with the friendly-board hypothesis that a friendly board facilitates information exchange between the CEO and the board and thus enhances the quality of board advising. However, as discussed above, our findings are also consistent with the view that less intense monitoring by friendly boards reduces performance pressure on CEOs, who would be then more motivated to take on risky but value-enhancing innovative projects. Although we are not able to distinguish which of these effects drives our results, the results generally indicate that friendly boards' better advising is *a key source* of their positive effect on innovation performance. For example, in our analysis, we control for *R&D* expenditures. Thus, the positive influence of friendly boards on innovation is not likely merely due to increased spending on R&D, suggesting that better selection of R&D projects due to board advising, not greater investment in risky innovation activities due to weak monitoring, is the main source of our results.

To further explore the friendly board hypothesis, we conduct several additional tests. First, we examine the committee memberships of connected directors. Prior works indicate that board decision process typically involves board committees bringing forth initiatives, which, in overwhelming majority of the cases, are then formally approved by the board (Schwartz-Ziv and Weisbach, 2013). We find that connected directors are more likely to sit on advisory committees than on monitoring committees. If reduced monitoring were the sole factor that creates improved innovation performance, connected directors would be more likely to be placed in monitoring committees to ensure lax monitoring. Thus, our finding suggests that connected directors play an important role in advising CEOs.

Second, we differentiate firms based on firms' advisory needs and on the innovativeness of the industries they belong to. We find that the positive effect of friendly boards on innovation performance is stronger for complex firms with higher advisory needs (i.e., larger firms, firms with multiple business segments, and R&D-intensive firms) (Coles, Daniel, and Naveen, 2008) and for firms in innovative industries with many innovation opportunities. These results suggest that the benefit of friendly boards is especially pronounced when board advising is more valuable to the firms.

Taken together, these additional findings further suggest that the advisory role of friendly boards is a key source of the positive effect of such boards on innovation performance.

To examine the welfare consequence of the enhanced advisory function of friendly boards, we examine the relation between friendly boards and firm value measured by Tobin's q. We find that friendly boards significantly improve the value of firms with strong advisory needs, and this positive effect is more pronounced for firms where innovation is an important source of value creation.

As supplementary evidence, we examine whether other types of social connections, namely, social ties between the CEO and directors that arise out of prior common employment, also influence innovation performance. We find that workplace ties do not have any significant effect on innovation performance. This result is consistent with those of previous studies such as Ingram and Zou (2008), who argue that connections arising from workplace may be fraught with tension and competition and thus, do not necessarily lead to "friendliness" between the connected parties.

Overall, our findings suggest that social connections between CEOs and outside directors developed from shared educational and non-business antecedents have a positive effect on firm innovation and value. These findings shed a positive light on a "friendly board" perspective in which outside directors are not merely monitors of but also advisors to CEOs.

Our study contributes to the literature in two important ways. First, it extends the literature on the role of corporate boards by showing a new channel through which connected boards can enhance value – increasing firm innovation through advising. While earlier studies on corporate boards mainly focused on the boards' monitoring role, a growing number of theoretical studies have started to emphasize the

importance of boards' advisory role (Raheja, 2005; Song and Thakor, 2006; Adams and Ferreira, 2007; Harris and Raviv, 2008; Baldenius, Melumad, Meng, 2014). Several empirical papers such as Linck, Netter, and Yang (2008), Coles, Daniel, and Naveen (2008, 2014) also have examined how boards are structured to balance their monitoring and advising needs. However, the evidence on how boards perform an advisory role and the channels through which board advising affects firms' important decision (e.g., innovation decision) and value remains thin. Faleye, Hoitash, and Hoitash (2011) focus on the oversight role of boards and find that intense monitoring by boards can be detrimental to acquisition and innovation outcomes. In a recent paper, Balsmeier, Fleming, and Manso (2015) examine the relation between board independence and the types of innovation projects firms undertake; they find that independent boards curtail risky and exploratory innovation. Our paper compliments these studies by showing that the composition of boards has a direct impact on innovation outcomes. In contrast to these studies, however, our study builds on the prior theoretical work (e.g. Adams and Ferreira, 2007) and makes use of a direct measure of board friendliness, constructed based on social connections between the CEO and directors that have shown to be a more nuanced measure of CEO-board relation (Hwang and Kim, 2009). Our evidence reveals that friendly boards add value by significantly improving innovation performance.[6]

Second, our paper contributes to the literature on the ramifications of CEO-director social connections. Previous studies on social ties mainly focus on the monitoring role of outside directors, and find a dark side of such ties (Hwang and Kim, 2009; Fracassi and Tate, 2012; Chidambaran, Kedia, and Prabhala, 2011).[7] One exception to the literature is Schmidt (2015), who finds that strong CEO-director social ties are associated with better acquisition outcomes for bidders with high board advisory needs on acquisition strategies. By examining the link between CEO-director social connections and innovation activities, we show a bright side of such connections and identify the circumstances under which they are most beneficial

[6] In a contemporaneous paper, Faleye, Hoitash, and Hoitash (2013) find that advisory directors who are classified according to their committee assignments are associated with increased innovation outcomes.

[7] The cost of social connections has also received considerable media coverage. For example, during the scandal, Enron donated $1.6 million to the University of Texas M.D. Anderson Cancer Center, whose president John Mendelsohn was on Enron's board as an independent director ("Inside, outside Enron, audit panel is scrutinized: links to company of certain members are called too cozy," *Wall Street Journal*, 1 February 2002).

to firm value. Our study also highlights the importance of separating the different origins of CEO-director social ties in examining the board's advisory role: while non-workplace ties lead to improved board advising and increased innovation, workplace ties do not.

The remainder of the paper proceeds as follows. In Section 2, we describe the data and sample characteristics. We also explain how we measure the performance of innovation activities and identify friendly boards. In Section 3, we examine the effect of friendly boards on innovation activities and in Section 4, we address the endogeneity bias inherent in our study. Section 5 presents additional evidence on the advisory benefit of friendly boards. Section 6 provides results on the effect of friendly boards on firm value and Section 7 examines how CEO-director social ties arising from workplace connections affect innovation activities. Finally, we summarize our findings and offer concluding remarks in Section 8.

2. Data, descriptive statistics, and variable construction

2.1. Sample

Our initial sample includes all firms covered in Management Diagnostics Ltd's BoardEx database from 1990 to 2004. [8] The BoardEx database contains information on board structures as well as detailed profiles of individual officers and directors of companies that the database covers.[9] The biographical data includes educational details, current and previous employment, affiliations to not-for-profit associations, club memberships, etc., that dates back to 1926. We then match firm names in BoardEx to those in the

[8] We start from 1990 since the coverage of Compustat/CRSP firms by BoardEx is low before 1990. The coverage of the BoardEx database has increased after 1990. For example, in 1990, 1999, and 2007, BoardEx covers approximately 74%, 88%, and 97% of the firms in Compustat/CRSP, respectively. We stop our sample period in 2004 to address the truncation bias in the NBER patent data from which we obtain patent-related information. Patents are included in the NBER database only if they are eventually granted and there is on average a two-year lag between patent application and patent grant (Hall, Jaffe, and Trajtenberg 2001). Since 2006 is the latest year in the NBER database, patents applied for after 2004 may not appear in the database.

[9] Since BoardEx starts to report board structure and directors' biographical data only starting from 1999, following previous papers (Cohen, Frazzini, and Malloy, 2008; Schmidt, 2015), we reconstruct these data based on directors' historical directorship and biographical data in BoardEx. We check the accuracy of our reconstructed data with the IRRC director database and find that the difference in board size is less than 1 for about 75% of the overlapping firm-years for the period before 2000. After 2000, the accuracy is almost the same between our constructed data and the IRRC director database. As a robustness check for the potential sample selection bias in BoardEx, we restrict our sample to the period from 2000 to 2004 and find similar results.

intersection of CRSP and Compustat following the approaches used in the previous studies (Chidambaran, Kedia, and Prabhala, 2011; Kang and Kim, 2011).[10]

To construct our final sample, we require that firms are in the 2006 edition of the NBER patent database. To minimize the potential sample selection bias, we include in the final sample all Compustat firms that operate in the same four-digit SIC industries as the firms in the NBER patent database. This procedure ensures that firms with similar industry characteristics but no patents are also included in the sample. After excluding firms in the financial or utility industries and those with missing data on the variables used in the regressions, our final sample consists of 29,340 firm-year observations.

2.2. Variable construction

In this section, we describe briefly the construction of the patent variables and how we measure board friendliness. We also discuss the control variables used in the regressions. Detailed definitions for all the variables are provided in the Appendix.

2.2.1. Performance of innovation activity

Following Hirshleifer, Low, and Teoh (2012), we use two variables to measure corporate innovation activity. The first measure, the number of patents applied (and eventually granted) by a firm during the year, quantifies the *output* from innovation. However, a simple count of the number of patents does not distinguish between groundbreaking discoveries and incremental technological improvements (Griliches, Pakes, and Hall, 1987). To gauge the significance and impact of innovation output, we use as our second measure the number of citations ultimately received by a patent. Hall, Jaffe, and Trajtenberg (2005) show that citations significantly contribute to firm value, so patent citation is a good measure of patent significance. One issue with using patent citations is the truncation bias due to the finite length of the sample period: because citations accumulate over many years after a patent is first created, patents created in the

[10] We thank Young Han Kim for sharing the link table between BoardEx and Compustat.

later part of the sample period have less accumulation time. To address this issue, we adjust the patent citation count using the weighting index by Hall, Jaffe, and Trajtenberg (2005), which is constructed using a quasi-structural approach that econometrically estimates the shape of the citation-lag distribution.

2.2.2. Board friendliness

Our key independent variable of interest is a *binary* indicator variable that equals one if the board is friendly and zero otherwise. A board is classified as a friendly board if at least one of the outside directors is connected to the CEO through common educational background or memberships in the same non-business organization, including golf clubs, fraternities, charitable organizations, trusts, university boards, etc. In defining friendly boards, we focus on non-workplace connections, because professional connections that arise from, for example, common prior employment, tend to be transactional and competitive in nature (Ingram and Zou, 2008). In contrast, non-workplace ties are more likely to foster trust and loyalty between the CEO and connected directors. Holmstrom (2005) and Adams (2009) emphasize the importance of mutual trust in the sharing of information between the CEO and the board of directors.[11]

To identify social connections based on educational background, we first extract the name(s) of the educational institution(s) for each director from BoardEx. BoardEx does not use a unique identifier for each of the educational institutions in the database, so the same educational institution may appear under different names, as in, for example, Harvard University and Harvard Business School. To remedy this problem, we manually match the names of the educational institutions in BoardEx to get a unique identifier for each institution. Following Cohen, Frazzini, and Malloy (2008), we identify a CEO and a director as sharing a tie through common educational background if they both obtained their degrees from the same institution, irrespective of their years of attendance and types of degrees.

[11] Cohen, Frazzini, and Malloy (2008) also use shared education networks to measure social links between mutual fund managers and corporate officers and directors. In their study of effect of social ties between the CEO and directors on fraud probability, Chidambaran, Kedia, and Prabhala (2011) find different effects of workplace and non-workplace ties on fraud probability. In Section 7, we also examine whether connections borne out of prior common employment have an effect on firm innovation.

To identify social ties based on common memberships at non-business organizations, we extract the names of organizations from "other activity" reported in BoardEx. Following Schmidt (2015), we exclude those professional or industrial organizations where social interaction is less likely to happen due to the compulsory nature of membership in the organizations (e.g., American Bar Association).

2.2.3. Control variables

To scrutinize board advisory function, we control for several board characteristics that are shown to affect the monitoring ability of boards, including board size and the proportion of outside directors (Weisbach, 1988; Yermack, 1996). We also control for the fraction of co-opted directors as Coles, Daniel, and Naveen (2014) find that the board monitoring intensity decreases when there is a higher proportion of directors who join the board after the CEO is appointed. Next, we control for CEOs' and directors' general connectedness in the regressions since our friendly board variable may simply capture their general connectedness. Faleye, Kovacs, and Venkateswaran (2014) and Forgel, Ma, and Morck (2014) document that firms with better-connected CEOs and better-connected directors have higher levels of innovation performance as they have better access to relevant network information.

We also include in our baseline regressions measures of CEO power and the quality of corporate governance. On one hand, CEOs with greater power vis-à-vis the boards are more likely to be able to appoint friendly directors to the boards (Fracassi and Tate, 2012). On the other hand, powerful CEOs tend to face less performance pressure or career concerns, and thus are more likely to be able to undertake risky investments including those in innovation (Hirshleifer and Thakor, 1992). We measure CEO power using CEO-chairman duality (Goyal and Park, 2002) and CEO tenure (Hermalin and Weisbach, 1998).[12] We control for the quality of a firm's governance by including institutional ownership and industry concentration (Aghion, Van Reenen, and Zingales, 2013; Parrino, Sias, and Starks, 2003).

[12] In untabulated tests, we measure CEO power using CEO founder status (Falenbrach, 2009) and find that our results do not change.

Finally, we control for several other firm-specific variables used in Hall and Ziedonis (2001) and Hirshleifer, Low, and Teoh (2012). First, we control for firm size using the natural logarithm of sales since larger firms have more resources to invest in innovation. Using the logarithm of total assets as the measure of firm size does not change the results. Second, we control for R&D intensity (R&D expenditures / total assets). Increased patent output can come from an increase in innovation input, namely, R&D expenditures, or in the efficiency of innovation process. Since we are mostly interested in the latter effect, we control for R&D intensity in the regressions.[13] Third, we control for investments in physical assets using capital intensity. Fourth, we control for the ratio of cash to assets and leverage since firms with higher cash holdings have more resources to spend on innovation and those with higher leverage may face greater debt overhang problems that inhibit investments in innovation (Myers, 1977). Fifth, we control for firm performance (annual buy and hold stock return and ROA) since better performing firms have easier access to the external capital markets and thus can raise funds at a lower cost. We also include proxies for growth opportunities (Tobin's *q* and sales growth) and control for stage of firm life cycle using firm age. All independent variables are lagged by one year and continuous variables are winsorized at the 1% level in both tails. To control for potential time trends and industry effects, we include in all regressions year and industry fixed effects (Fama-French (1997) 48 industry classification).

2.3. Summary statistics

Table 1 reports summary statistics for our sample firms. Panel A shows that based on CEO-director connection through common education background, 15.6% of our sample firms have friendly boards, and among these firms, on average 29% of the outside directors attended the same school as the CEO. Based on common membership in non-business organizations, we find that 17.9% of the sample firms have a CEO-director connection, and among them, on average 28% of the outside directors are connected to the CEO. Combining both types of the connections, 28.1% of our sample firms have friendly boards, and

[13] When firms have missing R&D values, we replace them with zeros. In our sample, about 47% of the firm year observations have zero R&D. The results do not change if these observations are excluded from the analysis.

among these friendly boards, on average 32% of the outside directors are connected to the CEO via either one or both types of connections. Since the average number of outside directors in firms with friendly boards is about 6, the 32% of connected outside directors translates to about 2 connected outside directors per board. These results suggest that CEO-director social connections are prevalent across U.S. firms. Board friendliness is also very stable. If a board is friendly in year *t*, the probabilities that it remains friendly in year *t*+1 and year *t*+2 are 80% and 63%, respectively.

In Panel B, we compare the profiles of connected outside directors with those of non-connected outside directors. We find that compared to non-connected directors, connected directors are older, more likely to be female, have longer tenure, and hold more directorships. We also find that connected directors have more experience in a different industry (11 years versus 6 years) but less experience in the same industry (3 years versus 5 years) as the firm's industry.

In Panel C of Table 1, we compare innovation performance and board and firm characteristics for the subsample of firms with a friendly board (connected firms) and those for the subsample of firms without a friendly board (non-connected firms). First, we find that connected firms have significantly higher innovation performance than non-connected firms: connected firms on average have 29 patents while non-connected firms have 6 patents. In addition, connected firms on average have 193 (440) adjusted (unadjusted) citations compared to 38 (88) adjusted (unadjusted) citations for non-connected firms. These results support the friendly-board hypothesis.

Second, the comparison of board structures shows that connected firms have a larger board and a higher percentage of outside directors on the board than non-connected firms. Connected firms have a slightly higher fraction of co-opted directors and their CEOs and outside directors have more external connections. CEOs of connected firms are more likely to be the chairperson of the board but there is no difference in CEO tenure between the two groups of firms.

Third, the comparison of firm characteristics show that relative to non-connected firms, connected firms are larger and more profitable, and have higher capital intensity, higher leverage, and more business

segments. However, these firms have lower cash to assets ratio and lower sales growth. We also find that connected firms are older and have higher institutional ownership.

3. Main results: Effect of friendly boards on firm innovation

In this section, we examine the effects of friendly boards on both the quantity and the quality of firm innovation. Our key explanatory variable of interest is the indicator variable, *Friendly board*, which takes the value of one if a board is friendly and zero otherwise.

The results are reported in Panel A of Table 2. In model 1, we use the log value of one plus the number of patents as the dependent variable. We find that the coefficient estimate on *Friendly board* is 0.117, significant at the 1% level, indicating that, all else being equal, firms with a friendly board have about 12% higher number of patents than those without a friendly board. Not only do friendly boards elevate the level of innovation output, they also enhance the quality of innovations. Model 3, in which the dependent variable is the log value of one plus the number of citations, shows that patents filed by firms with friendly boards accumulate about 14% more citations than those filed by firms without friendly boards.[14]

A binary indicator may not adequately capture the degree of board friendliness. Therefore, we replace *Friendly board* with two indicators that distinguish between boards with only one connected director and those with more than one connected directors. About 16% of our firm-year observations have only one connected director on the board, and 12% of the firm-year observations have more than one connected directors. The results reported in models 2 and 4 show that firms whose boards have two or more connected directors are associated with 19% more patents and 21% more citations than firms whose boards have no connected directors. The corresponding numbers for firms with only one connected director are halved at about 8% and 10%, respectively. The differences in these effects between firms with multiple connected directors and those with a single connected director are statistically significant at the 5% level. In

[14] The economic magnitudes are similar to those found in other papers. For example, Hirshleifer, Low, and Teoh (2012) find that overconfident CEOs are associated with a 9% increase in patent counts (Table 5, Model 1) and a 17% increase in citations (Table 6, Model 1).

untabulated tests, we also replace *Friendly board* with the proportion of connected directors on the board and find that the coefficient estimates on the proportion of connected directors are significant at 0.369 and 0.362 in the patent and citation regressions, respectively. Overall, the results in Table 2 are consistent with the beneficial effects of friendly boards as emphasized by Adams and Ferreira (2007).

Turning to the control variables, we find that while board size and board independence are not significantly related to innovation performance, the fraction of co-opted directors on the board is positively related to both patents and citations. We also find that the general external connectedness of CEOs have a positive impact on the innovation, consistent with Faleye, Kovacs, and Venkateswaran (2014). CEOs who also serve as chairman are associated with increased patent output but not citation count and longer tenured CEOs have worse innovation performance.

We also find that institutional ownership is significantly negatively related to the number of patents but insignificantly related to the number of citations. In addition, we find that larger firms, older firms, more capital-intensive firms, firms with higher R&D intensity, firms with higher cash to assets ratio, and firms with higher future growth opportunities have better innovation performance. However, patents and citations are both negatively associated with leverage.

To ensure that the positive relation between board friendliness and innovation outcomes is not driven by firm size or board size, we investigate whether our results from the above baseline regressions apply to firms of varying sizes, measured in terms of sales or board sizes.[15] The results are reported in Panel B of Table 2. We include indicators for all firm size quintiles (board size quintiles) except that for the smallest quintile in the regressions. We also include the interaction terms between *Friendly* board and the quintile indicators. The coefficient on the standalone variable, *Friendly board*, is positive and significant, indicating that the positive effects of friendly boards on innovation outcomes hold even among the smallest firms (firms with the smallest boards). Furthermore, we find that the coefficients on the interaction terms are

[15] We have similar results when we measure firm size as the market value of equity and total assets.

significantly positive, except for the one associated with the third largest board size quintile (model 2). In sum, our findings from the baseline regressions are robust to accounting for firm sizes and board sizes.[16]

3.1. Effect of friendly boards on R&D intensity

So far, to focus on the effect of friendly boards on the efficacy of the innovation process, we control for the scale of investments in innovation as measured by R&D intensity. To examine if friendly boards also influence R&D investments, in untabulated tests, we re-estimate the Table 2 regressions using R&D intensity as the dependent variable. We find that friendly boards do not have any significant effect on R&D intensity. Therefore, it appears that friendly boards do not indulge CEOs in excess spending on risky projects by simply rubber-stamping investment proposals by CEOs.

3.2. Robustness checks

We perform a number of additional tests to ensure that our main results are robust to using alternative model specifications and alternative measures of dependent and independent variables.[17]

First, our results are robust to several alternative measures of *Friendly board*: a measure estimated using social ties based on education, a measure estimated using social ties based on common memberships at non-business organizations, a measure using only non-top five connected schools, and a measure using only educational ties in which the CEO and director attended the same institution for their undergraduate degrees. Second, we estimate the regressions using Tobit models and Negative Binomial models and find that the main results remain robust to using these alternative estimation methods. Third, the results remain the same when we use several alternative measures of innovation performance: adjusting each patent's raw citation count by the average citation count of all patents applied for in the same year and technological class, calculating the citation count by excluding self-citations, using the average adjusted citations per

[16] We find that the strongest effects of friendly boards on innovation outcome come from the firms belonging to the largest size quintile. This result could be due to the greater advisory needs of larger firms as discussed in Section 5.3.
[17] Details of the additional tests are available from the authors upon request.

patent in each firm-year, using the average adjusted citations (excluding self-cites) per patent in each firm-year, and using the maximum of the citations obtained by each of the firm's patents in the year. Fourth, our results are robust to including additional controls for CEO overconfidence, CEO compensation structure (delta and vega of CEO's portfolio), indices to proxy for shareholder power, and various board and director characteristics. Fifth, our results hold across different sample periods. The number of patents increases substantially in the post-2000 period, during which governance reforms led to fundamental changes in board structures. Thus, it is possible that our finding for the positive relation between innovation outcomes and board structure is spurious. To address this issue, we divide the sample into two subperiods, from 1990 to 1997 and from 1998 to 2004. We find that our results hold for both subperiods. Sixth, as technological changes happen in waves across industries, we control for time-variant industry characteristics using industry-year fixed effects. We define the industry at the two-digit SIC level, although the results are similar with Fama-French 48 industry classification.[18] Finally, our results are robust to 1) using only firms with at least one patent, i.e., only firms in the NBER database, 2) using the three-year and five-year lags of *Friendly board*, and 3) excluding from the sample the firms involved in takeovers in the prior two years.

4. Endogeneity of board structure

Our main variable of interest, *Friendly board*, is unlikely to be of a random occurrence. If board structure and innovation activity are jointly determined by other omitted firm characteristics, our regression results are subject to an omitted variable bias. Alternatively, it could be that the direction of causality runs from innovative firms to connected directors and not the other way around. As suggested by Larcker and Rusticus (2010), we start with discussing the precise nature of the potential endogeneity problems, and then devise several tests to mitigate these problems.

4.1. Omitted CEO characteristics bias

[18] We have re-run the main results of our paper controlling for industry-year fixed effects and tabulated them in Appendix B.

Our *Friendly board* variable may proxy for CEO ability. Hermalin and Weisbach (1998) outline a model where CEOs with high ability or who has performed well in the past can influence the board selection process. Therefore, it is possible that talented CEOs are able to appoint friendly directors to the board and at the same time innovate better due to their better ability. In another scenario, it is also possible that directors with more extensive social connections are able to hire more competent CEOs since such connections may give them privileged information about CEO candidates to whom they are socially related. Again, CEO-director connection is indicative of higher CEO ability.

In Panel A of Table 3, we address this concern by including several proxies for CEO ability. In models 1 and 4, we control for CEO ability by including the average Scholastic Assessment Test (SAT) scores for CEOs' undergraduate programs.[19] Because the SAT scores are not available for some schools, our tests employing this variable are conducted using a smaller sample of 14,702 firm-years. Our results remain unchanged. In models 2 and 5, we proxy for CEO ability by including the average industry-adjusted stock returns of the firm over the previous 3 years (Linck, Netter, and Yang, 2008). When doing so, we include only CEOs with tenure longer than 3 years. The coefficient estimates on *Friendly board* remain positive and significant. Finally, in models 3 and 6, we directly measure CEOs' innovative ability by including the average number of patents (citations) in the past 3 years. Again, we restrict the sample to CEOs with tenures exceeding 3 years. Our results do not change.

To further examine whether directors' influence on CEO selection affects innovation, we decompose *Friendly board* into two indicators, one for connected directors who are appointed before the appointment of the incumbent CEO (12.3% of the sample) and another for those who are appointed after the appointment of the incumbent CEO (11.8% of the sample).[20] If directors use private information obtained from their

[19] The SAT score data comes from the Integrated Postsecondary Education Data System produced by the National Center for Education Statistics, a division of the U.S. Department of Education. The number is the historical median SAT score of incoming freshmen students at the time the CEO attended school. For schools that report ACT instead of SAT, the ACT scores are converted to SAT scores using the conversion table provided by the College Board. We thank Stephen Dimmock for sharing the SAT score data.

[20] The numbers add up to less than 28% (the proportion of friendly boards in the sample) because in some cases, the CEO is appointed at the same time as the director and the two indicator variables would both be equal to zero.

social connections to hire more capable CEOs, we would expect that the effect of friendly directors on innovation derives mainly from connected directors who are in place before the appointment of the incumbent CEO. The results are reported in Panel B of Table 3. We find that that the coefficient estimates on both indicators are positive and significant, although the significance (and magnitude) of the coefficient estimate on the former indicator is stronger. The difference in coefficient estimates on these two indicators is significant at the 5% (10%) in model 1 (2). [21] Thus, our results for the positive effect of *Friendly board* on innovation are not likely to be entirely driven by private information held by connected directors about prospective CEOs.

CEOs who are well-connected may differ in many unobservable dimensions compared to CEOs who are not. Although we control for several CEO characteristics in the regressions, it is still possible that *Friendly board* is picking up unobservable personal traits of socially-connected CEOs. Therefore, in Table 4, we perform two placebo tests. In Panel A, we first match the CEO to the board of another firm that is in the same Fama-French 48 industry classification and closest in total sales within +/-30% of the firm's sales. We, then, create *Friendly board* based on this pseudo board. If *Friendly board* in previous tests is picking up the effects of certain CEO personality traits on innovation outcomes, we should see that this measure based on pseudo board connections is also positive and significant in predicting innovation outcomes. We find that 10.21% of the firm-year observations in our sample have this pseudo friendly board. However, we find that the coefficient estimate on the pseudo friendly board variable is not significant.

In Panel B of Table 4, we add the variable that measures the average connections of the current CEO to local directors who sit on boards of *other* firms located within the same two-digit zip code. We find that on average firm's current CEO are connected to 3.69% of these local directors. We find that the coefficient estimate on this variable is not significant. Including it in the regressions does not change the significance of *Friendly board*.

[21] This result is consistent with the view that longer-tenured connected directors may be better at advising the CEO than shorter-tenured connected directors (Kim, Mauldin, and Patro, 2014).

4.2. Omitted firm characteristics bias

4.2.1. Propensity score matching

Although we control for various firm characteristics in the regressions, *Friendly board* may pick up nonlinear effects of these control variables on innovation outcomes. In addition, being different on observables would most likely also translate to differences in unobservables. To alleviate these concerns, we employ a matching technique that controls for selection based on observable firm characteristics: matching and treatment samples are similar in observable characteristics but differ in the existence of friendly board.

The matching procedure that we employ is a one-to-one nearest neighbour matching with replacement (Heckman, Ichimura, and Todd, 1997). We also employ two additional matching techniques – Gaussian kernel and local linear. The matching starts with a probit regression in which the dependent variable is *Friendly board* and the explanatory variables are the same as those in the baseline regression. Then, using the predicted probabilities—propensity scores—estimated from the probit regressions, we match to each friendly board firm-year observation a non-friendly board firm-year observation. To ensure the quality of the match, we drop 2% of the observations for which the propensity score density of the matched observations is the lowest (Smith and Todd, 2005; Bae, Kang, and Wang, 2011).

In Panel A of Table 5, we report the average firm characteristics of the treated firms (firms with friendly boards) and the matching firms without friendly boards and test the differences in these characteristics. We find that other than board size where the matched firms have marginally bigger boards, there are no statistical differences in firm and board characteristics between the two groups of firms, suggesting that the matching is effectively done.

Next, we calculate the difference in log (1+patent) and log (1+citation) between firms with and without friendly boards using each matching technique. We use bootstrapped standard errors based on 50 replications. The results are reported in Panel B of Table 5. We find that on average firms with friendly boards have significantly higher patent (citation) counts than matching firms without friendly boards.

Therefore, the positive effect of friendly boards on innovation outcomes is unlikely to be driven by observable firm characteristics other than board friendliness.

Summary statistics in Panel C of Table 1 suggest the firms with friendly boards have significantly larger firm size and board size. The regression analysis in Panel B of Table 2 controls for the effects of firm size and board size on innovation outcomes. However, to further alleviate the concern that board friendliness may simply be capturing firm or board size, in untabulated tests we perform a propensity score matching analysis that controls for only firm size and board size. We then run our baseline regressions for the pooled sample of treated firms and matching control firms. We find that our main conclusions do not change using this alternative match scheme.

4.2.2. Controlling for firm fixed effects and other firm characteristics

To further mitigate the concern that the results are driven by omitted firm characteristics, in Table 6, we report results of several checks where we explicitly control for various firm characteristics. First, we run firm fixed effects regressions to mitigate concerns about *unobservable* firm characteristics. The results are shown in Panel A of Table 6. We find that the coefficient estimate on *Friendly board* is marginally significant for patent counts but insignificant for citation counts. These results, however, are not surprising given that within-firm variations in board friendliness are very small in our sample. Thus, to increase the precision of the fixed effects regressions, we include only firms that experience CEO changes in the sample regressions in Panel B.[22] We find that a friendly board is associated with a 6% increase in patent counts (*p*-value = 0.03) and a 9% increase in citation counts (*p*-value = 0.10).

Second, in Panels C and D, we explicitly control for firms' innovation capabilities using the average innovation output either in the previous 3 years or the 3 years before the beginning of our sample period. Using the rolling 3-year average is expected to control for time-varying firm characteristics that affect both

[22] As expected, the subsample of firms that experience a CEO change shows greater within-firm variation in board friendliness than the full sample: the average within-firm standard deviation is 0.066 for the reduced sample and 0.044 for the full sample.

board friendliness and firm innovation outcomes. Our friendly board variable continues to be significant in predicting innovation outcomes.

Third, although in the baseline regression, we control for one-year lagged stock return and operating performance, these short-term performance measures may not be enough to control for firms' overall success. CEOs of innovative and successful firms may face less pressure from outside investors， and, as a result, can appoint their friends to the board. To rule out this explanation, we control for past 3-years average stock return and operating performance in Panels D and E. *Friendly board* continues to be significantly positive with similar magnitudes. Finally, in Panel G, we decompose total institutional investors into dedicated and other institutional investors using Bushee's (1998) institutional investor classification and find that our results continue to hold.[23]

In sum, our series of tests show that the observed relation between board friendliness and patenting outcomes is unlikely to be attributable to omitted firm characteristics.

4.3. Omitted board characteristic

We argue that friendly boards improve firm innovation because they facilitate better information exchange between the CEO and the board and this better information environment enables the board to provide better advice, leading to better innovation outcomes. However, it is possible that the CEO-director connections mainly capture the quality of advice provided by the board, not better information exchange since boards with connected directors may be better at advising. To rule out this alternative story, we adopt a propensity score matching approach and control for the quality of director advising. We capture the quality of director advising using their education and previous industry experience in other firms whose industry is the same as the focal firm's industry. A high quality education may proxy for the innate ability of the director while same-industry work experience proxy for her accumulated ability in advising. Faleye, Hoitash, and Hoitash (2014) find that directors with industry expertise improves board advising quality. To

[23] Previous studies show that dedicated institutional investors are more likely to perform a monitoring role relative to other types of institutional investors (see e.g., Chen, Harford, and Li, 2007)

measure outside directors' education quality, we use the SAT scores of their undergraduate programs. To measure industry experience, we use the number of years the director has previously worked as a senior manager in other firms that share the same Fama-French 48 industry as the focal firm.[24]

We then match each firm with a connected director (treatment firm) to a firm without a connected director (control firm). To ensure comparability in the overall board advising quality across treatment and control firms, we calculate the average education quality and the average industry expertise of the outside directors. Specifically, we perform a probit regression in which the dependent variable is *Friendly board* (an indicator that equals one if the board has a connected director and zero otherwise) and the explanatory variables are log (average SAT scores of outside directors' undergraduate schools) and log (average number of years of same-industry experience). Next, using the predicted probabilities estimated from the probit regressions, we match each friendly board firm-year observation to a non-friendly board firm-year observation. We employ one-to-one nearest neighbour matching. Using these treatment and control firms, we re-run the baseline regressions in Table 2. In untabulated results, we find that our conclusions remain the same. Therefore, our results are unlikely due to *Friendly board* proxying purely for the quality of board advising but more likely due to efficiencies arising from better information sharing between the CEO and the board.

4.4. Reverse causality

If innovative opportunities are predictable, it is possible that firms may tailor board structure to better capitalize on the opportunities as they arise. For example, firms foreseeing a wave of innovative opportunities may try to stack the board with friendly directors who are less likely to censor the investments. In this case, we might detect a spurious relation between the presence of friendly boards and innovation not

[24] Following Custódio and Metzger (2013), senior management positions includes CEO, CFO, COO, chairman, president, division CEO, division CFO, division chairman, division COO, division president, head of division, regional CEO, regional CFO, and regional president.

because friendly directors help firms create more innovations, but simply because they are being matched to innovative firms.

To address this concern, we divide *Friendly board* into two (not mutually exclusive) indicators, an indicator that equals to one if the CEO is connected to at least one newly-appointed director and an indicator that equals to one if the CEO is connect to at least one seasoned director. We define newly-appointed (seasoned) directors as those whose tenure at the firm is below (above) the sample median tenure, which is 3 years. If friendly directors are appointed because the firms anticipate future innovation opportunities, we should observe the effect of CEO-director connection on firm innovation to be more pronounced when the connection is with newly-appointed connected directors than when it is with seasoned connected directors.

The results are reported in Table 7. We find that the effect of social connections on innovation holds for both newly-appointed and seasoned connected directors. For example, newly-appointed friendly directors are associated with a 5.7% increase in patent counts and a 3.7% increase in citation counts, while seasoned friendly directors are associated with a 16.3% increase in patent counts and a 23.8% increase in citation counts. The differences in coefficient estimates between newly-appointed and seasoned connections are significant at the 5% and 1% levels in models 1 and 2, respectively. These results do not support the board adjustment explanation.[25] Instead, given that Kim, Mauldin, and Patro (2014) find that longer-tenured directors are better at providing advice as these directors have more firm-specific knowledge, the results are consistent with the view that friendly boards enhance information exchange, thereby allowing boards to provide better advice to improve the innovation process.

4.5. Instrumental variables approach

[25] One concern is that if it takes some time for the patents to materialize, then the newly-appointed directors who commissioned the R&D may have already become seasoned directors. To address this concern, we use 3 year lead innovation output as the dependent variable and repeat the analysis in Table 6. We find similar results. Specifically, newly-appointed friendly directors are associated with a 3.4% (p-value = 0.08) increase in patent counts and a 4.0% (p-value = 0.06) increase in citation counts, while seasoned friendly directors are associated with a 15.8% (p-value = 0.00) increase in patent counts and a 23.2% (p-value = 0.00) increase in citation counts.

To more formally address the endogeneity problems, we use an instrumental variables (IV) approach. To construct our instrument variable, we focus on nearby firms that share the same two-digit zip code as the focal firm. Furthermore, we include only nearby firms that are in industries different from those of the focal firms, and are in non-innovative industries.[26] Our instrument is then computed as the average number of CEO-director connections of the nearby firms. Thus, our IV measures the connections between the CEOs of nearby firms and their own board of directors, *not* between the CEO of the focal firm and the directors of other nearby firms. There is evidence that firms try to appoint directors from the local talent pool (Knyazeva, Knyazeva, and Masulis, 2013), suggesting that firms located in areas where there are more local directors with close connections with the CEOs are more likely to have friendly directors on the board. Thus, our IV is likely to be positively related to a firm's propensity to have a friendly board, thereby satisfying the relevance condition. However, since there is no particular reason why the CEO-director connections of other nearby firms in non-innovative industries affect innovation outcomes of the firm, our IV is likely to satisfy the exclusion criteria as well.

The results are reported in Panel A of Table 8. The control variables are the same as those in the Table 2 regressions. Model 1 shows the result of the first-stage regression where we use ordinary least squares (OLS) regressions to estimate the likelihood of having a friendly board.[27] As expected, we find that our IV is positively and significantly related to the likelihood of firms having friendly boards. The first stage *F*-statistics is 71.92, indicating that the IV is relevant (Staiger and Stock, 1997). Models 2 and 3 report results from the second-stage regressions in which we respectively use the patent count and citation count as the

[26] Following Chang et al. (2015), we consider only nearby firms in different Fama-French 48 industries to avoid local knowledge spillovers across firms in the same industry. We also consider only firms in non-innovative industries because firms' propensity to innovate is likely to vary depending on their geographic location (e.g., Jaffe, Trajtenberg, and Henderson, 1993). An innovative industry is the industry where the average citation (adjusted for truncation bias) per patent for the industry is greater than the median average citation across all industries.

[27] Angrist and Krueger (2001) point out the pitfalls of using non-linear models to estimate the first-stage regressions when dealing with endogenous dummy variables, and suggest that using a linear model to estimate the first-stage regression generates consistent second-stage estimates in such cases. Nevertheless, our results are robust to using a probit model in estimating the first-stage regression.

dependent variables. We find that the coefficient estimate on the instrumented *Friendly board* is positive and significant at the 5% level in both specifications.

To further ensure that our geography-based instrument is not picking up regional differences in propensity to innovate or driven by the technology firms in Silicon Valley, we exclude all firms headquartered in California when estimating the 2SLS regressions and find that our results continue to hold. The results using non-California firms are reported in Panel B of Table 8.

Overall, our series of tests in this section show that the positive relations between innovation and friendly boards are not driven by the endogeneity of the latter variable.

5. Additional evidence on the advisory role of friendly boards

In this section, to shed further light on the determinants of the advisory benefits that friendly boards provide and the channels through which these benefits are obtained, we examine the committee memberships and attendance records of connected directors. We also examine whether the positive relation between friendly boards and innovation output is more pronounced in complex firms where advisory needs are higher.

5.1. Committee membership and board meeting attendance records

First, we examine whether the committee memberships and board meeting attendance records of friendly directors are different from those of non-connected directors. If connected directors are more likely to perform an advisory role, we would expect them to be more often sitting on advisory than monitoring committees. Since committee membership data are only available in BoardEx starting from 2000, the analysis in this subsection is conducted over a sample of 173,980 director-committee-year observations. Following Klein (1998), we consider audit, compensation, and nominating/corporate governance committees as monitoring committees, and classify executive, investment, and finance committees as advisory committees.

In untabulated tests, we find that relative to non-connected directors, connected directors are more likely to be on advisory committees but less likely to be on monitoring committees. Specifically, out of 45,173 connected director observations, 13.1% (80.7%) of the connected directors sit on advisory (monitoring) committees. In contrast, out of the 128,807 non-connected directors, 8.6% (87.4%) of them sit on advisory (monitoring) committees. Chi-square tests reject the null hypothesis that there is no association between committee membership and director connection status. These results are consistent with the view that connected directors are more often appointed for their advisory than for their monitoring services, and accordingly are assigned to the committees that especially enable them to utilize their expertise.

Next, we examine the board attendance records of connected and non-connected directors. This test is estimated on a reduced sample of 7,231 firm-year observations since the data on attendance records is obtained from the Risk Metrics director database. We run a logit regression where the dependent variable is an indicator that takes the value of one if the director attended less than 75% board meetings during the year and zero otherwise. We include as control variables log (sales), ROA, board meeting fees, board size, percentage of outside directors, indicators for CEO-chairman duality, busy director, founder CEO, and female director, institutional ownership, and director age. We also include industry and year fixed effects in the regressions. We find that the coefficient estimate on connected directors is negative and marginally significant (p-value=0.097). This result shows that the connected director are not any less attentive to firm affairs than non-connected directors, and thus is *inconsistent* with the reduced-monitoring hypothesis, which attributes the positive relation between innovation performance and friendly boards to connected directors being less engaged in overseeing the CEO.

5.2. Advisory needs of firms

Coles, Daniel, and Neveen (2008) suggest that board advising tends to be more beneficial for firms with complex operations as these firms have greater advisory needs. Following Coles, Daniel, and Naveen (2008) and Faleye, Hoistah, and Hoitash (2013), we use a firm's operating complexity as a proxy for firm's

advisory needs. Under the friendly board hypothesis where the boards provide superior advisory service, we hypothesize that the positive effect of friendly boards on innovation will be more pronounced in firms with more complex operations.

Larger firms have more external contracting relationships, so CEOs of larger firms need more advising from the boards (Coles, Daniel, and Naveen, 2008). Raheja (2005) argues that R&D-intensive firms have higher project verification costs and thus can benefit more from board advising, and firms operating in multiple industries face multi-dimensional operating challenges and competition and therefore have high advisory needs (Hermalin and Weisbach, 1988).

The results are reported in Table 9. In model 1, we use firm size (Log(sales)) to measure a firm's advisory needs and include the interaction between firm size and *Friendly board* as an additional explanatory variable. The coefficient estimate on the interaction term is positive and significant at the 1% level, indicating that the advisory role of friendly boards in innovation is more pronounced for firms with high advisory needs. Our conclusions remain the same when we respectively use R&D intensity and number of business segments to proxy for firm advisory needs (models 2 and 3).

A caveat in our interpretations of the results in Table 9 is that our proxies for advisory needs may also reflect agency problems. For example, it is often argued that high R&D firms or multi-segment firms tend to have more shareholder-management agency conflicts. To verify our interpretations of Table 9 results, in Table 10, we use independent measures of agency problems that do not bear close relations with firms' advisory needs. Following previous studies, we measure potential agency problems and monitoring needs with analyst following (Faleye, Hoitash, and Hoitash, 2011), free cash flow (Jensen, 1986), CEO tenure, and the fraction of co-opted directors on the board (Coles, Daniel, and Naveen, 2014). We find little evidence that friendly boards have a greater effect on innovation for firms with high monitoring needs. On the contrary, there is some evidence that friendly boards have a stronger effect on innovation for firms with limited agency problems. For example, we find that the positive impact of friendly boards on innovation is stronger among firms with a higher number of analysts following where internal monitoring needs are likely to be low. Moreover, the positive impact of friendly boards on innovation performance is attenuated among

firms with high free cash flow but low Tobin's *q* where monitoring needs are potentially high. The results in Table 10 also allow us to reconcile our findings with those in previous studies that show a dark side of social ties: the findings on the benefit of friendly boards are especially relevant when agency problems are limited and monitoring needs are low.

Overall, the cross-sectional analysis shows that friendly boards are especially beneficial for firms with high advisory needs, consistent with friendly boards playing an important advisory role in the innovation process.

5.3. Effect of industry innovativeness

Although the results in previous sections show a positive effect of friendly boards on innovations, the channels through which this positive effect arises still remain unclear. It is possible that advising by friendly boards mainly helps management identify the most promising projects from the innovation opportunities available to the firms. Alternatively, it is possible that friendly boards bring more innovative ideas to the management and improve firm innovation by expanding the set of innovation opportunities. To test these two different views, we divide the sample firms into those in innovative and non-innovative industries and find that friendly boards significantly increase patent counts and citation counts only for firms belonging to an innovative industry, suggesting that the benefit of improving management choices is more important than that of increasing the set of innovation opportunities.

6. Friendly boards and firm value

Our results, thus far, show that friendly boards are associated with increased innovation performance, especially among firms with high advisory needs. Adams and Ferreira (2007) argue that the advising function of friendly boards increases firm value, particularly for firms to which board advising is more important relative to board monitoring. To this end, we regress Tobin's *q* on *Friendly board*, measures of firm advisory needs, and the interaction terms between these measures and *Friendly board*. The results are reported in Table 11. In general, we find that the value of firms with friendly boards that have high advisory

needs is higher than that of other firms. For example, the coefficient estimate on the interaction term between *Friendly board* and the firm size (multi-segment firm indicator) is positive and significant at the 1% (10%) level in model 1 (model 3).

To further identify the channel through which *Friendly board* affects firm value, we divide our sample firms according to whether they belong to innovative industries and re-estimate the regression separately for the two subsamples. Since innovation is a more important source of firm value in innovative industries, we expect the positive relation between Tobin's *q* and the interaction term to be more pronounced in innovative industries than in non-innovative industries. Indeed, we find that the positive valuation effects of the interaction terms apply primarily to firms that belong to innovative industries (models 4-6). In contrast, the coefficient estimates on the interaction terms between *Friendly board* and firm advisory needs are insignificant in the subsample of firms in non-innovative industries (models 7-9).

Previous studies show that boards with CEO-director social connections perform a weak monitoring role, resulting in reduced firm value on average (Hwang and Kim, 2009; Fracassi and Tate, 2012). Our results indicate that socially connected boards add value to firms for which innovation is a key source of firm value.

7. Alternative types of social connections: Connections from professional activities

Past studies on CEO-board connections (e.g. Fracassi and Tate, 2012) do not distinguish between connections arising from non-workplace activities, such as schooling and memberships in the same non-business organization, and those arising from professional activities, such as common past employment. As additional tests, we classify a board as friendly if at least one of the outside directors and the CEO previously worked together in the same company for at least one year as either a senior executive or a director. We then re-estimate the previous regressions and find that connections based on common employments do not have any significant impact on innovation activities, even for firms with high advisory needs. Our findings of the different effects of the connections arising from non-professional and professional activities on innovation are consistent with those of Cai, Walkling, and Yang (2014) who find that non-professional ties

are more important for information transfers than professional ties. Similarly, Chidambaran, Kedia, and Prabhala (2011) find that professional connections between the CEO and directors lower the likelihood of fraud while non-professional connections increase fraud incidence. Thus, directors with professional connections are more likely to be monitors rather than advisors.

8. Summary and Conclusion

In this paper, we examine how friendly boards affect firm performance in innovation activities. Using social connections (i.e., connections arising from common educational background and memberships in non-business organizations) between CEOs and directors as a measure of board friendliness, we find robust results indicating that firms with friendly boards achieve more patents and higher quality innovations. These results are generally consistent with the view that friendly boards facilitate greater information exchanges between management and the boards, thereby enabling boards to provide better advising. The beneficial effect of friendly boards on innovation performance may also come from their reduced monitoring of CEOs. We do not pose these two effects as mutually exclusive hypothesis but acknowledge that both channels could influence innovation. As past papers have already shown that intense monitoring by directors reduce innovation, we focus our effort on trying to provide evidence that the advising channel is also present. In particular, our results are stronger for firms with higher advisory needs and firms in innovative industries. We further find that relative to non-connected directors, connected directors are more likely to serve on advisory committees but are less likely to be on monitoring committees.

Overall, our results highlight the importance of board friendliness to boards' advisory role in firm innovation activity. The results therefore lend support to the perspective that directors are not merely monitors of but also advisors to firm CEOs.

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Table 1: Summary statistics

The initial sample consists of all non-financial and non-utility firms in BoardEx from 1990 to 2004. To be included in the final sample, firms are required to have financial and stock price data from Compustat and CRSP, respectively, patent data from the NBER patent dataset, and board data from BoardEx. The sample consists of 29,340 firm-year observations. Detailed CEO and director profile information from BoardEx is used to measure social ties between the CEO and directors. Connected directors are outside directors who attend the same university or are members of the same clubs/not-for-profit organizations as the CEO. We consider the board to be friendly if at least one outside director is connected to the CEO. Panel A shows summary statistics for different types of social connections. Panel B reports the summary statistics for selected director characteristics. Panel C shows the summary statistics for innovation performance and board and firm characteristics used in the regression analysis. Appendix A provides a detailed description of the construction of the variables. Two-sample *t*-tests (Wilcoxon-Mann-Whitney tests) are used to test whether the means (medians) of characteristics for connected firm-year / director-firm-year observations are significantly different from those for non-connected firm-years / director-firm-year observations. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: CEO ties to outside directors

Type of connections	Connected firm-years (%)	Number of connected directors / number of outside directors (conditional on the existence of connected directors)			
		p25	Median	Mean	p75
	(1)	(2)	(3)	(4)	(5)
Same school: a	15.56	0.17	0.25	0.29	0.33
Same non-business organization: b	17.87	0.15	0.25	0.28	0.33
Any type of a or b	28.06	0.17	0.25	0.32	0.40

Panel B: Director characteristics (using director-firm-year data)

	Connected outside directors (N = 16,314)		Non-connected outside directors (N = 177,151)	
	Mean	Median	Mean	Median
Director age (year)	58.37	59.00	56.86***	57.00***
Director is female (%)	7.07	--	5.43***	--
Director tenure (years)	6.67	5.00	6.29***	4.00***
Number of board seats	4.06	3.00	3.27***	2.00***
Attend < 75% of board meeting (%)	2.6	--	2.9	--
Experience in the same industry (years)	3.12	0.00	4.79***	0.00***
Experience in other industries (years)	10.67	0.00	6.11***	0.00***

Panel C: Innovation performance and board and firm characteristics (using firm-year data)

	Firm-years with friendly board (N = 8,232)		Firm-years with no friendly board (N = 21,108)	
	Mean	Median	Mean	Median
Innovation performance variables:				
Number of patents	28.66	0.00	6.28***	0.00***
Number of citations (adjusted)	192.96	0.00	38.10***	0.00***
Number of citations without truncation adjustment	440.37	0.00	88.43***	0.00***
Board and CEO characteristics:				
Board size	8.30	8.00	6.22***	6.00***
Fraction of outside directors	0.75	0.79	0.68***	0.71***
Fraction of co-opted directors	0.32	0.29	0.30***	0.25***
Log (external connections of CEO)	6.57	6.77	4.39***	5.16***
Log (external connections of outside directors)	6.73	6.94	6.01***	6.53***
CEO duality	0.67	--	0.58***	--
CEO tenure	6.17	4.00	6.04	4.00
Firm characteristics:				
Sales (millions of 2004 $)	4139.12	647.98	1165.43***	184.19***
R&D / assets	0.05	0.00	0.07***	0.00
Capital intensity	4.02	3.86	3.66***	3.53***
Cash	0.11	0.05	0.13***	0.07***
Leverage	0.22	0.21	0.21***	0.16***
Stock return	0.18	0.10	0.17	0.06***
ROA	0.11	0.13	0.05***	0.12***
Tobin's *q*	2.07	1.55	2.05	1.53***
Sales growth	0.30	0.09	0.60*	0.11***
Innovative industry	0.67	--	0.67	--
Segments	2.20	1.00	1.79***	1.00***
Firm age	19.29	12	12.11***	8.00***
Institutional ownership	0.44	0.45	0.35***	0.30***
Industry concentration	0.06	0.05	0.06	0.05

Table 2: Effect of friendly boards on firm innovation

The table presents results of regressing firm innovation on friendly board. The patent data is from the NBER patent dataset. Boardex provides the information on board structure and CEO and director profile and is used to measure social ties between the CEO and director. Connected directors are outside directors who attend the same university or are members of the same clubs/not-for-profit organizations as the CEO. We consider the board to be friendly if at least one outside director is connected to the CEO. Patent is the number of patents applied for during the year. Citation is the total number of citation counts of all patents applied for during the year. To take into account the truncation bias due to the finite length of the sample period, the number of citations earned by each patent is multiplied by the weighting index (Hall, Jaffe, and Trajtenberg, 2001) provided in the NBER patent database. All independent variables are lagged by one year. In Panel A, we show results from our baseline regressions. In Panel B, we examine the effects of firm size and board size on the relation between friendly boards and innovation outcomes. We divide the firms into quintiles according to their sales revenues and board size, respectively, and include an indicator for each quintile group and its interaction with *Friendly board*. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Baseline regressions

	Log (1+patent)		Log (1+citation)	
Variables	(1)	(2)	(3)	(4)
Friendly board (indicator)	0.117***		0.144***	
	(0.00)		(0.01)	
Only one outside director is connected to CEO (indicator)		0.075**		0.104*
		(0.03)		(0.07)
Multiple outside directors are connected to CEO (indicator)		0.192***		0.214**
		(0.00)		(0.01)
Board size	0.014*	0.012*	0.010	0.009
	(0.06)	(0.10)	(0.32)	(0.39)
Fraction of outside directors	0.105	0.093	0.284*	0.273*
	(0.27)	(0.33)	(0.07)	(0.08)
Fraction of co-opted directors	0.121**	0.122**	0.192**	0.193**
	(0.01)	(0.01)	(0.02)	(0.02)
Log (external connections of CEO)	0.028***	0.028***	0.048***	0.048***
	(0.00)	(0.00)	(0.00)	(0.00)
Log (external connections of outside directors)	0.003	0.003	0.021	0.021
	(0.69)	(0.69)	(0.15)	(0.15)
CEO duality	0.044*	0.043*	0.065	0.063
	(0.07)	(0.08)	(0.11)	(0.12)
CEO tenure	-0.009***	-0.009***	-0.013***	-0.013***
	(0.00)	(0.00)	(0.00)	(0.00)
Log (sales)	0.268***	0.267***	0.383***	0.382***
	(0.00)	(0.00)	(0.00)	(0.00)
R&D / assets	1.903***	1.899***	3.302***	3.299***
	(0.00)	(0.00)	(0.00)	(0.00)
Capital intensity	0.149***	0.149***	0.229***	0.229***
	(0.00)	(0.00)	(0.00)	(0.00)
Cash	0.349***	0.350***	0.563***	0.564***
	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	-0.335***	-0.333***	-0.593***	-0.591***
	(0.00)	(0.00)	(0.00)	(0.00)
Stock return	-0.011*	-0.011*	-0.002	-0.002
	(0.08)	(0.08)	(0.84)	(0.85)
ROA	0.028	0.028	0.114	0.113
	(0.55)	(0.56)	(0.15)	(0.15)
Tobin's *q*	0.048***	0.048***	0.082***	0.082***
	(0.00)	(0.00)	(0.00)	(0.00)
Sales growth	-0.008	-0.008	-0.014	-0.014
	(0.78)	(0.79)	(0.81)	(0.81)
Firm age	0.010***	0.010***	0.014***	0.014***
	(0.00)	(0.00)	(0.00)	(0.00)
Institutional ownership	-0.226***	-0.225***	-0.137	-0.137
	(0.00)	(0.00)	(0.15)	(0.15)
Industry concentration	-0.705*	-0.705*	-1.502**	-1.503**
	(0.07)	(0.08)	(0.03)	(0.03)
Observations	29,340	29,340	29,340	29,340
Adjusted R^2	0.434	0.434	0.398	0.398
Year fixed effects	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y

Panel B: Regressions with indicators for firm size and board size quintiles

	Log (1+patent)		Log (1+citation)	
Variables	(1)	(2)	(3)	(4)
Friendly board (indicator): a	0.005*	0.020**	0.003**	0.028*
	(0.09)	(0.02)	(0.04)	(0.06)
2nd quintile of sales	0.171***		0.258***	
	(0.00)		(0.00)	
3rd quintile of sales	0.421***		0.675***	
	(0.00)		(0.00)	
4th quintile of sales	0.649***		1.020***	
	(0.00)		(0.00)	
5th quintile of sales	1.174***		1.747***	
	(0.00)		(0.00)	
2nd quintile of sales * a	0.014*		0.009**	
	(0.07)		(0.05)	
3rd quintile of sales * a	0.011**		0.026*	
	(0.03)		(0.06)	
4th quintile of sales * a	0.028**		0.019**	
	(0.04)		(0.02)	
5th quintile of sales * a	0.044**		0.042**	
	(0.02)		(0.03)	
2nd quintile of board size		0.026		0.068
		(0.33)		(0.19)
3rd quintile of board size		0.032		0.078
		(0.39)		(0.24)
4th quintile of board size		0.001		0.015
		(0.98)		(0.84)
5th quintile of board size		0.016		0.029
		(0.79)		(0.77)
2nd quintile of board size * a		0.030**		0.027**
		(0.04)		(0.05)
3rd quintile of board size * a		0.032		0.031**
		(0.11)		(0.03)
4th quintile of board size * a		0.025**		0.012**
		(0.03)		(0.02)
5th quintile of board size * a		0.021**		0.017**
		(0.02)		(0.04)
Other controls in Panel A of Table 2	Y	Y	Y	Y
Observations	29,340	29,340	29,340	29,340
Adjusted R^2	0.504	0.532	0.528	0.554
Year fixed effects	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y

Table 3: Endogeneity issues: Controlling for omitted CEO characteristics

The table presents results of regressing firm innovation on friendly board controlling for CEO innovative ability and CEO selection. Connected directors are outside directors who attend the same university or are members of the same clubs/not-for-profit organizations as the CEO. We consider the board to be friendly if at least one outside director is connected to the CEO. Patent is the number of patents applied for during the year. Citation is the total number of adjusted citation counts of all patents applied for during the year. Panel A shows regression results where the measures of CEO ability are controlled for. Panel B reports regression results where the indicator *Friendly board* is separated into two indicators, indicators for whether there is at least one connected director who is appointed before and after the incumbent CEO is appointed. All independent variables are lagged by one year. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Controlling for CEO innovative ability

	Log (1+patent)			Log (1+citation)		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Friendly board (indicator)	0.143***	0.161***	0.043**	0.173**	0.184**	0.083*
	(0.00)	(0.00)	(0.05)	(0.03)	(0.02)	(0.06)
Log (CEO's undergraduate institution SAT score)	0.325* (0.09)			0.383 (0.23)		
Average industry adjusted return in previous 3 years		0.019 (0.62)			0.025 (0.70)	
Average number of patent in previous 3 years			0.775*** (0.00)			
Average number of citation in previous 3 years						0.554*** (0.00)
Other controls in Table 2	Y	Y	Y	Y	Y	Y
Observations	14,702	16,795	16,795	14,702	16,795	16,795
Adjusted R^2	0.490	0.468	0.650	0.450	0.432	0.628
Year fixed effects	Y	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y	Y
Sample used	Full	CEO tenure>3	CEO tenure>3	Full	CEO tenure>3	CEO tenure>3

Panel B. Controlling for CEO selection

Variables	Log (1+patent)	Log (1+citation)
Connected director is appointed before incumbent CEO (indicator)	0.203*** (0.00)	0.276*** (0.00)
Connected director is appointed after incumbent CEO (indicator)	0.058* (0.08)	0.090* (0.09)
Other controls in Table 2	Y	Y
Observations	29,340	29,340
Adjusted R^2	0.434	0.399
Year fixed effects	Y	Y
Industry fixed effects	Y	Y

Table 4: Endogeneity issues: Placebo tests

The table presents results of placebo tests in which we construct pseudo boards by matching the CEO to the boards of other similar firms and then regress firm innovation on the friendliness of these pseudo boards. Connected directors are outside directors who attend the same university or are members of the same clubs/not-for-profit organizations as the CEO. *Friendly board* is an indicator variable that equals one if the CEO is connected to at least one outside director from his own firm. In Panel A, *Pseudo friendly board* is an indicator that equals one if the CEO is connected to at least one outside director from another matched firm. We match the CEO to the board of another firm that is in the same industry and closest in total sales within +/-30% of the firm's sales. In Panel B, we match the CEO to the boards of other firms located within the same 2-digit zip code. *Average connections between CEO and local directors* is the average number of connections between the current CEO and outside directors of other nearby firms. All independent variables are lagged by one year. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Industry and size-matched firms

	Log (1+patent)		Log (1+citation)	
Variables	(1)	(2)	(3)	(4)
Pseudo friendly board (indicator)	0.052	0.047	0.048	0.042
	(0.19)	(0.21)	(0.41)	(0.47)
Friendly board (indicator)		0.117***		0.145***
		(0.00)		(0.01)
Control variables in Table 2	Y	Y	Y	Y
Observations	29,340	29,340	29,340	29,340
Adjusted R^2	0.432	0.433	0.397	0.398
Year fixed effects	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y

Panel B. Local firms

	Log (1+patent)		Log (1+citation)	
Variables	(1)	(2)	(3)	(4)
Average connections between CEO and	-0.034	-0.277	-0.164	-0.473
local directors	(0.92)	(0.39)	(0.75)	(0.36)
Friendly board (indicator)		0.126***		0.161***
		(0.00)		(0.00)
Control variables in Table 2	Y	Y	Y	Y
Observations	29,340	29,340	29,340	29,340
Adjusted R^2	0.432	0.433	0.397	0.398
Year fixed effects	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y

Table 5: Endogeneity issues: Propensity score matching

The table presents results from propensity score matching where firms with friendly boards are matched to firms without friendly boards. The matching starts with a probit regression in which the dependent variable is *Friendly board* and the explanatory variables are the same as those in the baseline regression in Table 2. Then, using the predicted probabilities estimated from the probit regressions, we match to each friendly board firm-year observation a non-friendly board firm-year observation. We employ one-to-one nearest neighbour matching, Gaussian kernel matching, and local linear matching. Panel A reports summary statistics for firm characteristics between sample (treated) firm and matched firm from the nearest neighbour matching technique. Appendix A provides a detailed description of the construction of the variables. Panel B reports results from the propensity score matching where the numbers reported are the differences in log (1+patent) and log (1+citation) between firms with and without friendly boards. *P*-values based on bootstrapped standard errors using 50 replications are reported in parentheses and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Summary statistics for firm characteristics between treated firm and matched firm

Variables	Treated firm (Mean)	Matched firm (Mean)	Test of difference *t*-statis
Board size	8.30	8.41	-1.89*
Fraction of outside directors	0.75	0.75	0.82
Fraction of co-opted directors	0.32	0.34	-1.45
Log (external connections of CEO)	6.57	6.45	1.29
Log (external connections of outside directors)	6.73	6.63	1.47
CEO duality	0.67	0.69	-0.59
CEO tenure	6.17	6.49	-1.24
Log (sales)	6.44	6.49	-0.96
R&D / assets	0.05	0.05	0.45
Capital intensity	4.02	4.02	0.16
Cash	0.11	0.11	0.20
Leverage	0.22	0.23	-0.99
Stock return	0.18	0.25	-0.57
ROA	0.11	0.10	0.84
Tobin's *q*	2.07	2.18	-0.36
Sales growth	0.30	0.00	1.05
Firm age	19.29	19.69	-0.10
Institutional ownership	0.44	0.43	1.60
Industry concentration	0.06	0.06	-0.61

Panel B. Propensity score matching: Differences in innovation outcomes

	Log (1+patent)			Log (1+citation)		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Difference in innovation outcomes between firms with friendly boards and matched firms without friendly boards	0.122***	0.126***	0.112***	0.205***	0.202***	0.199***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)
Matching method	Nearest neighborhood	Gaussian Kernel	Local Linear	Nearest neighborhood	Gaussian Kernel	Local Linear

Table 6: Endogeneity issues: Controlling for omitted firm characteristics

The table presents results from various tests that examine omitted firm characteristics bias. Connected directors are outside directors who attend the same university or are members of the same clubs/not-for-profit organizations as the CEO. We consider the board to be friendly if at least one outside director is connected to the CEO. For brevity, only the coefficients on *Friendly board* indicator and additional control variables are reported. All the regressions also include the set of control variables used in the baseline regression in Table 2. In Panels C and D, we control for the average number of patent when predicting patent counts and average number of citation when predicting citation. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Log (1+patent)	Log (1+citation)
Panel A: Controlling for firm fixed effects: Full sample		
Friendly board (indicator)	0.043*	0.067
	(0.06)	(0.16)
Panel B: Controlling for firm fixed effects: Subsample of firms with CEO change		
Friendly board (indicator)	0.057**	0.089*
	(0.03)	(0.10)
Panel C: Controlling for average number of patent/citation in previous 3 years		
Friendly board (indicator)	0.036**	0.079**
	(0.04)	(0.03)
Average number of patent/ citation in previous 3 years	0.756***	0.551***
	(0.00)	(0.00)
Panel D: Controlling for average number of patent/citation 3 years before the beginning of sample period		
Friendly board (indicator)	0.064*	0.108*
	(0.06)	(0.07)
Average number of patent/citation 3 years before	0.731***	0.545***
the beginning of sample period	(0.00)	(0.00)
Panel E: Replacing one-year lagged ROA with average ROA in previous 3 years		
Friendly board (indicator)	0.108***	0.133**
	(0.01)	(0.04)
Average ROA in previous 3 years	0.014	0.074
	(0.83)	(0.52)
Panel F: Replacing one year lagged stock return with average stock return in previous 3 years		
Friendly board (indicator)	0.110***	0.141**
	(0.01)	(0.03)
Average stock return in previous 3 years	0.018	0.020
	(0.52)	(0.67)
Panel G: Dividing total institutional ownership into ownership by dedicated and other institutional investors		
Friendly board (indicator)	0.122***	0.158***
	(0.00)	(0.01)
% of shares held by dedicated institutions	-0.297**	-0.394*
	(0.04)	(0.10)
% of shares held by other institutions	-0.163**	-0.095
	(0.02)	(0.38)

Table 7: Reverse causality tests: Selection of friendly directors

The table shows results of regressing firm innovation on friendly board where friendly boards are differentiated based on connected directors' tenure. Connected directors are outside directors who attend the same university or are members of the same clubs/not-for-profit organizations as the CEO. We consider the board to be friendly if at least one outside director is connected to the CEO. Newly-hired (Seasoned) directors are defined as directors with tenure below (above) 3 years. All independent variables are lagged by one year. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Log (1+patent)	Log (1+citation)
Variables	(1)	(2)
CEO is connected with	0.057*	0.037*
newly-hired director (indicator)	(0.09)	(0.08)
CEO is connected with	0.163***	0.238***
seasoned director (indicator)	(0.00)	(0.00)
Other controls in Table 2	Y	Y
Observations	29,340	29,340
Adjusted R^2	0.434	0.399
Year fixed effects	Y	Y
Industry fixed effects	Y	Y

Table 8: Two stage least square (2SLS) regression of friendly boards on firm innovation

The table presents results from 2SLS regressions. In the first stage, we use OLS regressions to estimate the likelihood of having a friendly board. In the second stage, we regress firm innovation on instrumented *Friendly board*. Connected directors are outside directors who attend the same university or are members of the same clubs/not-for-profit organizations as the CEO. We consider the board to be friendly if at least one outside director is connected to the CEO. We use as the instrumental variable the average number of CEO-director connections in other firms that are located in the same 2-digit zip code but are in different industries and in non-innovative industries. Panel A reports results using full sample and Panel B reports results using non-California firms only. All independent variables are lagged by one year. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Full Sample

	1st stage	2nd stage	
	Friendly board	Log (1+patent)	Log (1+citation)
Variables	(1)	(2)	(3)
Instrumented Friendly board (indicator)		0.200**	0.255**
		(0.01)	(0.02)
Average number of connections between the directors and CEOs of local firms	1.423***		
	(0.00)		
Control variables in Table 2	Y	Y	Y
Observations	29,340	29,340	29,340
Adjusted R^2	-	0.422	0.380
Partial R^2	0.112	-	-
F-statistics for 1st stage	71.92	-	-
Year fixed effects	Y	Y	Y
Industry fixed effects	Y	Y	Y

Panel B: Subsample of non-California firms

	1st stage	2nd stage	
	Friendly board	Log (1+patent)	Log (1+citation)
Variables	(1)	(2)	(3)
Instrumented Friendly board (indicator)		0.170**	0.260**
		(0.02)	(0.02)
Average number of connections between the directors and CEOs of local firms	1.253***		
	(0.00)		
Control variables in Table 2	Y	Y	Y
Observations	25,206	25,206	25,206
Adjusted R^2	-	0.401	0.391
Partial R^2	0.106	-	-
F-statistics for 1st stage	65.31	-	-
Year fixed effects	Y	Y	Y
Industry fixed effects	Y	Y	Y

Table 9: Firms' advisory needs and innovation

The table examines the effect of a firm's advisory needs on the relation between friendly board and firm innovation. The firm's advisory needs are measured by firm size, the ratio of R&D expenditure to total assets, and an indicator that equals one if the firm has more than one business segment as reported in the Compustat segment files and zero otherwise. We consider the board to be friendly if at least one outside director and the CEO attended the same university or are members of the same clubs/not-for-profit organizations. Panels A and B report results from the regressions in which the dependent variables are log (1+patent) and log (1+citation), respectively. All independent variables are lagged by one year. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Patent counts as the dependent variable

	Log (1+patent)		
Variables	(1)	(2)	(3)
Friendly board (indicator): a	-0.577***	0.026	0.057
	(0.00)	(0.46)	(0.14)
a*Log (sales)	0.117***		
	(0.00)		
a*R&D / assets		1.649***	
		(0.00)	
a*Multi-segment (indicator)			0.135**
			(0.02)
Control variables in Table 2	Y	Y	Y
Advisory needs proxy included as standalone variable	Y	Y	Y
Observations	29,340	29,340	29,340
Adjusted R^2	0.434	0.441	0.437
Year fixed effects	Y	Y	Y
Industry fixed effects	Y	Y	Y

Panel B: Citation counts as the dependent variable

	Log (1+citation)		
Variables	(1)	(2)	(3)
Friendly board (indicator): a	-0.782***	0.029	0.087
	(0.00)	(0.61)	(0.20)
a*Log (sales)	0.156***		
	(0.00)		
a*R&D / assets		2.073***	
		(0.00)	
a*Multi-segment (indicator)			0.129*
			(0.06)
Control variables in Table 2	Y	Y	Y
Advisory needs proxy included as standalone variable	Y	Y	Y
Observations	29,340	29,340	29,340
Adjusted R^2	0.399	0.398	0.403
Year fixed effects	Y	Y	Y
Industry fixed effects	Y	Y	Y

Table 10: Firms' monitoring needs and innovation

The table examines the effect of a firm's monitoring needs on the relation between friendly board and firm innovation. The firm's monitoring needs are measured by the number of analyst following, the amount of excess cash (Dittmar and Mahrt-Smith, 2007), an indicator that equals one if the firm has high excess cash and low Tobin's *q* (using the medians), CEO tenure, and the fraction of co-opted directors. We consider the board to be friendly if at least one outside director and the CEO attended the same university or are members of the same clubs/not-for-profit organizations. Panels A and B report results from the regressions in which the dependent variables are log (1+patent) and log (1+citation), respectively. All independent variables are lagged by one year. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Patent counts as the dependent variable

	Log (1+patent)				
Variables	(1)	(2)	(3)	(4)	(5)
Friendly board (indicator): a	-0.032	0.093**	0.160***	0.161***	0.150***
	(0.41)	(0.01)	(0.00)	(0.00)	(0.00)
a*analyst following	0.022***				
	(0.00)				
a*excess cash		0.030			
		(0.76)			
a*high excess cash and low Tobin's q (indicator)			-0.158**		
			(0.02)		
a*CEO tenure				-0.007*	
				(0.08)	
a* Fraction of co-opted directors					-0.098
					(0.26)
Control variables in Table 2	Y	Y	Y	Y	Y
Monitoring needs proxy included as standalone variable	Y	Y	Y	Y	Y

Panel B: Citation counts as the dependent variable

	Log (1+citation)				
Variables	(1)	(2)	(3)	(4)	(5)
Friendly board (indicator): a	-0.026	0.123**	0.175***	0.172**	0.165**
	(0.68)	(0.04)	(0.00)	(0.01)	(0.02)
a*analyst following	0.025***				
	(0.01)				
a*excess cash		-0.119			
		(0.42)			
a*high excess cash and low Tobin's q (indicator)			-0.150***		
			(0.01)		
a*CEO tenure				-0.004	
				(0.54)	
a* Fraction of co-opted directors					-0.057
					(0.69)
Control variables in Table 2	Y	Y	Y	Y	Y
Monitoring needs proxy included as standalone variable	Y	Y	Y	Y	Y

Table 11: Effect of friendly boards on firm value

The table presents results of regressing Tobin's *q* on friendly boards. We consider the board to be friendly if at least one outside director and the CEO attended the same university or are members of the same clubs/not-for-profit organizations such as golf clubs, fraternities, charitable organizations, trusts, university boards, etc. Models 1 to 3 show results for the full sample and models 4 to 6 (7 to 9) show results for the subsample of firms in innovative (non-innovative) industries. An innovative industry is the industry where the average citation (adjusted for truncation bias) per patent for the industry is greater than the sample median average citation across all industries. All independent variables are lagged by one year. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Full sample			Innovative industry			Non-Innovative industry		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Friendly board (indicator): a	0.058	0.072	0.031	0.072	0.051	0.002	0.063	0.057	0.085
	(0.27)	(0.17)	(0.65)	(0.25)	(0.32)	(0.98)	(0.44)	(0.44)	(0.33)
Log (sales): b	-0.072**	-0.033	-0.028	-0.081*	-0.082***	-0.020	-0.096***	-0.026	-0.082***
	(0.01)	(0.16)	(0.29)	(0.05)	(0.00)	(0.59)	(0.00)	(0.43)	(0.00)
R&D / assets: c		0.048***			0.098***			0.042***	
		(0.00)			(0.00)			(0.00)	
Multi-segment (indicator): d			-0.388***			-0.465***			-0.159***
			(0.00)			(0.00)			(0.00)
a*b	0.070***			0.089**			0.022		
	(0.01)			(0.01)			(0.52)		
a*c		0.002			0.067*			0.002	
		(0.84)			(0.08)			(0.80)	
a*d			0.138*			0.193*			0.009
			(0.08)			(0.07)			(0.92)
Board size	0.038***	0.041***	0.044***	0.044***	0.028**	0.052***	0.029***	0.049***	0.031***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Fraction of outside directors	-0.185	-0.382**	-0.180	-0.259	-0.206	-0.287	-0.148	-0.511**	-0.126
	(0.32)	(0.03)	(0.34)	(0.33)	(0.20)	(0.29)	(0.37)	(0.04)	(0.45)
Capital intensity	-0.027	-0.025	-0.032	0.012	-0.064***	-0.002	-0.080***	0.007	-0.079***
	(0.28)	(0.31)	(0.19)	(0.75)	(0.00)	(0.96)	(0.00)	(0.85)	(0.00)
Stock return	0.506***	0.490***	0.503***	0.569***	0.248***	0.566***	0.270***	0.557***	0.269***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.000)	(0.00)
ROA	2.224***	1.267**	2.261*	2.543***	1.543***	2.589	0.994**	1.679**	0.947**
	(0.00)	(0.05)	(0.10)	(0.00)	(0.00)	(0.20)	(0.02)	(0.02)	(0.03)
Observations	29,340	29,340	29,340	20,105	20,105	20,105	9,235	9,235	9,235
Adjusted R^2	0.172	0.191	0.174	0.175	0.138	0.178	0.101	0.191	0.104
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y

Appendix A

This appendix defines the variables used in the study.

Variable	Description
Innovation performance variables:	
Average number of patent/ citation 3 years before the beginning of sample period	Average number of patent/ citation over 3 years fiscal years before the beginning of sample period.
Average number of patent/ citation in previous 3 years	Average number of patent/ citation in previous 3 fiscal years.
Citation	Number of citations summed across all patents applied for during the year. Each patent's number of citations is multiplied by the weighting index from Hall, Jaffe, and Trajtenberg (2001) before aggregating up to the firm-year level.
Patent	Number of patents applied for during the year.
R&D / assets	Research and development expenditures scaled by total assets. Missing values are coded with zero.
Connection variables:	
Average connection between CEO and local directors	Average connections of the current CEO to local directors who sit on the boards of other firms located within the same two-digit zip code.
Average number of connections between the directors and CEOs of local firms	Average number of CEO-director connections of local firms that share the same two-digit zip code as the firm, but are in different industries and in non-innovative industries.
the directors and CEOs of local firms	Indicator variable equals to one if at least one of the connected director's tenure at the firm is below 3 years (sample median tenure) and zero otherwise.
CEO is connected with seasoned director (indicator)	Indicator variable equals to one if at least one of the connected director's tenure at the firm is above 3 years (sample median tenture) and zero otherwise.
Connected director is appointed before incumbent CEO (indicator)	Indicator variable equals to one if at least one of the connected director is appointed prior to the incumbent CEO's appointment and zero otherwise.
Connected director is appointed after incumbent CEO (indicator)	Indicator variable equals to one if at least one of the connected director is appointed after the incumbent CEO's appointment and zero otherwise.
Fraction of connected outside directors	Number of socially connected outside directors/number of outside directors
Friendly board (indicator)	Indicator variable equals to one if at least one of the outside director attends the same educational institutions and/ or non-business organization as the CEO and zero otherwise.
Pseudo friendly board (indicator)	Indicator variable equals to one if at least one of the outside director from the matched firm attends the same educational institutions and/ or non-business organization as the CEO and zero otherwise. The matched firm is the firm with the same Fama-French 48 industry and closest total sales within +/-30% of the firm's sales.
Firm and board characteristics:	
Analyst following	Number of analysts following the firm during the previous fiscal years.
Average industry adjusted return in previous 3 years	Firm's three year compounded monthly stock returns over the last three fiscal years minus median return of the same Fama-French (1997) 48 industry.
Board size	Number of directors on the board.
Capital intensity	Natural logarithm of the ratio of net property, plant, and equipment in millions of 2004 dollars to number of employees in thousands.

Cash	Cash/ total assets
Excess cash	Calculated as in Dittmar and Mahrt-Smith (2007).
Firm age	The year of birth is computed as the the first year the firm appears on the CRSP tapes.
Fraction of co-opted directors	Number of director who joined the board after the CEO assumed office/board size
Fraction of outside directors	Number of outside directors / board size.
Industry concentration	Sales-based Herfindahl-Hirschman index calculated at Fama-French 48 industry level.
Innovative industry (indicator)	Indicator variable equals to one if the firm is in an industry where the average citation (adjusted for truncation bias) per patent for the industry is greater than the median average citation across all industries and zero otherwise.
Institutional ownership	Aggregated ownership for sample firm as reported by 13-F institutions
Leverage	(Long-term debt + debt in current liabilities) / total assets.
Log (external connections of outside directors)	Natural logarithm of 1 plus the average number of individuals with whom the outside directors shares a common educational, employment, or social history in BoardEx excluding those individuals connected to them solely via their positions as outside directors of the current firm.
Multi-segment (indicator)	Indicator variable equals to one if the firm has reported more than one business segments.
ROA	Operating income before depreciation / lagged total assets.
Sales	Firm sales in millions of 2004 dollars.
Sales growth	Natural logarithm of the ratio of sales to lagged sales
Segments	Number of business segments reported by the firm.
Stock return	Compounded monthly stock returns over the fiscal year.
Tobin's *q*	(Total assets – book equity + market value of equity - deferred taxes) / total assets.
CEO characteristics:	
CEO duality (indicator)	Indicator variable equals to one if the CEO is the chairman of the firm and zero otherwise.
CEO's tenure	Number of years that the CEO has been serving in the current position.
CEO's undergraduate institution SAT score	The SAT score of the college that the CEO attended as an undergraduate.
Log (external connections of CEO)	Natural logarithm of 1 plus the number of individuals with whom the CEO shares a common educational, employment, or social history in BoardEx excluding those individuals connected to him solely via his position as CEO of his own firm.

Appendix B: Controlling for industry-year fixed effects

The table reports the robustness checks using industry-year fixed effects in the regressions, where we classify industry based on 2-digit SIC code. We consider the board to be friendly if at least one outside director and the CEO attended the same university or are members of the same clubs/not-for-profit organizations. Each panel presents the results of one table with the control variables and regression specification suppressed for brevity. Appendix A provides a detailed description of the construction of the variables. Standard errors are clustered at the firm level. *P*-values are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Effect of friendly boards on firm innovation (Table 2).

	Log (1+patent)	Log (1+citation)
Variables	(1)	(2)
Friendly board (indicator)	0.119***	0.142***
	(0.00)	(0.01)

Panel B: Reverse causality tests: Selection of friendly directors (Table 7).

	Log (1+patent)	Log (1+citation)
Variables	(1)	(2)
CEO is connected with	0.062*	0.045*
newly-hired director (indicator)	(0.08)	(0.06)
CEO is connected with	0.157***	0.231***
seasoned director (indicator)	(0.00)	(0.00)

Panel C: Two stage least square (2SLS) regression (Table 8).

	1st stage	2nd stage	
	Friendly board	Log (1+patent)	Log (1+citation)
Variables	(1)	(2)	(3)
Instrumented Friendly board (indicator)		0.217**	0.274**
		(0.02)	(0.04)
Average number of connections between	1.542***		
the directors and CEOs of local firms	(0.00)		

Panel D: Firms' advisory needs and innovation (Table 9).

Panel D1: Patent counts	Log (1+patent)		
Variables	(1)	(2)	(3)
Friendly board (indicator): a	-0.572***	0.038	0.059
	(0.00)	(0.52)	(0.12)
a*Log (sales)	0.117***		
	(0.00)		
a*R&D / assets		1.649***	
		(0.00)	
a*Multi-segment (indicator)			0.136**
			(0.02)

Panel D2: Citation counts	Log (1+citation)		
Variables	(1)	(2)	(3)
Friendly board (indicator): a	-0.776***	0.031	0.062
	(0.00)	(0.64)	(0.16)
a*Log (sales)	0.153***		
	(0.00)		
a*R&D / assets		2.062***	
		(0.00)	
a*Multi-segment (indicator)			0.131*
			(0.07)

Panel E: Firms' monitoring needs and innovation (Table 10)

Panel E1: Patent counts	Log (1+patent)				
Variables	(1)	(2)	(3)	(4)	(5)
Friendly board (indicator): a	-0.032	0.086**	0.160***	0.159***	0.148***
	(0.41)	(0.02)	(0.00)	(0.00)	(0.00)
a*analyst following	0.022***				
	(0.00)				
a*excess cash		0.045			
		(0.72)			
a*high excess cash and low Tobin's q			-0.161**		
(indicator)			(0.03)		
a*CEO tenure				-0.006*	
				(0.06)	
a* Fraction of co-opted directors					-0.102
					(0.31)

Panel E2: Citation counts	Log (1+citation)				
Variables	(1)	(2)	(3)	(4)	(5)
Friendly board (indicator): a	-0.045	0.138**	0.175***	0.174**	0.164**
	(0.72)	(0.03)	(0.00)	(0.00)	(0.02)
a*analyst following	0.024***				
	(0.00)				
a*excess cash		-0.141			
		(0.52)			
a*high excess cash and low Tobin's q			-0.149***		
(indicator)			(0.00)		
a*CEO tenure				-0.003	
				(0.62)	
a* Fraction of co-opted directors					-0.061
					(0.72)

Panel F: Effect of friendly boards on firm value (Table 11)

	Full sample			Innovative industry		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Friendly board (indicator): a	0.062	0.068	0.030	0.074	0.053	0.001
	(0.31)	(0.21)	(0.62)	(0.22)	(0.44)	(0.82)
Log (sales): b	-0.085**	-0.042	-0.031	-0.08**	-0.061***	-0.031
	(0.02)	(0.14)	(0.32)	(0.04)	(0.00)	(0.68)
R&D / assets: c		0.050***			0.102***	
		(0.00)			(0.00)	
Multi-segment (indicator): d			-0.386***			-0.474***
			(0.00)			(0.00)
a*b	0.070***			0.082**		
	(0.00)			(0.02)		
a*c		0.003			0.066*	
		(0.74)			(0.07)	
a*d			0.141*			0.196*
			(0.07)			(0.06)