Essays in Corporate Finance

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Contents

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Abstract

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This thesis presents three essays related to corporate finance. The first essay focuses on a firm's going public decision, the second essay examines the value of CEOs' innovation leadership, and the third essay studies the impact of a CEO's social performance on her reputation and career.

The first essay studies the antecedents and consequences of U.K. reverse takeovers (RTOs). I find private firms seeking exchange listing tend to choose RTO instead of IPO in poor market conditions. Related, RTO firms do not hoard cash out of capital raised as IPO firms often do. Compared to IPO firms, RTO firms spend less capital raised on paying dividends and retiring debt. They are not, however, much different from IPO firms in terms of post-listing business expansion, access to external equity market or operating performance. Overall, our evidence suggests that U.K. firms strategically time their RTO listings and RTOs do not introduce inferior listings.

In the second essay, I examine whether the outside director labor market values CEOs' innovation leadership and how innovation leadership diffuses across firm boundaries. I find a robust positive relation between the strength of a CEO's innovation leadership, measured by her on-the-job innovation performance, and the likelihood and number of her outside directorships. CEOs with proven innovation leadership are more popular among firms that are more innovative or have technologies more similar to the CEOs' own firms. Firms appointing innovative CEOs onto their boards significantly improve their innovation and operating performance in post-appointment years. I conclude the benefit of CEO innovation leadership diffuses across firm boundaries via a subsection of the labor market.

The third essay is related to the effect of a CEO's social performance on her reputation and career. I find the CEOs of those firms having greater strengths (controversies) in corporate social responsibilities (CSR) are more (less) likely to serve on external boards and they hold more (fewer) outside directorships. This effect vanishes when the CEOs' own firms are poorly governed. My findings suggest the leadership of using CSR to engage stakeholders and maximize shareholders' value is a highly-valued type of human capital. My results also indicate that the outside director labor market provides an effective market-based institution for promoting CSR.

Declaration

I, Yan Xu, declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Copyright Statement

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Chapter 1

Introduction

1.1 Overview of empirical studies

This thesis is composed of three self-contained essays in Chapters 2, 3, and 4. Chapter 2 examines the antecedents and consequences of U.K. reverse takeovers (RTOs). Chapter 3 studies the impact of CEOs' innovation leadership on their reputation in the outside director labor market. Chapter 4 investigates the importance of CEOs' social performance for their reputation and career.

In the first essay, I examine the antecedents and consequences of U.K. reverse takeovers (RTOs). Going public is the milestone event in a company's lifecycle. A substantial amount of work has studied traditional initial public offerings (IPOs). By contrast, less attention has been paid to reverse takeovers. A common misconception on RTO is that it only serves as a fast track substitute to traditional IPOs. Previous studies on RTOs mostly focus on the U.S. market and find that RTO firms are usually younger, smaller, more financially constrained, less profitable and less transparent. During the post-RTO period, these firms are more likely to de-list; and there is no evidence showing that firm performance improves after RTO. These findings are not surprising, given the fact that most U.S. RTO firms are listed on the exchanges that have much less stringent listing requirements (i.e., OTCBB and Pink Sheets). In contrast with U.S. firms, U.K. firms face much different regulatory framework when going public through RTO. In the U.K., firms going public by RTO need to comply with

the same set of listing and disclosure requirements as for IPO firms, which considerably increases the cost and the duration of going public through RTO. Given this stringent regulatory framework in the U.K., I examine whether U.K. firms strategically consider market valuation when deciding to go public through RTO instead of IPO and how effective RTOs are in terms of achieving a firm's goals of expansion, financing, and operation.

Using different measures of market valuation, I find that U.K. private firms tend to go public via RTO instead of IPO when the market condition is unfavorable. Previous studies on IPO market timing (e.g., Ritter and Welch (2002), Ibbotson, Sindelar, and Ritter (1994)) argue that it is easier for private firms to list through IPO when market valuation is high, as the public investors are more likely to accept pricing that reflects fundamental value. On the contrary, it is more difficult for private firms to price consistently to their fundamentals in IPOs when market valuation is low because it is difficult to convince a large number of public investors who are pessimistic about the economy's prospects. In line with this intuition, my results show that more private firms time the market and engage in a private takeover negotiation with a public firm when market valuation is low. In this way, private firms can communicate more effectively to the actual or potential shareholders of a public firm than to a much broader base of public investors, thereby achieving a more precise pricing after going public. Further and important, I also show that U.K. RTO firms do not save cash out of their equity-issuing proceeds as their IPO counterparts do. This finding provides additional evidence supporting the market timing explanation of a firm's choice to go public via RTO in the U.K. As demonstrated by Kim and Weisbach (2008) and Hertzel and Li (2010), overvalued firms tend to save cash from capital raised. The absence of cash-saving observation for RTO firms indicates that these firms do not go public to exploit market overvaluation. To study the effectiveness of RTO compared to IPO, I further examine the post-listing business expansion, certification effect on the internal and external capital market, and operating performance. I do not find clear evidence that RTO firms invest differently in capital expenditure or acquisitions than IPO firms do in post-listing years. Existing studies (Röell, 1996; Stoughton, Wong, and Zechner, 2001; Rydqvist and Högholm, 1995) find that public listing certifies a firm's quality to capital providers and stakeholders, thus allowing the firm to access

further capital market. I show that, when RTO firms raise more funds at the time of going public, they subsequently pay less dividends and spend less to retire long-term debt. This finding suggests that going public successfully via RTO certifies the quality of a firm to existing shareholders and debt holders, and RTO firms can exploit the restructuring opportunities to renegotiate new terms with existing capital investors. In terms of the certification effect to external capital providers, I find that RTO firms and IPO firms do not experience differently in follow-on equity issuance and analyst coverage in post-listing years, suggesting that, unlike U.S. RTO firms, U.K. RTO firms receive similar certification effect from external equity providers through listing comparing with their IPO counterparts. Finally, I examine U.K. RTO firms' post-listing operating performance relative to their IPO counterparts'. I show RTO firms exhibit similar performance to IPO firms in the U.K.

This essay provides useful insights on the strategic motive behind RTOs. Previous studies, mostly on U.S. RTOs, build the misimpression that RTO is only a fast-track and low-cost alternative to IPO, usually used by firms that are not qualified for IPO. Drawing on the more stringent regulatory framework in the U.K., I find private firms in the U.K. strategically choose to go public via RTO under unfavorable market condition. This finding also adds to those in Derrien and Kecskes (2007) who demonstrate that U.K. firms prefer to list through "Introduction" in unfavorable market conditions. My studies on the post-listing certification and performance of RTO firms also suggest that the effectiveness of RTO can be affected by the country-specific institutional environment.

My second essay examines whether the outside director labor market values CEOs' innovation leadership and how innovation leadership diffuses across firm boundaries. In today's fast-moving economy, firms need innovation to survive. The leadership to cultivate and promote technological innovation, therefore, becomes one of the most important aspects of a CEO's human capital. Previous literature has well established that a CEO's experience of successfully managing innovative companies provides them with a unique ability to select, assess, and execute innovative projects (e.g., Cho, Halford, Hsu, and Ng (2016); Custódio, Ferreira, and Matos (2017); Makri and Scandura (2010); Yadav, Prabhu, and Chandy (2007)). I study whether a CEO's

innovation leadership is valued by external firms in the director labor market and whether a CEO is able to transfer her expertise of leading innovative companies to the firms in which she serves as an outside director.

Fama and Jensen (1983) point out that individuals receive outside directorships when the external labor market recognizes their management skills demonstrated by their on-the-job performance. In line with this view, Kaplan and Reishus (1990) suggest that outside directorships enhance CEO prestige by certifying a CEO's management expertise. Inspired by these insights, if the labor market for outside directors serves as an effective market-based institution that certifies CEO skills, and if the ability of cultivating and promoting innovation is considered as a valuable management skill for maximizing shareholders' value, a CEO's on-the-job innovation performance should have a positive impact on her outside directorships. Using patenting activities to measure a firm's innovation performance, I find a strong positive relation between firm innovativeness and a CEO's attractiveness in the director labor market. The CEOs of firms with better innovation performance (measured by patent counts, citation counts, and citations per patent) are more likely to serve as outside directors on other firms' board, and they also hold more outside directorships. This finding is robust to using the two-stage least square (2SLS) approach. I also demonstrate that CEOs of firms with better innovation performance are more likely to hold outside directorships in other innovative firms or firms with similar technological base, which confirms the view in Hermalin and Weisbach (1998) suggesting that firms appoint individuals as outside directors when they are able to bring valuable experience and expertise that match the firm's advising and monitoring needs. To further investigate the impact of appointing external CEOs from innovative firms as outside directors, I examine the appointing firms' post-appointment innovation performance and operating performance. The results show that firms appointing such directors outperform control firms in terms of their innovation performance during the three post-appointment years, and this outperformance is more pronounced when the outside CEO-director is from a more innovative firm (i.e., with more patent citations), the technological proximity between two firms is higher, and the appointing firm invests more in R&D. Further and importantly, we find that firms appointing innovative CEO-directors experience better operating performance in the post-appointment years,

suggesting enhanced innovation capacity translates into productivity.

This essay contributes to three strands of the literature. First, it adds new evidence to the literature on the director labor market by showing that the leadership of cultivating and promoting technological innovation is a valuable trait sought after in director labor market. Second, previous studies on a CEO's innovation leadership mainly focus on examining the internal impact and value of this type of leadership. This essay shows that CEOs' innovation leadership is also recognized and rewarded in the external labor market, suggesting that the external labor market serves as an effective institution to motivate CEOs to innovate. Third, it suggests that appointing outside directors is a possible channel of knowledge transfer across firms.

The third essay focuses on the importance of CEOs' social performance for their reputation and career. In recent years, the increasing attention to corporate social responsibility (CSR) has taken corporate decisions beyond the conventionally perceived scope of capitalism. Companies considerably increase their spending on CSR activities while institutional investors and activist groups also start pressurizing companies to have a better delivery of CSR (see Barko, Cremers, and Renneboog (2017); Edmans (2011); Renneboog, Ter Horst, and Zhang (2008a,b)). However, it remains unresolved to what extent that CEOs are held responsible for poor delivery of CSR or rewarded for outstanding CSR performance. In this essay, I ask whether the director labor market provides a market-based institution that effectively rewards or penalizes CEOs according to their CSR performance.

I find that the CEOs of firms having better CSR ratings are more likely to serve on external boards and they hold more outside directorships. When analyzing the CSR strength score and CSR controversy score separately, I show that CEOs with more CSR controversies incur a greater reputational penalty, resulting in fewer outside directorships, while a higher strength score significantly enhances a CEO's reputation, suggesting that the labor market for outside directors rewards superior CSR performance. Bénabou and Tirole (2010) argue that the investments in CSR may be a result of CEOs pursuing their private interests and therefore harmful to shareholders. This agency conflict is more likely to be associated with poorly governed firms. Consistent with this view, I find that when a firm is poorly governed (measured

by E-index and the fraction of independent directors), the positive CSR effect on CEO outside directorships disappears. The next question to ask is what is investors' reaction to the appointment of an outside director who is the CEO of a socially responsible firm. The results show that investors react positively when the CEO's own firm is well governed. This finding, together with my earlier results, suggests that both the stock market and the director labor market are conscious about the possible agency issues associated with CSR.

The contract theory and the theory of firms postulate that a company is a nexus of implicit or explicit contracts between shareholders and stakeholders where the stakeholders possess resources essential for the company's success (Alchian and Demsetz, 1972; Coase, 1937; Cornell and Shapiro, 1987; Hill and Jones, 1992; Jensen and Meckling, 1976). The findings in this essay demonstrate that the capability of managing CSR activities appropriately to engage stakeholders is a valuable human capital for CEOs, which provides a plausible motivation for CEOs to be socially more responsible. In addition, I find that the absence of positive effect of CSR on a CEO's outside directorships is conditional on the robustness of the CEO's firm's governance, which adds to the recent literature on agency concerns arising from CSR (Ferrell, Liang, and Renneboog, 2016; Krüger, 2015; Masulis and Reza, 2014).

1.2 Thesis structure

The thesis structure follows the format accepted by the Accounting and Finance Group, Alliance Manchester Business School, at The University of Manchester. This format allows each chapter to be suitable for submission and publication in peer-reviewed academic journals. Therefore, this thesis is structured by three essays containing original research in chapters 2, 3, and 4. Each chapter contains a separate literature review, hypotheses development, description of the data, research methodology discussion, and reporting of empirical findings. The equations, footnotes, tables, and figures are independent and are numbered from the beginning of each chapter. Page numbers, titles, and subtitles have a sequential order throughout the thesis.

The thesis continues as follows. Chapter 2 examines the antecedents and consequences of U.K. reverse takeovers (RTOs). Chapter 3 studies the impact of a CEO's innovation leadership on her reputation in the outside director labor market. Chapter 4 investigates the importance of social performance for a CEO's reputation and career. I conclude in Chapter 5 by summarizing contributions and describing suggestions for future research.

In chapters 2−4 I use the third person (we, our) rather than the first person (I, my), as these chapters are in the form of working, or submitted, papers co-authored with my supervisors.

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Chapter 2

The determinants and effectiveness of reverse takeovers in the U.K.

2.1 Introduction

In a reverse takeover (RTO), a public firm acquires a private firm. Unlike in an ordinary takeover, the private firm's shareholders take majority control of the enlarged firm post transaction and the private firm's business constitute the main part of the enlarged firm.[1]

A common misconception about RTO is that it is only an expedient and cost efficient substitute to Initial Public Offering (IPO). Previous studies predominantly focus on RTOs in the U.S. and authors find that RTO firms are usually younger, smaller, more financially constrained, less profitable and less transparent (Adjei, Cyree, and Walker, 2008; Arellano Ostoa and Brusco, 2002; Bayar and Chemmanur, 2006; Gleason, Rosenthal, and Wiggins, 2005); post RTO, private firms obtain initial listings mostly on either Over-The-Counter Bulletin Board (OTCBB) or pink sheets (Gleason et al. 2005, Lee, Li and Zhang 2014); they are more likely to de-list post listing

[1]UK Financial Conduct Authority (FCA) employs a broad definition of RTO that includes some takeovers between public firms (see Appendix B for more details.). We are interested in RTOs conducted by private firms that seek exchange listing. In the remainder of this paper, to avoid confusing, we use "private firm" to refer to a private firm involved in an RTO, which actually is the surviving firm, and "public firm" to refers to a public firm which is essentially the firm being taken over.

(Gleason et al. 2005, Adjei et al. 2008, Arellano-Ostoa and Sandro, 2002); and there is no clear evidence of performance improvement of RTO firms (Gleason et al., 2005).[2] These observations are not surprising, considering that OTCBB and Pink Sheets have much less stringent listing standards than those imposed by major U.S. stock exchanges (i.e. New York Stock Exchange (NYSE), NASDAQ and AMEX).

In this paper, we examine whether firms in the U.K. strategically consider market valuation when choosing to list via RTO and how effective RTOs are in terms of achieving strategic goals such as business expansion, financing and operation. Different from their U.S. counterparts, U.K. RTO firms have to comply with the same set of listing and disclosure requirements as IPO listing firms do.[3] In the U.K., after an RTO, FCA normally suspends or cancels the public firm's listing. The newly combined firm needs to submit a detailed prospectus and other required materials before obtaining re-admission to exchange listing (See Appendix B of this paper and Chapter 5 of the Financial Conduct Authority (FCA) listing rules for more details). These stringent requirements minimize the benefits of RTO as an expedient and cost-efficient alternative to IPO. Therefore, we conjecture that U.K. private firms are more likely to pursue RTOs on strategic grounds rather than simply use them as a convenient substitute for IPO when the later is difficult to achieve.

As is revealed by Figure 1, the ratio of the number of RTOs to the number of IPOs is counter cyclical in that it peaks at the trough of market valuation. Using logistics regressions, we further confirm that private firms prefer RTO to IPO when market valuation is low. This regression result is robust to alternative measures of valuation and to valuation measured at both the market and the firm level. Kim and Weisbach (2008) and Hertzel and Li (2010) posit that equity-issuing firms that take advantage of high market valuation tend to save cash out of their proceeds. We confirm their findings using our sample of U.K. IPOs. However, this cash-saving phenomenon is absent from our RTO sample. When market valuation is high, it is easier for private

[2]Lee, Li, and Zhang (2014) find that Chinese firms outperform benchmarks after their RTO listings on U.S. market.

[3]In the U.S., before 2011, firms only need to file a Form 8-K to close an RTO transaction. The Security and Exchange Commission toughened listing requirements for RTOs seeking subsequent listing on major exchanges, making it more burdensome to conduct an RTO. However, new rules allow RTO firms to be exempted from standard exchange listing requirements, provided certain conditions are met.

firms to list through IPO as the public investors are willing to accept pricing that reflects fundamental value. Some firms can even list at inflated prices (i.e., market timing)[4]. On the contrary, when market valuation is low, it is more difficult for an IPO firm to be priced consistently to fundamentals because it is difficult for the listing firm to pass information to a large number of public investors who are pessimistic about the economy's prospects. Our results demonstrate that, when market valuation is low, more private firms strategically resort to RTO and engage in a private takeover negotiation with a public firm. This way, pricing is easier as value-relevant information can be communicated more effectively to the actual or potential shareholders of a public firm than to a broad base of generic public investors. Further and important, low market valuation reduces the cost of taking over a public firm.

To study the effectiveness of RTO compared to IPO, we further examine two important strategic considerations related to listing and highlighted in the previous literature, namely, business expansion and capital raising (Poulsen and Stegemoller, 2008). Poulsen and Stegemoller (2008) argue that firms with greater growth opportunities choose to list via IPO. However, we do not find clear evidence that RTO firms invest more conservatively in capital expenditure or acquisitions than IPO firms do in post-listing years. In terms of capital raising, we find that RTO firms issue equity at a similar frequency as IPO firms do. We further find that, when private firms raise more funds from RTO, they subsequently pay less dividend and spend less to retire long-term debt. We do not observe this phenomenon with IPO firms. Previous literature finds that exchange listing enables a firm to access further capital market and certify the firm's quality to capital providers and stakeholders (Röell, 1996; Stoughton, Wong, and Zechner, 2001; Rydqvist and Högholm, 1995). Our evidence on capital raising suggests that a successful RTO certifies the quality of a listing firm not only to prospective equity investors but also to existing shareholders and debt holders. Building on successful certification, RTO firms are able to take advantage of the restructuring opportunities and negotiate new terms with existing capital providers. In contrast, IPO firms only target prospective external equity investors and do not have similar opportunity to rearrange payment to existing equity or debt holders. We

[4]There is a vast literature on market timing. See Ritter (1984); Ibbotson, Sindelar, and Ritter (1994) among others.

perform two robustness tests with regard to our dividend payment and debt retiring results. In particular, we use Heckman's (1979) method to control for RTO firm's insider information and other unobservable factors and find our results are robust to this test. However, when we use propensity score matching to control for observable factors that determine RTO vs IPO, these results vanishes. It suggests that when existing capital providers cannot distinguish RTO motives from IPO motives, they refuse to renegotiate the existing financing arrangements with the RTO firms.

Finally, we examine RTO firms' post-listing operating performance relative to IPO firms', following the method of Healy, Palepu, and Ruback (1992). We find RTO firms exhibit similar performance to IPO firms'.

In summary, we show that private firms strategically time their RTO listing and use RTO to certify firm quality to both existing and prospective capital providers. Combined with our results on RTO firms' operating performance, these results demonstrate that RTOs do not introduce inferior listings, contradicting conclusions drawn from U.S. studies.

Previous literature, mostly conducted in the U.S., gives the mis-impression that RTO is only an expedient and low-cost alternative to IPO, often used by firms that cannot secure listing on main stock exchanges. Gleason et al. (2005) cast doubt on this mis-concept but do not further examine it. Using a sample of U.K. RTOs listed on AIM or the main market, we demonstrate that RTO can be a strategic alternative to IPO for firms seeking exchange listing. We find private firms strategically list shares via RTO under low market valuation when communicating with mass public investors is difficult. This is consistent with the observation of Gleason et al. (2005) that only a minority of RTOs occur during the hot IPO wave of late 1990s. Semenenko (2011) finds the number of RTOs announced in a quarter is negatively related to aggregate market returns in the previous four quarters. Different from Semenenko (2011), we formally model firm's choice between IPO and RTO, using valuation at the market, the industry and the firm level. Our results also add to those of Derrien and Kecskes (2007) who find U.K. private firms prefer to list via "introduction" in cold market.[5] By examining the effect of valuation on listing firms' choice between

[5]The only difference between and introduction and IPO is that issuing firms do not sell shares in

IPO and RTO, we also contribute to a literature that study the determinants of RTO (Adjei et al., 2008; Brown, Ferguson, and Lam, 2010). Our results on RTO firms' subsequent expansion, certification to capital providers and operating performance further confirm the strategic motive behind RTOs. We conclude RTO is by no means just an expedient and low-cost alternative to IPOs under U.K.'s institutional setting.

Our results also suggest that the determinants and effectiveness of RTO can be affected by the country-specific institutional environment. Brown et al. (2010) find RTOs take longer to complete than IPOs in Australia and attribute this to the specific Australian institutional environment. Lee et al. (2014) find Chinese firms that list via RTO on the U.S. market out perform their risk-based benchmarks. Our study demonstrate that the U.K. institution contribute to the strategic motives behind private firms listing via RTO. Therefore, further studies of RTO using international data can be fruitful.

The rest of the paper is organized as follows. Section 2.2 describes the data and sample. Section 2.3 describes our research design and explains motivation and methodology for each test. Section 2.4 present our empirical results. Section 2.5 summaries the conclusion.

2.2 Sample and Data

We obtain our initial RTO sample from the SDC Mergers and Acquisitions Database. SDC has a broad definition of RTO, it includes transactions between two public firms. To focus on RTO as a mechanism of listing, we only include RTOs between a private and a public firm. This yields an initial sample of 292 RTOs during the period from January 1, 1995 to December 31, 2012 [6]. We further drop transactions in which the newly combined firms did not subsequently list on the stock exchange and this guarantees all RTOs we examine are pursued for the purpose of going public rather than purely seeking synergies from business combination. This is done by matching the initial sample to the London Stock Exchange new issue list. Consequently, 195

an introduction. Existing shareholders trade with one another after introduction.

[6]We choose 1995 as the beginning year of our sample period, as it is when the Alternative Investment Market (AIM) was established.

RTOs remain in the sample. The IPO sample is retrieved from the SDC Global New Issues Database. We obtain 1,472 IPOs in the London Stock Exchange main market and AIM market during our sample period.

We further require data to be available to calculate variables needed for our regression analyses. These data are collected from FAME, Datastream and deal prospectus. This yields a sample of 137 RTOs and 854 IPOs for our analysis of how market valuation impact the choice of RTO versus IPO. In another set of analysis, we examine how capital raised is used in post listing years. This set of study requires three years of data after listing. Sample size reduces further accordingly. Finally, We have 73 RTO firms and 747 IPO firms for these set of analyses.

2.3 Hypotheses and tests

2.3.1 Market valuation and the choice of RTO versus IPO

Firms tend to go public through IPO when market condition is favorable so that they can fully exploit market valuation to raise capital. Under favorable market condition, it is easy to convey information about fair firm value to the market and, sometimes, market even over value a listing firm's equity (Baker and Wurgler, 2000; Loughran, Ritter, and Rydqvist, 1994; Lowry, 2003; Pástor and Veronesi, 2005; Ritter and Welch, 2002). Unlike in an IPO, firms do not solely rely on share issuance to raise funds in an RTO. First, most RTOs involve restructuring. Maksimovic, Phillips, and Prabhala (2011) show that acquiring firms raise funds via vigorously selling target firm's assets during post-merger restructuring. Second, the public firm's cash reserve is another source of funds. Third, RTO represents an efficient way of certifying to potential capital providers, beginning with the shareholder base of the public firm and then expand to a broader shareholder base. Given a listed firm only needs to satisfy minimal requirements to further sell shares, RTO firms could raise funds through follow-on equity issuance when market recovers. These alternative ways of raising funds make market valuation less important for the timing of RTOs. When market valuation is low, it is difficult to validate fundamentals about a listing firm's valuation to a broad

base of public investors who are pessimistic and skeptical about the economy's outlook. A firm then can resort to an RTO to list its shares. It is much easier to negotiate with just one public firm and communicate to a much smaller base of shareholders. Adding to the benefit of easy communication is the opportunity of lowering acquisition cost via taking advantage of low market valuation. Specifically, we formulate the following hypothesis,

H1: Listing firms prefer RTO to IPO when market valuation is low.

To test H1, we estimate the following baseline logistic regression:

$$P(\text{RTO}_i = 1|x) = G(\alpha + \beta \text{ Market Valuation}_i + \gamma \text{ Controls}_i + \lambda \text{ Industry Dummy}_i + \epsilon_i), \tag{2.1}$$

where i indexes sample firms; G(.) is the logistic function; *RTO* is a binary variable, which is equal to 1 when a firm chooses RTO and 0 when a firm chooses IPO; *Market Valuation* is a proxy of market conditions which we explain in more details below; *Controls* is a vector of control variables, suggested in the previous literature, that impact a firm's decision to use RTO or IPO. All control variables are defined in Appendix A; *Industry Dummy* is a vector of binary variables indicating industries defined according to the Fama-French 12 industry classification.[7]

We use two sets of proxies for market valuation. The first set is based on market returns. Pástor and Veronesi (2005) develop a model to attribute the fluctuation of IPO volume to the variation in market conditions. They show that IPO volume is positively related to recent aggregate market returns. Baker and Wurgler (2000) find that firms tend to issue equity instead of debt before periods of low market returns. Following these studies, we use three aggregate market return measures covering different time periods to proxy market valuation. In particular, we measure market returns using the FTSE All-Share Index during 3-month (-3 months market return), 6-month (-6 months market return) and 12-month (-12 months market return) before RTO/IPO. According to H1, RTOs should be preceded by relatively lower market returns than IPOs and therefore β is predicted to be significantly negative.

[7]Because using the Fama-French 48 industry classification substantially reduces the degree of freedom of our regressions, we use the Fama-French 12 industry classification instead.

Our second proxy builds on decomposing the ratio of market to book ratio of equity (P/B).Several previous studies suggest that the predominant reason for firms to go public is to exploit market overvaluation (Lowry, 2003; Pagano, Panetta, et al., 1998; Ritter and Welch, 2002). The P/B ratio contains information on both growth opportunity and misvaluation.[8] Following Lee, et al. (1999), we decompose the P/B ratio into two parts: one is the price-to-value ratio (hereafter P/V), which measures misvaluation and the other is value-to-book-value ratio (hereafter V/B), which reflects the potential growth opportunities. According to H1, we expect that the higher the P/V ratio is the lower the probability a firm will choose RTO.

The value (V) is estimated using a residual income model over a three-period forecast horizon:

$$V_t = B_t + \frac{(FROE_{t+1} - r_e)}{(1 + r_e)} B_t + \frac{(FROE_{t+2} - r_e)}{(1 + r_e)^2} B_{t+1} + \frac{(FROE_{t+3} - r_e)}{(1 + r_e)^2 r_e} B_{t+2}, \tag{2.2}$$

where B_{t+i} is the book value of equity for period $t + i$; r_e is the annualized cost of equity;[9] $FROE_{t+i}$ is the forecasted ROE for period $t + i$.

$$B_{t+i} = B_{t+i-1} + (1 - k) FEPS_{t+i}, \tag{2.3}$$

where $FEPS_{t+i}$ is the forecasted EPS for period $t + i$ from I/B/E/S. k is the dividend payout ratio computes as D_t divided by EPS_t.

$$FROE_{t+i} = \frac{FEPS_{t+i}}{\bar{B}_{t+i-1}}, \tag{2.4}$$

[8]Market price is a forward-looking measure and high market value indicates that a firm is running well and has good future perspective. Book value reflects historical costs. Therefore, P/B ratio captures growth opportunity. At the same time, to the extent that market value may deviate from the true fundamental value for a firm, P/B ratio can capture misvaluation.

[9]In this study, we use two methods to compute the annualized cost of equity (r_e). One is a constant rate of 12.5%, following D'mello and Shroff (2000), the other is a firm-specific cost of equity determined by the Capital Asset Pricing Model (CAPM), following Dong, Hirshleifer, Richardson, and Teoh (2006). The results are insensitive to alternative measures, similar to what D'mello and Shroff (2000) and Lee, et al. (1999) observe. For brevity, we only report the results using the constant cost of equity.

where

$$\bar{B}_{t+i-1} = \frac{B_{t+i-1} + B_{t+i-2}}{2}, \tag{2.5}$$

Since the residual income value (V) is estimated by using analysts' forecasts of future earnings, P/V ratio excludes information about growth and managerial agency problems contained in P/B ratio and is a better measure of misvaluation than P/B. Compared to using market return as the proxy for market conditions, using these ratios enables us to explicitly distinguish between the overvaluation effect (measured by P/V) and the growth effect (measured by V/B) on a firm's choice between RTO and IPO.

Since the market value and the analyst forecasts data are not available for private firms, we cannot directly calculate the firm-level P/V and V/B ratio. We therefore begin with using the market-wide P/V and V/B measured as the median ratio of all U.K. listed firms in the month prior to listing. To allow the firm-level analysis, we use the implied value of P/V and V/B. Specifically, for each sample firm, we match it with a recently listed firm that is from the same industry and is closest in size and then we use the P/V and V/B ratio of this matched public firm as the implied P/V and V/B ratio of the sample firm. This leads to further sample attrition as we cannot find a matching recently listed firm for every sample firm.

2.3.2 Post-listing cash savings

A listing firm's post-listing pattern of cash saving represents a further opportunity to analyze the extent to which market valuation relates to RTO and IPO. We cannot directly observe a listing firm's motive of exploiting favorable market valuation. However, several studies suggest that this motive relates to a listing company's behavior of cash savings out of the capital raised. McLean (2011) reports that, during the latest decade, US firms save \$0.60 cash out of \$1.00 of share issuance proceed, suggesting cash savings constitutes a primary motive of the listing. Hertzel and Li (2010) and Kim and Weisbach (2008) point out that IPO firms with higher overvaluation save more cash out of proceeds in years following share issuance whereas firms with greater growth opportunities tend to spend more on real assets. Motivated

by these studies and given our conjecture that listing via RTO is less dependent on high market valuation, , we formulate our second hypothesis,

H2: Compared to IPO firms, RTO firms are less likely to save cash out of capital raised.

We test H2 by estimating a regression equation in the spirit of Kim and Weisbach (2008), for IPO and RTO firms respectively. Specifically,

$$\begin{aligned}\Delta\text{Cash}_t \;=&\alpha \;+\beta_1 \;\ln\left[1+\frac{\text{Capital Raised}}{\text{Total Assets}_0}\right] \;+\; \beta_2 \;\ln\left[1+\sum_{\tau=1}^{t}\frac{\text{Total Funds}_\tau}{\text{Total Assets}_0}\right] \\ &+\;\beta_3 \;\ln\left(\text{Total Assets}_0\right) \;+\; \theta_i \sum_{i=1995}^{2012}\text{Year Dummy}_i \\ &+\;\gamma_j \sum_{j=1}^{11}\text{Industry Dummy}_j \;+\; \varepsilon_t,\end{aligned} \tag{2.6}$$

where $\Delta\text{Cash}_t = \ln\left[1 + \left(\text{Cash}_t - \text{Cash}_0\right) / \text{Total Assets}_0\right]$. Year $t = 0$ is the year prior to listing, and $t = 1, 2, 3$ year after listing. For RTO firms, *Total Assets*$_0$ is the sum of the public firm's total assets excluding cash and the private firm's total assets prior to RTO. *Total Funds* is the sum of funds from operations, sale of property, plant, and equipment, long-term debt issuances, and sale of common and preferred stock. *Industry dummy* is created according to the Fama-French 12 industries classification. For IPOs, *Capital Raised* is the product of the number of primary shares issued and the offer price. For RTOs, *Capital Raised* is the sum of the cash reserves of the public firm before the RTO and the proceeds from equity issuance (if any) at the RTO. Total Assets$_0$ of RTO firms are combined assets of the public firm's total assets excluding cash and the private firm's total assets at the end of the year prior to the RTO.

2.3.3 The effectiveness of RTO

In this section, we examine how effective RTOs are, compared to IPOs, in allowing listing firms to achieve their strategic goals, namely business expansion and certification to internal and external capital providers (Paulsen and Stegemoller

(20008)).

2.3.3.1 Post-listing business expansion

Prior literature suggests that facilitating future business expansion is a significant motive of going public. Poulsen and Stegemoller (2008) argue that firms with greater growth opportunities choose to list via IPO. Consistent with this view, Kim and Weisbach (2008) find that the capital raised in an IPO are more likely to be spent on both capital expenditures and R&D, which leads to growth in total assets in the post-listing years. To test how to achieve the strategic goal of business expansion, we follow the specification in Kim and Weisbach (2008) to investigate how listing firms use funds on total asset, capital expenditure, and acquisitions in the post-listing years. Specifically,

$$\begin{aligned} Y_t = & \alpha + \beta_1 \ln\left[1 + \frac{\text{Capital Raised}}{\text{Total Assets}_0}\right] + \beta_2 \ln\left[1 + \sum_{\tau=1}^{t} \frac{\text{Total Funds}_\tau}{\text{Total Assets}_0}\right] \\ & + \beta_3 \ln(\text{Total Assets}_0) + \theta_i \sum_{i=1995}^{2012} \text{Year Dummy}_i \\ & + \gamma_j \sum_{j=1}^{11} \text{Industry Dummy}_j + \varepsilon_t, \end{aligned} \tag{2.7}$$

where

$Y_t = \ln\left[1 + (\sum_{\tau=1}^{t} V_\tau \,/\, \text{Total Assets}_0)\right]$ for V = capital expenditure (CAPEX) and acquisitions.

$Y_t = \ln\left[1 + (V_t - V_0) \,/\, \text{Total Assets}_0\right]$ for V = total assets.

Year $t = 0$ is the year prior to listing, and $t = 1, 2, 3$ year after listing. Independent variables are the same as those defined under equation (6).

2.3.3.2 Certification effect to internal capital providers

In the process of business combination, firms going public via RTO are able to take advantage of the restructuring opportunities and negotiate new terms with existing capital providers (internal capital provider), while IPO firms are not able to do so.

In this subsection, we investigate the potential certification effect to internal capital providers by examining how listing firms use raised capital for dividend payment and long-term debt reduction. If a RTO certifies firm quality to internal capital providers, we expect to observe that RTO firms spend less proportion of capital raised on paying dividends or retiring long-term debt. We use the specification similar to Equation (7) to test this hypothesis:

$$\begin{aligned} Y_t =& \alpha + \beta_1 \ln\left[1 + \frac{\text{Capital Raised}}{\text{Total Assets}_0}\right] + \beta_2 \ln\left[1 + \sum_{\tau=1}^{t} \frac{\text{Total Funds}_\tau}{\text{Total Assets}_0}\right] \\ &+ \beta_3 \ln(\text{Total Assets}_0) + \theta_i \sum_{i=1995}^{2012} \text{Year Dummy}_i \\ &+ \gamma_j \sum_{j=1}^{11} \text{Industry Dummy}_j + \varepsilon_t, \end{aligned} \tag{2.8}$$

where

$Y_t = \ln\left[1 + \left(\sum_{\tau=1}^{t} V_\tau \,/\, \text{Total Assets}_0\right)\right]$ for $V =$ dividend payment, and reduction in long-term debt.

Year $t = 0$ is the year prior to listing, and $t = 1, 2, 3$ year after listing. Independent variables are the same as those defined under equation (6).

2.3.3.3 Certification effect to external equity investors

According to previous studies conducted for U.S. firms, the RTO process is relatively fast and cost efficient compared to the IPO process. It is not necessary to hire investment banks as underwriters or conduct a roadshow. Due to this simplified process, an RTO firm may not receive similar attention from prospective equity investors, which in turn could reduce the external certification benefit of going public. Certification to external equity investors is important because firms may use going public to signal their quality (Bustamante, 2011; Stoughton et al., 2001; Rydqvist and Högholm, 1995). Weak certification could result in difficulty of raising funds through follow-on equity issuance. To examine how effective RTOs are in terms of certification to external equity investors, we further investigate whether RTO firms differ from IPO

firms in terms of the I/B/E/S analyst coverage and follow-on equity issuance activities in the post-listing years. Specifically, we estimate the regression equations as follows. If firms going public by RTO can receive similar level of external certification effect, we should observe non-negative coefficients associated with the RTO dummy variable.

$$\begin{aligned} P(\text{Follow-on issuance}_i = 1|x) =& G(\alpha + \beta \text{ RTO dummy}_i + \gamma \text{ Controls}_i \\ &+ \lambda \text{ Industry Dummy}_i + \sigma \text{ Year Dummy}_i + \epsilon_i), \end{aligned} \tag{2.9}$$

$$\begin{aligned} P(\text{Analyst Coverage}_i = 1|x) =& G(\alpha + \beta \text{ RTO dummy}_i + \gamma \text{ Controls}_i \\ &+ \lambda \text{ Industry Dummy}_i + \sigma \text{ Year Dummy}_i + \epsilon_i), \end{aligned} \tag{2.10}$$

where i indexes sample firms; G(.) is the logistic function; *Follow-on issuance* is a binary variable equals 1 if the firm raises additional capital through follow-on equity issuance during the 3-year period following listing, and 0 otherwise; *Analyst Coverage* is a binary variable equals 1 if the firm is covered by the I/B/E/S database during the 3-year period following listing, and 0 otherwise; *RTO dummy* equals 1 if the firm going public by RTO and 0 if the firm going public by IPO; *Controls* is a vector of control variables, including log(Total Asset), Return on assets, Capital intensity and Leverage; *Industry Dummy* is a vector of binary variables indicating industries defined according to the Fama-French 12 industry classification. *Year Dummy* is a vector of binary variables with each element representing a year during the sample period.

2.3.3.4 Post-listing operating performance

Previous studies on U.S. RTOs suggest RTO introduces inferior listings compared to IPO (Gleason et al. 2005, Adjei et al. 2008, Arellano-Ostoa and Sandro, 2002). In this subsection, we compare the post-listing operating performance between the RTO and the IPO firms to see whether U.K. RTO firms deliver inferior operating performance. Following Barber and Lyon (1996) and Healy et al. (1992), we measure a firm's actural

operating performance by its operating cash flow deflated by total assets.[10] In each year, we adjust the actual operating performance by the median value of those firms in the same Fama-French 12 industry. The adjusted yearly operating performances are then averaged over 3 years both before and after listing. We examine the post-listing operating performance using the following equation:

$$\begin{aligned}\text{Post-listing Adj.}\, OPCF/TA_i =& \alpha + \beta_1 \text{ Pre-listing Adj.}\, OPCF/TA_i + \beta_2 \text{ RTO Dummy}_i \\ &+ \theta_t \sum_{t=1995}^{2011} \text{Year Dummy}_t + \epsilon_i,\end{aligned} \tag{2.11}$$

where i indexes the listing firms. β_1 captures the continued operating performance in post-listing years. α and β_2 capture the incremental operating performance as a consequence of the listing. In addition, β_2 captures the difference in the incremental operating performance between IPO firms and RTO firms in post-listing years.

2.3.4 Addressing selection bias

The choice between RTO and IPO is endogenous. To address this self-selection bias, we employ two methods. One is the propensity score matching approach (Rosenbaum and Rubin, 1983), and the other is the Heckmen two-step approach (Heckman, 1979).

The propensity score matching approach allows us to identify a control sample of IPO firms have similar propensity to list via RTO. By comparing the RTO sample with the matching IPO sample, we can rule out the possibility that our results are driven by other observable characteristics of listing firms rather than RTO itself. To estimate the propensity score, we use Model (5) in Table 2.3. To ensure the matching IPO sample is sufficiently similar to our RTO sample, we apply the closest matching method and require that the maximum difference between the score of each RTO sample firm and its matching IPO firm does not exceed 0.1% in absolute value. We are able to find a matching IPO for 68 RTOs in our sample.

[10]For RTO firms, the pre-listing actual operating performance is the average value of the target firm's and the acquiring firm's operating cash flow deflated by total assets.

To control for the selection bias due to unobservables, we use the Heckmen two-step approach. In the first step, we estimate the choice between IPO and RTO by Model (5) in Table 2.3 and calculate the Inverse Mills Ratio (IMR). In the second step, we include the IMR. A significant coefficient IMR indicate the selection bias is significant and, in this case, we rely on the self-selection-adjusted two-step regression for our statistical inference. Otherwise, we rely on the OLS regression estimates for inference.

2.4 Empirical results

2.4.1 Market valuation and the choice of RTO versus IPO

2.4.1.1 Univariate analysis

Figure 2.1 and Panel A of Table 2.1 show the time distribution of IPOs and RTOs in our sample.[11]. Consistent with previous literature (Baker and Wurgler, 2000; Lowry, 2003; Loughran et al., 1994; Pástor and Veronesi, 2005; Ritter and Welch, 2002), private firms tend to choose RTO when market conditions are unfavorable because the cost of acquiring a firm is lower during the cold market and RTO also offers private firms the flexibility to time the market twice, first to obtain listing and second to further issue equity. We observe that the ratios of the number of RTO to the number of IPO are higher during the crisis periods, which are 0.26 during the 2000-2002 dot-com bubble crash and 0.64 during the 2008-2009 financial crisis respectively. Meanwhile, after the crisis periods, the ratio drops considerably (0.12 from 2003 to 2007, and 0.09 from 2010 to 2012).

Panel A of Table 2.2 presents descriptive statistics for the variables used in our baseline regressions. The results show that RTO firms are smaller (by total assets) and less profitable (by return on assets) than IPO firms, which is consistent with the observation of Floros and Sapp (2011) and Gleason et al. (2005). However, RTO firms are not significantly different from IPO firms in cash holdings and leverage ratio to

[11]To better compare the time distribution of IPOs and RTOs, we normalize the scales in Figure 2.1.

IPO firms. This suggests that RTO firms are not financially constrained, which is contrary to the findings in previous studies (e.g., Adjei et al. (2008); Arellano Ostoa and Brusco (2002); Bayar and Chemmanur (2006); Gleason et al. (2005)). In terms of the variables measuring market valuation, we observe that both the market returns and the P/V ratio are lower for RTO firms, which is consistent with our H1.

Panel B of Table 2.2 compares the characteristics of the private firms and the public firms involved in the RTO. The private firms exhibit significantly higher operating performance (measured by return on assets) and asset turnover than acquiring firms. Meanwhile, the private and public firms are similar in size but the public firms hold more cash. This indicates that the public firms' cash reserve is an important source of funds for the private firms listing via RTO.

2.4.1.2 Baseline results

We present the results of the baseline logistic regressions in Table 2.3. First, we provide evidence to show how pre-listing market returns affect the choice of RTO and IPO. In Model 1, 2 and 3, we estimate equation (2.1) using market returns measured over three different time periods (3 months, 6 months and 12 months prior to the IPO/RTO). Consistent with H1, all three market return measures have significantly negative coefficients (see Model 1, 2 and 3). The marginal effects indicate that a 10% increase in the -3 months/-6 months/-12 months market return results in a 6.41%/5.31%/3.09% decrease in the probability of listing through RTO. To put this results into context, the unconditional probability of choosing RTO in the sample is 13.82%. This suggests that the pre-listing market return, to a considerable extent, explains the choice of listing through an RTO.

In Model 4, we decompose the 12 month market returns prior to listing into returns of three sub-periods:1 to 3 month (-3 months), 4 to 6 months (-6 to -4 months), and 7 to 12 months (-12 to -7 months) prior to listing. This decomposition enables us to further understand a firm's decision horizon for the choice of RTO versus IPO. We observe that the coefficients associated on -3 months market return and the -6 to -4 months market return are both significant (at the 5% and 1% level respectively) and negative, whereas the coefficient of the -12 to -7 months market return is

insignificant, indicating that the choice between RTO and IPO is sensitive to the market conditions in the most recent 6 months prior to listing.

In Model 5, 6 and 7, we use the market-level P/V and V/B ratio to measure market valuation, which allows us to distinguish between fair valuation and overvaluation. The significantly negative coefficient associated on the market-level P/V ratio in Model 5 confirms our H1 that, private firms are more likely to choose an RTO when market valuation is lower. The marginal effect we estimate in Model 5 indicates that a 10% increase in the market-level P/V ratio leads to 11.8% decrease in this probability of choosing an RTO. We estimate Model 7, further controling for the effect of growth opportunities by including V/B in the regression. We observe a significantly negative coefficient on the market-level P/V ratio but an insignificant coefficient on the market-level V/B ratio. In Model 6, where we have V/B and drop P/V, we find V/B has a negative coefficient (-1.796) which is only marginally significant at the 10% level. Together, these results indicate that it is market overvaluation rather than growth opportunities that drive a firm's choice of the RTO versus IPO.

In Model 8, 9 and 10 of Table 2.3, we use the implied firm-level P/V and V/B ratio to check how robust the results above are to variation in firm-level valuation. Because we are not able to find a recently listed firm for every private firm in our sample, the sample size reduces to 668. Overall, we find results that are qualitatively the same to what we find with market level ratios. In model 8, the coefficient on firm-level P/V ratio is -0.032 and significant at the 1% level. The marginal effect is much lower compared to the effect of market level P/V. A 10% increase in P/V at firm level reduces the probability of RTO by 0.3%. This suggests that the overall market condition is more important for a listing firm to choose between RTO and IPO. In model 10, we include both P/V and V/B in the regression. We note that the significantly negative coefficient on firm-level P/V ratio persists and the V/B ratio is significantly (at the 1%) positive. This indicates that listing firms with more growth opportunities are more likely to choose RTO. In model 9, we only include V/B ratio and drop P/V ratio and the significantly positive coefficient on V/B persists. Overall, results in table 2.3 are consistent with our H1 that, when market valuation is low, private firms strategically resort to RTO for listing.

2.4.1.3 Post-listing cash savings

In Table 2.4, we report the regression estimates of Equation (2.6) using OLS, the Heckman two-step approach and the propensity score matching approach. The results here shed further light on understanding the extent to which the motive of exploiting market valuation relates to RTO and IPO. In line with Kim and Weisbach (2008), in Panel A, we observe that the coefficients on *Capital Raised* of IPO firms are significantly positive in all the post-listing years. For example, the coefficient is 0.434 in year 3 and statistically significant at the 1% level, which suggests that a one-dollar increase in the capital raises lead to a 43-pence increase in cash savings in year 3 post-listing. This positive coefficient on capital raised remains qualitatively unchanged in panel B and C where we use the propensity-score matching and the Heckman two-step method respectively. In panel D, we use the Heckman two-step method and introduce the interaction terms between Capital Raised and the high P/V dummy and the high V/B dummy. We find the coefficient on the interaction term between high P/V dummy and capital raised is significantly (at the 1% level) positive for all the post-listing years. At the same time, the coefficient on Capital Raised remains significantly positive. This is consistent with the view that more overvalued IPO firms are more likely to save cash from capital raised, consistent with Kim and Weisbach (2008) and Hertzel and Li (2010).

In contrast, for the RTO sample in panel A, the coefficient on Capital Raised is only significantly (at the 5% level) positive in year one and the magnitude is much lower (0.456) compared to the corresponding coefficient for IPO (0.832). This positive coefficient is not robust to the variation based on propensity score matching. For year 2 and 3, the coefficient on Capital Raised are statistically insignificant in under all specifications in panel A to D. In panel D, we fails to find a coefficient on the interaction term between Capital Raised and the high P/V ratio dummy, which demonstrates that even for RTO firms more likely to be overvalued, the motivation to time market valuation is weak.

2.4.2 The effectiveness of RTO

2.4.2.1 Post-listing business expansion

To analyze RTO firms strategy of seeking expansion and growth via listing, we investigate how *Capital Raised* relates to their changes in total assets, accumulated cash spending on capital expenditure and accumulated cash spending on acquisitions. Accumulated spending on capital expenditure reflect the use of funds on internal growth and accumulated spending on acquisitions demonstrates the use of funds on external growth.

Overall, the results are mixed. There is no clear evidence that RTO firms are more or less aggressive than IPO firms in expanding their business in post-listing years. In panel A of Table 2.5, where we use OLS regressions, the coefficient on Capital Raised for the IPO sample is significantly positive in all years for both the change in total assets regression and the capital expenditure regression. For the RTO sample, this coefficient is only significant in the first year of the change-in-total-assets regression. But when we test the equality in coefficients between RTO and IPO firms, we fail to reject the null that there is no significant difference between RTO firms and IPO firm, with one exception which is the change-in-total-assets regression in years 2. Turning to the the regression of spending on acquisitions, only in year 1 that IPO firms exhibit a significant higher coefficient on Capital Raised (0.213) than the RTO firms. When we use the Heckman two-step method and the propensity score matching, our previous observation persist. Overall, there is no clear evidence that RTO firms are more or less aggressive than IPO firms expanding their business in post-listing years.

2.4.2.2 Certification effect to internal capital providers

Another strategic role of listing is to certify the quality of the listing firm to internal and external capital providers (Roell (1996); Stoughton, Wong and Zechner (2001); Ferrari (1992); Rydqvist and Hogholm (1995)). By internal, we refer to capital providers who are existing shareholders or creditors of the listing firm; by external, we refer to potential equity investors in the post-listing years. Table 2.6 reports the

regression estimates of Equation (8), examining how capital raised relates to dividend payment and spending on long-term debt reduction. In Panel A (OLS regressions) of Table 2.6, we observe that the coefficients on *Capital Raised* are significantly positive in every year for both the spending-on-dividend and the spending-on-debt-reduction regression. For example, in the first year, the coefficient on Capital Raised in the spending-on-dividend regression is -0.085 (significant at the 5%), which indicate that when the *Capital Raised* increases by one dollar, the spending on dividends reduces by 8.5 pence. This finding suggests that the higher *Capital Raised* plays a stronger effect in certifying the quality of the listing firm and , when internal capital providers observe this, they are willing to keep more of their investments within the listing firm. Therefore, RTO also provides a good opportunity for the listing firm to re-structure the agreements with existing capital providers. Moving on to the IPO firms, we do not find a significantly negative coefficient on *Capital Raised* in any of the regressions, contrary what we find with RTO firms. Wald tests of equality of coefficient cross regressions suggests that the coefficient on *Capital Raised* changes significant between RTO and IPO in all years. In panel B, we repeat our analysis in panel A using the Heckman two-step method and the results are largely consistent. In panel C, we repeat the analysis using propensity-score matching and find the negative coefficient on *Capital Raised* vanishes. Since the propensity-score matching approach controls for the observable factors that determines the choice of RTO and IPO, this result suggests that, when internal investors cannot distinguish the motive of RTO from that of IPO, they are not prepared to keep more of their investment in the RTO firm via restructuring their financing agreements with the RTO firm.

2.4.2.3 Certification effect to external equity providers

Table 2.7 reports our findings on the certification effect to internal capital providers, which is another important dimension of the strategic roles of listing. Specifically, we investigate the I/B/E/S analysts coverage and follow-on equity issuance activities in the post-listing years. Previous studies on listing firms argue that analysts coverage adds value to listing firms through two mechanisms. One is non-financial aspect. Better analysts coverage following listing can increase a firm's publicity and attract

new consumers (Cliff and Denis, 2004). The other is financial aspect, better analyst coverage following listing can boost the share price (Aggarwal, Krigman, and Womack, 2002; James and Karceski, 2006) and facilitate future financing (Chang, Dasgupta, and Hilary, 2006). In Panel A of Table 7, we investigate the number of firms received analysts coverage in the post-listing years, we do not observe significant difference between RTO firms and IPO firms. 63.01% of RTO firms receive coverage of the I/B/E/S database within the three years after going public while 66.27% of IPO firms do. However, the average number of analysts for IPO firms is significantly larger than that for RTO firms. In terms of the follow-on equity issuance, we show that higher proportion of RTO firms (63.01%) raised additional capital through follow-on equity issuance than IPO firms (52.21%) during the 3-year period after listing, but the difference is marginally significant at 10% level. This difference is mainly driven by a significant number of follow-on equity issuance made by RTO firms in the first year following listing.

In Panel B of Table 2.7, we report the regression estimates of Equation (9) and (10). The insignificant coefficients on *RTO dummy* indicates that there is no significant difference between RTO firms and IPO firms in terms of the follow-on equity issuance activities and analyst coverage in post-listing years. This finding is also robust after using the Heckman two-step method and the propensity score matching method to control for selection bias.

In short, our results suggest that, unlike U.S. RTO firms, U.K. RTO firms receive similar certification effect to external equity providers through listing comparing with their IPO counterparts.

2.4.2.4 Post-listing operating performance

In this section, we analyze whether RTO firms differ from IPO firms on post-listing operating performance. We report the regression estimates of Equation (2.11) in Table 2.8. In Model 1, we do not include *RTO dummy*. The significantly positive constant term suggests that, on average, operating performance improves after listing. In Model 2, we add the *RTO dummy*. The coefficient on *RTO dummy* is positive but insignificant, which indicates that, on average, RTO firms yield an operating

performance similar to that of IPO firms. This finding is in line with our conjecture that RTO does not introduce inferior listings under the U.K. regulatory framework, contrary to what is suggested by studies on U.S. RTOs.

2.5 Conclusion

Using a sample from the U.K., we examine the determinants and effectiveness of RTOs. The stringent requirements imposed on RTO listing reduce the benefits of RTO as a fast and cost-efficient alternative to IPO. Rather, our results demonstrate that when market valuation is low, private firms are more likely to strategically resort to RTO for listing. By choosing RTO, a listing firm only needs to communicate with the shareholders of a public firm rather than with a large number of public equity investors; further, RTO firms can take advantage of low market valuation to acquire a public firm.

Post listing, we find no clear evidence showing that RTP firms are different from IPO firms in operating performance, business expansion or certification to prospective equity investors in post-listing years. Different from IPO firms, RTO firms spend less funds on dividends and reducing long-term debt, consistent with the interpretation that RTO certifies a listing firm's quality to internal capital providers and these capital providers agree to keep more of their investments within the RTO firms. Overall, we demonstrate that RTOs do not introduce inferior listings in the U.K.

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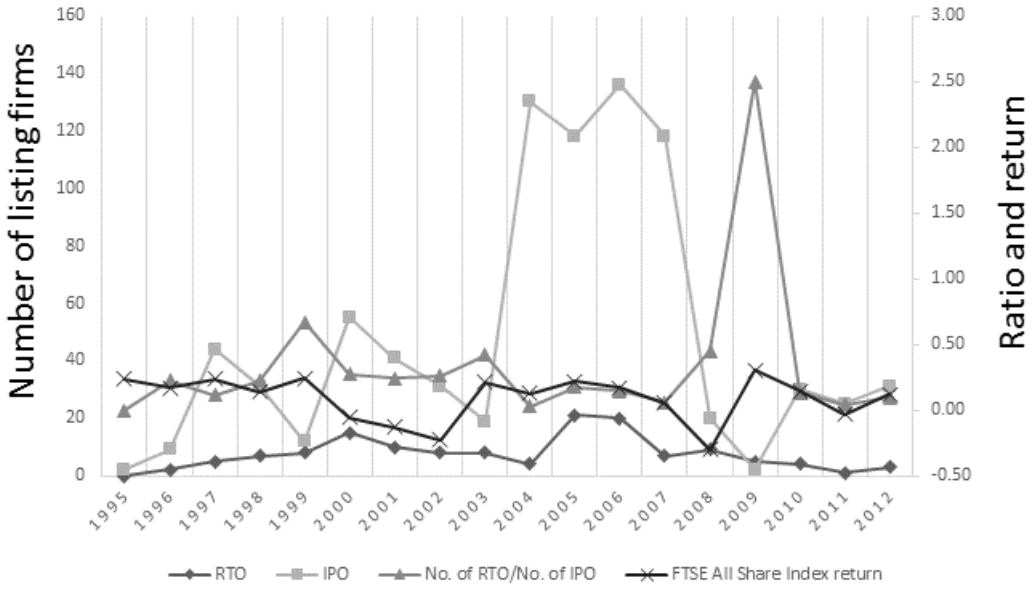

Figure 2.1: Time distribution of IPOs and RTOs from 1995 to 2012

Table 2.1: Distribution of listing firms by industry and year

Panel A: Distribution by year

	RTO		IPO		
Year	Number	Percent	Number	Percent	No. of RTO/No. of IPO
1995	0	0.00	2	0.23	0.00
1996	2	1.46	9	1.05	0.22
1997	5	3.65	44	5.15	0.11
1998	7	5.11	31	3.63	0.23
1999	8	5.84	12	1.41	0.67
2000	15	10.95	55	6.44	0.27
2001	10	7.30	41	4.80	0.24
2002	8	5.84	31	3.63	0.26
2003	8	5.84	19	2.22	0.42
2004	4	2.92	130	15.22	0.03
2005	21	15.33	118	13.82	0.18
2006	20	14.60	136	15.93	0.15
2007	7	5.11	118	13.82	0.06
2008	9	6.57	20	2.34	0.45
2009	5	3.65	2	0.23	2.50
2010	4	2.92	30	3.51	0.13
2011	1	0.73	25	2.93	0.04
2012	3	2.19	31	3.63	0.10
1995−1999: pre dot-com bubble crash period					
	22	16.06	98	11.48	0.22
2000−2002: dot-com bubble crash period					
	33	24.09	127	14.87	0.26
2003−2007: pre-crisis period					
	60	43.80	521	61.01	0.12
2008−2009: financial crisis period					
	14	10.22	22	2.58	0.64
2010−2012: post-crisis period					
	8	5.84	86	10.07	0.09
Total	137		854		

Panel B: Distribution by the private firms' industry (Fama-French 12 industries classification)

		IPO		RTO	
Industry code	Classification	Number	Percent	Number	Percent
1	Consumer NonDurables: Food, Tobacco, Textiles, Apparel, Leather, Toys	6	4.38	37	4.33
2	Consumer Durables: Cars, TVs, Furniture, Household Appliances	1	0.73	11	1.29
3	Manufacturing	0	0.00	40	4.68
4	Oil, Gas, and Coal Extraction and Products	4	2.92	55	6.44
5	Chemicals and Allied Products	3	2.19	16	1.87
6	Business Equipment: Computers, Software, and Electronic Equipment	31	22.63	142	16.63
7	Telephone and Television Transmission	12	8.76	38	4.45
8	Utilities	1	0.73	8	0.94
9	Wholesale, Retail, and Some Services (Laundries, Repair Shops)	9	6.57	54	6.32
10	Healthcare, Medical Equipment, and Drugs	12	8.76	69	8.08
11	Finance	21	15.33	135	15.81
12	Other	37	27.01	249	29.16
Total		137		854	

Table 2.2: Summary statistics

Panel A reports the summary statistics of the sample used to estimate the effect of market valuation on the choice of RTO versus IPO. Panel B reports the summary statistics of private and public firms involved in RTOs. Panle C reports the summary statistics of the data used to examine the effectiveness of RTO. Control variables included in the regressions but unreported for brevity are log(Total Assets), Return on assets, Capital intensity, and Leverage. All variables are defined in Appendix A. Two-sample t-tests are conducted to test the significance of the differences in means. Z-statistics for the statistical significance of the differences in medians are based on the Wilcoxon rank sum test. * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

	Panel A: Market value and the choice of RTO versus IPO						Panel B: Private versus public firms					
	Mean			Median			Mean			Median		
	IPO	RTO	t-stat	IPO	RTO	Z-stat	Private	Public	t-stat	Private	Public	Z-stat
log(Total Assets)	9.807	8.403	5.059***	9.314	8.343	4.838***	8.403	7.954	1.086	8.343	7.979	0.920
Asset turnover	1.188	1.784	−2.623***	0.769	1.205	−3.709***	1.784	0.670	3.175***	1.205	0.201	6.168***
Cash / Total Assets	0.162	0.179	−0.840	0.064	0.076	−1.914*	0.179	0.471	−6.699***	0.076	0.323	−5.245***
Leverage	0.238	0.166	0.904	0.033	0.011	1.526	0.166	0.033	2.995**	0.011	0.000	3.139***
Return on assets	−0.018	−0.075	1.476	0.085	−0.005	4.570***	−0.075	−0.395	3.341***	−0.005	−0.110	4.157***
−3 months market return	0.030	0.008	4.559***	0.036	0.024	3.165***						
−6 months market return	0.064	0.025	5.426***	0.078	0.042	3.484***						
−12 months market return	0.138	0.076	5.263***	0.159	0.127	3.736***						
−6 to −4 months market return	0.033	0.016	3.284***	0.036	0.027	2.151**						
−12 to −7 months market return	0.069	0.047	2.845***	0.081	0.073	2.385**						
Market-level P/V ratio	1.646	1.581	3.109***	1.632	1.621	2.275**						
Market-level V/B ratio	1.338	1.331	0.777	1.370	1.354	0.427						
RTOs with equity issuance (%)		38.89										
No. of obs	854	137		854	137		137			137		
Firm-level P/V ratio	7.584	3.369	2.725***	1.681	1.594	2.143**						
Firm-level V/B ratio	2.249	3.141	−3.485	1.614	2.074	−2.575***						
No. of obs	587	81		587	81							

Table 2.2 (Continued)

Panel C: Variables used to examine the effectiveness of RTO							
		Mean			Median		
Variable	t	IPO	RTO	t-stat	IPO	RTO	Z-stat
Sources of funds							
Capital Raised/Total Assets$_0$	1	2.033	1.993	0.106	0.769	0.778	0.289
ΣTotal Funds	1	0.758	0.792	−0.293	0.420	0.402	0.559
	2	1.705	1.878	−0.635	0.880	0.894	−0.147
	3	2.993	3.042	−0.090	1.326	1.517	−0.556
Post-listing cash savings							
ΔCash	1	1.062	0.728	1.308	0.205	0.035	4.005***
	2	−0.201	−0.184	−0.122	−0.016	−0.024	−0.364
	3	−0.084	0.108	−1.894*	−0.001	−0.015	0.092
Variables related to business expansion							
ΔTotal Assets	1	2.363	3.681	−2.635***	0.770	1.590	−2.258**
	2	0.871	−0.633	3.900	0.239***	0.102	1.093
	3	0.733	0.569	0.557	0.178	−0.043	1.89*
ΣCAPEX	1	0.168	0.171	−0.083	0.061	0.025	3.389***
	2	0.430	0.472	−0.502	0.155	0.107	1.92**
	3	0.705	0.665	0.315	0.256	0.135	1.294
ΣAcquisitions	1	0.136	0.349	−3.625***	0.000	0.000	−0.505
	2	0.068	0.270	−4.692***	0.000	0.000	−0.996
	3	0.000	0.008	−6.573***	0.000	0.000	−6.41***
Variables related to certification to internal capital providers							
ΣDividend	1	0.009	0.015	−1.873*	0.000	0.000	1.026
	2	0.029	0.018	1.553	0.000	0.000	2.483**
	3	0.054	0.024	2.444**	0.000	0.000	2.626***
ΣLong-term Debt Reduction	1	0.122	0.054	2.638***	0.006	0.002	1.751*
	2	0.194	0.136	1.542	0.026	0.044	−0.506
	3	0.307	0.271	0.636	0.073	0.101	−1.066
No. of obs (for t=1, 2 and 3)		747	73		747	73	
Post-listing operating performance							
Post-listing Adj. OPCF/TA	1-3	−0.049	−0.014	−1.472	0.056	0.055	0.356
Pre-listing Adj. OPCF/TA	1-3	−0.186	−0.375	1.120	0.048	−0.060	2.419**
No. of obs		247	25		247	25	

Table 2.3: Market valuation and the choice of RTO versus IPO

This table shows the results of the logistic regressions estimating the effect of market valuation on a firm's choice between RTO and IPO. The dependent variable is a binary variable equals 1 if a firm chooses RTO, and 0 if a firm chooses IPO. All variables are defined in Appendix A. Control variables are measured at the end of the fiscal year prior to listing. Industry dummies are defined according to the Fama-French 12 industries classification. Standard errors are robust to heteroskedasticity and p-values are reported in parentheses. The marginal effect of each regressor is measured at sample mean and reported in square brackets. * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
−3 months market return	−6.348***			−5.372***			
	(0.001)			(0.007)			
	[−0.660]			[−0.551]			
−6 months market return		−5.298***					
		(0.000)					
		[−0.543]					
−12 months market return			−3.094***				
			(0.000)				
			[−0.318]				
−6 to −4 months market return				−4.623**			
				(0.016)			
				[−0.474]			
−12 to −7 months market return				−1.089			
				(0.413)			
				[−0.112]			
Market-level P/V ratio					−1.121**		−0.977**
					(0.015)		(0.028)
					[−0.118]		[−0.103]
Market-level V/B ratio						−1.796*	−1.267
						(0.098)	(0.247)
						[−0.191]	[−0.133]
log(Total Assets)	−0.154***	−0.158***	−0.152***	−0.152***	−0.162***	−0.180***	−0.168***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[−0.016]	[−0.016]	[−0.016]	[−0.016]	[−0.017]	[−0.019]	[−0.018]
Asset turnover	0.052	0.053	0.058	0.055	0.048	0.052	0.050
	(0.165)	(0.154)	(0.117)	(0.135)	(0.254)	(0.210)	(0.238)
	[0.005]	[0.005]	[0.006]	[0.006]	[0.005]	[0.006]	[0.005]
Cash	−0.274	−0.329	−0.254	−0.320	−0.207	−0.269	−0.252
	(0.492)	(0.419)	(0.528)	(0.433)	(0.611)	(0.514)	(0.541)
	[−0.029]	[−0.034]	[−0.026]	[−0.033]	[−0.022]	[−0.029]	[−0.026]
Leverage	−0.248	−0.287*	−0.265	−0.277*	−0.259*	−0.254*	−0.261*
	(0.128)	(0.079)	(0.110)	(0.091)	(0.098)	(0.098)	(0.092)
	[−0.026]	[−0.029]	[−0.027]	[−0.028]	[−0.027]	[−0.027]	[−0.027]
Return on assets	−0.200	−0.156	−0.141	−0.151	−0.198	−0.194	−0.194
	(0.407)	(0.497)	(0.535)	(0.517)	(0.394)	(0.407)	(0.407)
	[−0.021]	[−0.016]	[−0.015]	[−0.015]	[−0.021]	[−0.021]	[−0.020]
Constant	−0.580	−0.397	−0.411	−0.421	1.168	1.923	2.688*
	(0.131)	(0.294)	(0.276)	(0.276)	(0.148)	(0.220)	(0.092)
Industry effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs	991	991	991	991	991	991	991
Pseudo R-square	0.073	0.085	0.081	0.086	0.064	0.060	0.066

Table 2.3 (Continued)

Variable	Model 8	Model 9	Model 10
Firm-level P/V ratio	-0.032^{***}		-0.026^{***}
	(0.000)		(0.000)
	[−0.003]		[−0.002]
Firm-level V/B ratio		0.140^{***}	0.115^{***}
		(0.001)	(0.008)
		[0.013]	[0.01]
log(Total Assets)	-0.179^{**}	-0.190^{**}	-0.168^{*}
	(0.025)	(0.032)	(0.050)
	[−0.016]	[−0.018]	[−0.015]
Asset turnover	0.015	0.021	0.019
	(0.513)	(0.387)	(0.431)
	[0.001]	[0.002]	[0.002]
Cash	0.168	0.240	0.205
	(0.686)	(0.530)	(0.593)
	[0.015]	[0.022]	[0.018]
Leverage	-0.668^{**}	-0.645^{*}	-0.672^{*}
	(0.047)	(0.064)	(0.062)
	[−0.061]	[−0.059]	[−0.06]
Return on assets	−0.146	−0.165	−0.163
	(0.426)	(0.402)	(0.398)
	[−0.013]	[−0.015]	[−0.015]
Constant	−0.017	−0.467	−0.482
	(0.979)	(0.570)	(0.536)
Industry effect	Yes	Yes	Yes
No. of obs	668	668	668
Pseudo R-square	0.063	0.065	0.071

Table 2.4: Post-listing cash savings

This table reports the results showing the effect of capital raised on post-listing cash savings for RTO firms and IPO firms. Panel A reports the results of OLS regressions. Panel B reports the results of regressions estimated on the propensity-score matched sample. Panel C reports the results of regressions estimated using Heckman two-step method. The dependent variable Y is $\Delta\text{Cash}_t = \ln[1 + (\text{Cash}_t - \text{Cash}_0) / \text{Total Assets}_0]$. Capital Raised = $\ln[\text{Capital Raised/Total Assets}_0]$. Year 0 is the year prior to listing, and t = 1, 2, 3 year after listing. All regressions include year and industry dummies. Industry dummies are created according to the Fama-French 12 industries classification. For the sake of brevity, we do not report the coefficients on the year and industry dummies as well as the coefficients on the log of total assets and the log of total funds. All variables are defined in Appendix A. Standard errors are robust to heteroskedasticity. *p*-values are reported in parentheses. Column (1) under the section "Test of equality" contains the p-value of a χ^2 test of statistical equality of the coefficients on Capital Raised in both the RTO and IPO regressions. Column (2) contains the *p*-value of a F-test of jointly statistical equality of all coefficients in each RTO and IPO regression in year t. * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

		RTO			IPO			Test of equality	
Panel A: Post-listing cash savings estimated by OLS									
Y	t	Obs	Capital Raised	adj. R-sq	Obs	Capital Raised	adj. R-sq	(1)	(2)
ΔCash	1	73	0.456**	0.673	747	0.832***	0.688	0.025**	0.000***
			(0.026)			(0.000)			
	2	73	0.233	0.592	747	0.599***	0.499	0.031**	0.000***
			(0.235)			(0.000)			
	3	73	0.082	0.567	747	0.434***	0.434	0.043	0.000
			(0.678)			(0.000)			
Panel B: Post-listing cash savings on the propensity-score matched sample									
Y	t	Obs	Capital Raised	adj. R-sq	Obs	Capital Raised	adj. R-sq		
ΔCash	1	68	0.428	0.358	68	0.905***	0.591	0.061*	0.000***
			(0.155)			(0.000)			
	2	68	−0.246	0.242	68	0.716***	0.322	0.000***	0.000***
			(0.380)			(0.001)			
	3	68	−0.496**	0.282	68	0.530***	0.383	0.000***	0.000***
			(0.040)			(0.009)			
Panel C: Post-listing cash savings estimated by Heckman two-step method									
Y	t	Obs	Capital Raised	Lambda	Obs	Capital Raised	Lambda		
ΔCash	1	73	0.411***	0.301	747	0.813***	−0.621**	0.079*	0.000***
			(0.002)	(0.450)		(0.000)	(0.026)		
	2	73	0.056	1.060**	747	0.536***	−1.490**	0.030**	0.000***
			(0.762)	(0.041)		(0.000)	(0.023)		
	3	73	−0.142	1.545**	747	0.367***	−1.698**	0.012**	0.000***
			(0.506)	(0.017)		(0.001)	(0.024)		

Panel D: Post-listing cash savings estimated by Heckman two-step method (including high P/V and high V/B dummy)

Y	t	Obs	Capital Raised	D_HIGH_P/V × Capital Raised	D_HIGH_V/B × Capital Raised	Lambda	Obs	Capital Raised	D_HIGH_P/V × Capital Raised	D_HIGH_V/B × Capital Raised	Lambda		
ΔCash	1	73	0.169	0.244	0.091	0.330	747	0.754***	0.092**	0.090*	−0.278	0.066*	0.000***
			(0.523)	(0.375)	(0.659)	(0.421)		(0.000)	(0.049)	(0.051)	(0.207)		
	2	73	−0.614	0.907*	−0.407	1.779**	747	0.415***	0.240***	0.130	−0.945**	0.116	0.000***
			(0.230)	(0.066)	(0.316)	(0.029)		(0.000)	(0.005)	(0.127)	(0.016)		
	3	73	−0.784	0.904	−0.486	2.262**	747	0.225**	0.301***	0.112	−1.164**	0.104	0.000***
			(0.209)	(0.148)	(0.348)	(0.028)		(0.024)	(0.004)	(0.287)	(0.016)		

Table 2.5: Post-listing business expansion

This table reports the results estimating the use of funds on business expansion in post-listing years. Panel A reports the results of OLS regressions. Panel B reports the results of regressions estimated using Heckman two-step method. Panel C reports the results of regressions estimated on the propensity-score matched sample. The dependent variable $Y_t = \ln\left[1 + (\sum_{\tau=1}^{t} V_\tau \,/\, \text{Total Assets}_0)\right]$ for V = capital expenditure (CAPEX) or acquisitions, $Y_t = \ln\left[1 + (V_t - V_0)\,/\,\text{Total Assets}_0\right]$ for V = total assets. Capital Raised = $\ln\left[\text{Capital Raised}/\text{Total Assets}_0\right]$. Year 0 is the year prior to listing, and t = 1, 2, 3 year after listing. All regressions include year and industry dummies. Industry dummies are created according to the Fama-French 12 industries classification. For the sake of brevity, we do not report the coefficients on the year and industry dummies as well as the coefficients on the log of total assets and the log of total funds. All variables are defined in Appendix A. Standard errors are robust to heteroskedasticity. *p*-values are reported in parentheses. Column (1) under the section "Test of equality" contains the p-value of a χ^2 test of statistical equality of the coefficients on Capital Raised in both RTO and IPO regressions. Column (2) contains the *p*-value of a F-test of joint statistical equality of all coefficients in each RTO and IPO regression at year t. * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

		Panel A: Results estimated by OLS						Panel B: Results estimated by Heckman two-step method					
		RTO		IPO		Test of equality		RTO		IPO		Test of equality	
Y	t	Capital Raised	adj. R-sq	Capital Raised	adj. R-sq	(1)	(2)	Capital Raised	Lambda	Capital Raised	Lambda	(1)	(2)
Implication for growth and expansion													
ΔTotal Assets	1	0.535***	0.613	0.642***	0.714	0.496	0.000***	0.694***	−1.054*	0.648***	0.227	0.601	0.000***
		(0.005)		(0.000)				(0.001)	(0.100)	(0.000)	(0.372)		
	2	−0.031	0.520	0.313***	0.671	0.021**	0.000***	−0.006	−0.149	0.303***	−0.225	0.288	0.000***
		(0.857)		(0.000)				(0.981)	(0.840)	(0.000)	(0.447)		
	3	0.025	0.576	0.132**	0.634	0.517	0.000***	0.068	−0.295	0.116**	−0.410	0.882	0.000***
		(0.893)		(0.046)				(0.757)	(0.660)	(0.020)	(0.238)		
ΣCAPEX	1	0.172	0.730	0.071***	0.311	0.365	0.003***	0.258***	−0.567**	0.070***	−0.047	0.018**	0.001***
		(0.209)		(0.001)				(0.004)	(0.033)	(0.000)	(0.674)		
	2	0.015	0.756	0.104***	0.492	0.470	0.000***	0.075	−0.358	0.099***	−0.120	0.523	0.000***
		(0.921)		(0.005)				(0.484)	(0.248)	(0.000)	(0.467)		
	3	0.040	0.732	0.106**	0.554	0.635	0.000***	0.110	−0.480	0.101***	−0.134	0.482	0.001***
		(0.805)		(0.010)				(0.322)	(0.156)	(0.000)	(0.503)		
ΣAcquisitions	1	−0.050	0.054	0.213*	0.062	0.025**	0.000***	−0.084	0.224	0.217***	0.119	0.012**	0.000***
		(0.375)		(0.055)				(0.396)	(0.443)	(0.000)	(0.720)		
	2	−0.044	0.172	−0.045	0.100	0.988	0.000***	−0.060	0.099	−0.032	0.299	0.696	0.000***
		(0.365)		(0.419)				(0.451)	(0.675)	(0.433)	(0.280)		
	3	−0.011	0.684	−0.063**	0.029	0.153	0.000***	−0.024	0.087	−0.055**	0.211	0.612	0.000***
		(0.678)		(0.031)				(0.486)	(0.409)	(0.030)	(0.228)		
Industry dummy		Yes		Yes				Yes		Yes			
Year dummy		Yes		Yes				Yes		Yes			
Obs		73		747				73		747			

Table 2.5 (Continued)

		Panel C: Results on the propensity-score matched sample					
		RTO		IPO		Test of equality	
Y	t	Capital Raised	adj. R-sq	Capital Raised	adj. R-sq	(1)	(2)
Implication for growth and expansion							
ΔTotal Assets	1	0.703*	0.297	0.750***	0.656	0.890	0.000***
		(0.089)		(0.000)			
	2	−0.306	0.213	0.383**	0.690	0.010***	0.000***
		(0.304)		(0.027)			
	3	−0.191	0.278	0.077	0.665	0.383	0.000***
		(0.587)		(0.651)			
ΣCAPEX	1	0.130	0.252	0.076**	0.363	0.594	0.000***
		(0.294)		(0.027)			
	2	−0.045	0.166	0.028	0.534	0.728	0.000***
		(0.856)		(0.770)			
	3	−0.079	0.210	0.021	0.626	0.647	0.000***
		(0.751)		(0.863)			
ΣAcquisitions	1	−0.166	0.045	0.357	0.242	0.014**	0.000***
		(0.136)		(0.166)			
	2	−0.126	0.169	−0.094	0.000	0.798	0.000***
		(0.144)		(0.496)			
	3	−0.057	0.702	−0.015	0.000	0.320	0.000***
		(0.250)		(0.434)			
Industry dummy		Yes		Yes			
Year dummy		Yes		Yes			
Obs		68		68			

Table 2.6: Certification effect to internal capital providers

This table reports the results estimating the use of funds on business expansion in post-listing years. Panel A reports the results of OLS regressions. Panel B reports the results of regressions estimated using Heckman two-step method. Panel C reports the results of regressions estimated on the propensity-score matched sample. The dependent variable $Y_t = \ln\left[1 + (\sum_{\tau=1}^{t} V_\tau \,/\, \text{Total Assets}_0)\right]$ for V = dividends and reduction in long-term debt . Capital Raised = $\ln$[Capital Raised/Total Assets$_0$]. Year 0 is the year prior to listing, and t = 1, 2, 3 year after listing. All regressions include year and industry dummies. Industry dummies are created according to the Fama-French 12 industries classification. For the sake of brevity, we do not report the coefficients on the year and industry dummies as well as the coefficients on the log of total assets and the log of total funds. All variables are defined in Appendix A. Standard errors are robust to heteroskedasticity. p-values are reported in parentheses. Column (1) under the section "Test of equality" contains the p-value of a χ^2 test of statistical equality of the coefficients on Capital Raised in both RTO and IPO regressions. Column (2) contains the p-value of a F-test of joint statistical equality of all coefficients in each RTO and IPO regression at year t. * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

		Panel A: Results estimated by OLS						Panel B: Results estimated by Heckman two-step method					
		RTO		IPO		Test of equality		RTO		IPO		Test of equality	
Y	t	Capital Raised	adj. R-sq	Capital Raised	adj. R-sq	(1)	(2)	Capital Raised	Lambda	Capital Raised	Lambda	(1)	(2)
Implication for financial policy													
ΣDividend	1	−0.085**	0.561	−0.004	0.021	0.013**	0.000***	−0.064**	−0.136*	−0.002	0.072**	0.105	0.000***
		(0.039)		(0.144)				(0.010)	(0.065)	(0.645)	(0.032)		
	2	−0.336**	0.612	−0.006	0.054	0.002***	0.000***	−0.285***	−0.301	−0.001	0.121**	0.031**	0.000***
		(0.016)		(0.338)				(0.000)	(0.136)	(0.930)	(0.023)		
	3	−0.300**	0.562	−0.017	0.075	0.007***	0.000***	−0.224***	−0.519**	−0.011	0.142**	0.144	0.000***
		(0.023)		(0.122)				(0.004)	(0.030)	(0.264)	(0.040)		
ΣLong-term Debt Reduction	1	−0.369**	0.592	0.023	0.154	0.002***	0.059*	−0.270***	−0.663**	0.016	−0.267**	0.068*	0.002***
		(0.021)		(0.256)				(0.005)	(0.018)	(0.346)	(0.026)		
	2	−0.397**	0.595	−0.019	0.287	0.004	0.055	−0.325***	−0.432*	−0.036	−0.397**	0.091*	0.007***
		(0.014)		(0.484)				(0.000)	(0.081)	(0.179)	(0.023)		
	3	−0.435***	0.586	−0.027	0.333	0.002***	0.012**	−0.354***	−0.561*	−0.044	−0.433**	0.056*	0.016**
		(0.006)		(0.487)				(0.000)	(0.061)	(0.120)	(0.025)		
Industry dummy		Yes		Yes				Yes		Yes			
Year dummy		Yes		Yes				Yes		Yes			
Obs		73		747				73		747			

Table 2.6 (Continued)

		Panel C: Results estimated on the propensity-score matched sample					
		RTO		IPO		Test of equality	
Y	t	Capital Raised	adj. R-sq	Capital Raised	adj. R-sq	(1)	(2)
Implication for financial policy							
ΣDividend	1	0.010	0.234	−0.021	0.000	0.049**	0.000***
		(0.450)		(0.169)			
	2	0.000	0.265	−0.048	0.000	0.166	0.000***
		(0.987)		(0.279)			
	3	−0.014	0.212	−0.078	0.070	0.227	0.000***
		(0.426)		(0.242)			
ΣLong-term Debt Reduction	1	0.041*	0.106	0.021	0.000	0.553	0.000***
		(0.091)		(0.558)			
	2	0.021	0.162	0.005	0.000	0.777	0.000***
		(0.626)		(0.937)			
	3	−0.048	0.035	−0.044	0.006	0.971	0.000***
		(0.612)		(0.747)			
Industry dummy		Yes		Yes			
Year dummy		Yes		Yes			
Obs		68		68			

Table 2.7: Certification effect to external equity providers

This table shows the post-listing analyst coverage and follow-on equity issuance activities of RTO and IPO firms. In Panel A, we present the coverage of listing firms by the I/B/E/S database and the proportion of listing firms conducting follow-on equity issuance in the post-listing years. Two-sample t-tests are conducted to test the significance of the differences in means. In Panel B, we report the results of logistic regressions examining how the choice of RTO versus IPO affects the post-listing follow-on equity issuance activities and analyst coverage. *Follow-on issuance* is a binary variable equals 1 if the firm raises additional capital through follow-on equity issuance during the 3-year period following listing, and 0 otherwise. *Analyst Coverage* is a binary variable equals 1 if the firm is covered by the I/B/E/S database during the 3-year period following listing, and 0 otherwise. Control variables included in the regressions but unreported for brevity are log(Total Assets), Return on assets, Capital intensity, Leverage and Cash. Industry effect is based on the Fama-French 12 industries classification. All variables are defined in Appendix A. Standard errors are robust to heteroskedasticity and within year and industry clustering. p-values are reported in parentheses. * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

Panel A: Post-listing analyst coverage and follow-on equity issuance activities					
	t	RTO	IPO	Difference	t-statistics
Analyst coverage (%)	1	32.88%	42.70%	9.83%	1.63
	2	45.21%	52.61%	7.40%	1.21
	3	52.05%	54.75%	2.70%	0.44
	$1-3$	63.01%	66.27%	3.25%	0.56
Average number of analysts	1	0.49	1.14	0.64	2.34**
	2	0.92	1.53	0.61	1.90*
	3	0.97	1.83	0.85	2.23**
	$1-3$	0.79	1.50	0.70	2.28**
Follow-on equity issuance (%)	1	49.32%	23.43%	−25.89%	−4.89***
	2	23.29%	27.31%	4.02%	0.74
	3	23.29%	27.98%	4.69%	0.86
	$1-3$	63.01%	52.21%	−10.80%	−1.77*
Obs		747	73		

Panel B: Regression analysis of the certification effect to external equity providers		
Dependent variable:	Follow-on issuance	Analyst coverage
Panel B1: Logistic regressions		
RTO dummy	0.302	0.059
	(0.301)	(0.849)
Obs	820	820
Pseudo R-square	0.064	0.166
Panel B2: Regressions estimated using Heckman two-step method		
RTO dummy	1.302	2.569
	(0.348)	(0.144)
Inverse mills ratio	−0.468	−1.314
	(0.513)	(0.161)
Obs	805	805
Pseudo R-square	0.051	0.155
Panel B3: Regressions estimated on the propensity-score matched sample		
RTO dummy	−0.060	0.224
	(0.919)	(0.700)
Obs	136	136
Pseudo R-square	0.122	0.286
Control variables	Yes	Yes
Year effect	Yes	Yes
Industry effect	Yes	Yes

Table 2.8: Post-listing operating performance

This table reports the OLS regression estimates of post-listing operating performance. The dependent variable is the adjusted post-listing three-year average operating performance. The RTO dummy equals 1 if a firms goes public by a RTO and 0 if it goes public by an IPO. Coefficients for year dummies are omitted for the sake of brevity. Standard errors are robust to heteroskedasticity and within year clustering. p-values are reported in parentheses. * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

Dependent variable	Post-listing Adj. *OPCF/TA*	
	Model 1	Model 2
Pre-listing Adj. *OPCF/TA*	0.250***	0.252***
	(0.000)	(0.000)
RTO dummy		0.081
		(0.103)
Constant	0.029***	0.029***
	(0.000)	(0.000)
Year effect	Yes	Yes
No. of obs	272	272
R-squared	0.374	0.379

Appendix A: Variable definition

Variable	Definition
Total assets	Book value of assets
Return on assets	Operating income before depreciation/total assets
Asset turnover	Sales/Total assets
Cash	Cash/Total assets
Leverage	Long-term debt/Total assets
CAPEX	Capital expenditures/Total assets
Market-to-book	(total assets − book equity + market value of equity − deferred taxes) / total assets
Capital intensity	Tangible assets/Total assets
Dividend	Dividends paid to common and preferred shareholders/Total assets
Long-term debt reduction	The amount of cash spent to retire long-term debt.
Acquisitions	The amount of cash spent on acquisitions.
Total funds	The sum of funds from operations, sale of property, plant, and equipment, long-term debt issuances, and sale of common and preferred stock
Capital raised	For IPO firms, it is the product of the number of primary shares and the offer price; For RTO firms, is is the sum of the cash reserves of the public firm before the RTO and the proceeds from equity issuance (if any) at the RTO.
Adj. OPCF	In each year, a firm's operating cash flow performance is adjusted by the median value of firms in each Fama-French 12 industry.
−3 months Market return	The buy-and-hold return of the FTSE All-Share Index during 3-month prior to listing.
−6 months Market return	The buy-and-hold return of the FTSE All-Share Index during 6-month prior to listing.
−12 months Market return	The buy-and-hold return of the FTSE All-Share Index during 12-month prior to listing.
−6 to −4 months Market return	The buy-and-hold return of the FTSE All-Share Index during 4 to 6 months prior to listing.
−12 to −7 months Market return	The buy-and-hold return of the FTSE All-Share Index during 7 to 12 months prior to listing.
P/V ratio	Price-to-residual-income ratio as a proxy of market misvaluation, which is estimated as in Dong et al. (2006) and Lee et al. (1999).
V/B ratio	Residual income value relative to book value of equity, which is used as a proxy of growth opportunity.
Implied P/V and V/B ratio	The P/V and V/B ratio of recently listed firms that is from the same Fama-French 12 industry and is closest in size with the sample firm.
Analyst coverage (%)	The proportion of sample firms are covered by the I/B/E/S analysts in post-listing years.
Average number of analysts	The average number of analysts for the firm in the I/B/E/S database.
Follow-on equity issuance (%)	The proportion of sample firms issue equity in post-listing years.

Appendix B: Reverse takeover process and disclosure requirements

Step 1: Preparation
- Hire reverse takeover advisor (usually investment banks)
- Find a suitable public firm as target
- Prepare required documents for application

Step 2: Negotiation and due diligence
- Perform due diligence on the public firm
- Negotiate and get approval by the public firm's shareholders

Step 3: Conduct the transaction
- Exchange of shares: above 50% of the shares of the newly combined firm to be held by the private target firm
- Replacement of the management team
- Name change

Step 4: Apply for readmission
- Prepare a prospectus
- Prepare full accounting disclosures
- Submit all other documents and information as FCA required
- Promote shares if the firm tends to issue equity

Chapter 3

The market for innovation leadership

3.1 Introduction

In a technology-driven economy like the one we have, the leadership to galvanize and sustain technological innovation is probably the most important aspects of a Chief Executive Officer's (CEO) human capital. Innovation leadership is complex. It builds on a CEO's outstanding perception of external environment (e.g., customer demands, industrial dynamics and legal context), her superior capability to mobilize internal and external resources (e.g., human and capital resources, corporate culture and corporate procedures), her skills to exploit disruptive opportunities, lead changes and organizational renewal, and her expertise in managing risks.[1] There is a large volume of popular coverage on innovation leadership. A simple search for "innovation leadership" on Google returns nearly 700,000 results. Many think tanks write about innovation leadership, and a considerable number of educational organizations offer programmes on innovation leadership. Sizable recent literature has also begun to establish the relevance of leadership to innovation success. Extant studies highlight several aspects of CEO leadership that drive innovation, for example, the ability of directing employee attention (Yadav, Prabhu, and Chandy, 2007), the skills in developing human and

[1] An article published in the Harvard Business Review lists ten traits of innovative leaders, reflecting the complexity of innovation leadership.

social capital (Makri and Scandura, 2010) and exploring paths of new development (Makri and Scandura, 2010), the capability of handling transformations (Chen, Tang, Jin, Xie, and Li, 2014a; Gumusluoğlu and Ilsev, 2009; Jung, Chow, and Wu, 2003), the virtue of coordinating sociocultural environment (Elenkov, Judge, and Wright, 2005; Elenkov and Manev, 2005). Another strand of literature finds that CEOs' personal traits play a crucial role in firm innovation, including education and work experience (Custódio, Ferreira, and Matos, 2017), overconfidence (Galasso and Simcoe, 2011; Hirshleifer, Low, and Teoh, 2012), social connection (Faleye, Kovacs, and Venkateswaran, 2014), risk preference (Sunder, Sunder, and Zhang, 2017). Further, González-Uribe and Groen-Xu (2016) find the horizon of CEO employment contract also influences firm innovation. We provide a more detailed account of literature in Section 4.2.

Innovation leadership is a rare and complex human capital. Even CEOs, who are often overconfident (Malmendier and Tate, 2005), are humbled by the difficulties involved in exercising sound innovation leadership. In a survey by McKinsey & Company (Barsh, Capozzi, and Davidson, 2008), as high as sixty-five percent of the executives responding to the survey say they were only "somewhat" confident about their decisions on innovation. Leadership, by definition, has the potential to mobilize a wide range of resources to the intended purposes, exerting influence not only within firms but also across firm boundaries. An effective mechanism facilitating the diffusion of innovation leadership potentially generates broader economic and social benefits. In the current paper, we ask whether the director labor market provides such an effective mechanism that facilitates the diffusion of a CEO's innovation leadership to benefit other firms in the economy.[2] In particular, we examine whether CEOs with superior innovation leadership are in greater demand on the director labor market and whether companies that actively acquire innovation leadership in the labor market benefit from doing so.

Although the provision of innovation leadership is the inescapable responsibility of incumbent executives, the complexity and scarcity of sound innovation leadership often

[2]Other institutions include, for example, the forums for corporate executives to share their expertise, articles written by human resource experts, and invited talks on the leadership programs offered by universities. However, these institutions are most likely to be more casual and less direct than the director labor market.

require incumbent executives to seek external advice. By appointing an innovative CEO-director (i.e., a director who is the CEO of a firm with superior innovation performance) onto its board, a firm benefits through at least three channels — an innovative CEO-director provides valuable advice (Dalton, Daily, Johnson, and Ellstrand, 1999; Hermalin and Weisbach, 1988), conducts superior monitoring services (e.g., Adams and Ferreira (2007); Jensen (1993)) and certifies the appointing firms' quality (Fahlenbrach, Low, and Stulz, 2010). There is a considerable number of anecdotal cases where a firm invites the CEO of an innovative company to join its board. For example, on April 5, 2017, BlackRock appoints Chuck Robbins, Cisco's CEO, as an outside director.[3] As the CEO of a world's top-twenty innovative company (according to the Boston Consulting Group "The Most Innovative Companies 2018" report), Chuck Robbins was expected to bring his technology expertise to BlackRock's new strategic focus on using technological advancement to reshape its investments and operations. Mr. Robbins' appointment reflects the trend in which companies actively seek innovation leadership in the external labor market. However, extant literature is agnostic about whether and to what extent the labor market transmits the benefit of innovation leadership from one firm to another. In this paper, we aim to conduct a systematic analysis on a CEO's innovation leadership diffusion among firms via the labor market.

Direct data on how CEOs exercise innovation leadership is not available as far as we know. Therefore, we rely on a CEO's on-the-job innovation performance to proxy this CEO's strength in innovation leadership. Fama and Jensen (1983) also maintain that on-the-job performance in their own firms reflects managers' skills. Following recent literature on innovation (Aghion, Van Reenen, and Zingales, 2013; Hall, Jaffe, and Trajtenberg, 2005; Hirshleifer, Hsu, and Li, 2013; Kogan, Papanikolaou, Seru, and Stoffman, 2017), we use patenting activities to measure a firm's innovation performance. In particular, we measure a firm's innovation performance along several dimensions, including innovation quantity (patent count and citation count), innovation quality (citation count per patent), and innovation economic-value impact (the economic value of innovation, following Kogan et al. (2017)).

[3]https://www.reuters.com/article/us-blackrock-board/cisco-ceo-nominated-to-bring-tech-chops-to-blackrock-board-idUSKBN1772TP?il=0

For the convenience of expression, we call CEOs of firms with superior innovation performance innovative CEOs and call them innovative CEO-directors when they sit on other firms' board. Our baseline prediction is that superior innovation leadership increases the likelihood and number of a CEO's outside directorships. Previous literature show that firms seek specific expertise on the labor market valuable for their shareholders, for example industry experience (Dass, Kini, Nanda, Onal, and Wang, 2014), financial expertise (Güner, Malmendier, and Tate, 2008) and political influence (Goldman, Rocholl, and So, 2008). Coles, Daniel, and Naveen (2008) and Hermalin and Weisbach (1988) maintain the role of outside directors in advising incumbent management is vital to business success. Extant literature also studies innovation leadership from the supply side. In particular, outside directorships grant a CEO reputation, information and resources (Fama and Jensen, 1983; Kaplan and Reishus, 1990), benefiting the CEO's work and career. Previous studies use financial performance as a proxy for CEO business skills and find CEOs of firms with better financial performance hold more outside directorships (Ferris, Jagannathan, and Pritchard, 2003; Fich, 2005; Yermack, 2004). For two reasons, however, our baseline prediction can be twofold. First, CEOs of more innovative firms are arguably more productive within their own firms. Therefore the opportunity cost of a CEO accepting an outside directorship can be higher, reducing the likelihood and the number of her outside directorships. Second, firms concerned about leakage of technology secrets may be reluctant to appoint a CEO-director from innovative firms potentially competing with themselves. When these two reasons prevail, the director labor market will be less effective transmitting the benefit of innovation leadership to other firms.

We use a dataset containing non-financial and non-utility firms in the S&P 1500 index, spanning the period from 2000 to 2008. Our baseline results show that CEOs of firms with better innovation quantity or quality are more likely to serve as outside directors on other firms' board, and they hold more outside directorships. Endogeneity occurs when there are unobservable factors that affect firm innovativeness as well as CEO outside directorships. To address this issue, we use two-stage least square (2SLS) regressions, in which we instrument the measures of innovation performance using local gambling preference (a county's Catholics-to-Protestants ratio) and urban industrial diversity (one minus the Herfindahl index of local employment across two-digit

industries in the county where the firms headquarter is). Local gambling preference constitutes an important aspect of corporate culture that can significantly impact a company's innovation strategy. Chen, Podolski, Rhee, and Veeraraghavan (2014b) demonstrate that firms located in gambling-prone counties tend to undertake more radical innovation strategies and, consequently, have greater innovation performance. The prior literature also finds that most innovations occur in cities, particularly in those cities with the more diversified industrial base. Industrial diversification in urban areas facilitates knowledge transfer across industries by reducing searching costs, providing inspirations and cross-industry expertise, and supplying the assortment of components needed for new products (see Glaeser, Kallal, Scheinkman, and Shleifer (1992) and Duranton and Puga (2001)). Our first stage regressions confirm the relevance of the instrumental variables (IV). In the second stage of regression, the positive effect of firm innovation performance on CEO outside directorships persists after instrumenting. Apart from the IV approach, we also exploit the randomness of innovation economic-value impact measured following (Kogan et al., 2017). We find, when a CEO's firm has one or more high-value-impact patents (i.e., in the top ten percent of economic value among all the patents issued in the same year), her number of outside directorships increases by 0.145 in the subsequent three years relative to the CEO of a firm with a similar likelihood of generating high-impact patents but happens to have no high-impact patent in that year. We also find our results are robust to several additional robustness checks, including reverse causality, removing self-citations, and further controlling for CEO overconfidence and ownership. These robustness analyses indicate the positive relation between CEO innovation leadership and the likelihood/number of her outside directorships are not because of omitted variables.

We perform further analysis to understand in greater depth how the labor market matches innovation leadership to companies. Hermalin and Weisbach (1998) state that firms appoint outside directors to obtain valuable experience and expertise that match the firm's advising and monitoring demand. More recent studies (e.g., Coles et al. (2008), Dass et al. (2014), and Faleye, Hoitash, and Hoitash (2013)) confirm their view. Fahlenbrach et al. (2010) also postulates that CEOs select firms when deciding which board to join. They prefer to sit on boards that offer greater prestige or business

opportunities, and on those that incur less opportunity cost. Our analysis using multinomial logistic regressions reveal that CEOs with greater innovation leadership are more likely to join the board of firms with more innovation outcome, greater technology similarity to the CEO's firm, or more research and development (R&D) investment. These additional findings are consistent with the view that the director market is effective in matching CEOs to boards. The findings that CEOs with greater innovation leadership are more likely to join boards with similar technology suggests that certain mechanisms are in place to prevent leakage of confidential information through the boardroom, and therefore, the concern of information leakage does not corrupt the market for innovation leadership.[4]

We do not find measures of financial performance (e.g., *Return on assets*) or firm growth (e.g., *Market-to-book* and *Sales growth*) reduce the number or likelihood of a CEO's outside directorships significantly. Therefore, the view that a more productive CEO prefers to spend more time and effort in her company (thus accept fewer outside appointments) does not find support in our sample. This result suggests the benefits of prestige and opportunities embedded in outside directorships outweighs the opportunity costs of an innovative CEO.

In our last set of analysis, we ask to what extent firms benefit from obtaining advice on innovation leadership in the outside labor market. We use a difference-in-difference approach to analyze the impact of appointing an innovative CEO-director on the appointing firm's innovation and operating performance. We find firms appointing innovative CEO-directors outperform control firms in both innovation quantity and quality in the three years following appointment. The outperformance is more pronounced when the CEO-director's firm is more innovative, the appointing firm has greater technological proximity with the CEO's firm, and the appointing firm invests more in R&D. We also find firms appointing innovative CEO-directors achieve better operating performance in the post-appointment years, which suggests the benefit of acquired innovation leadership translates into productivity.

In this paper, we find the benefits of innovation leadership diffuse to other firms

[4]The mechanisms for preventing information leakage in the boardroom is a research topic in its own right. We delegate this topic to further research for the sake of focus in the current study.

via the director labor market. The labor market provides an effective and sustainable mechanism that matches innovation leadership to company boards. Given the scarcity and complexity of innovation leadership in the economy, the director labor market plays an essential role in realizing the potential positive externality of innovation leadership and enhancing the broader economy and social welfare. We show that firms seeking advice on innovation leadership in the labor market achieve better innovation and operating performance subsequently, confirming the effectiveness of the market for innovation leadership. Our results is also consistent with the view that the innovation leadership is an essential element of a CEO's human capital. Moreover, we contribute to the literature on what promotes a firm's innovation (e.g., Balsmeier, Buchwald, and Stiebale (2014); Balsmeier, Fleming, and Manso (2017); Cho, Halford, Hsu, and Ng (2016); Custódio et al. (2017); Makri and Scandura (2010); Yadav et al. (2007)) — we find innovation leadership acquired in the labor market enhances a firm's innovation performance.

The rest of the paper proceeds as follows. Section 4.2 reviews the related literature and develops our main hypotheses. Section 3.3 describes data and variable construction. Section 3.3.6 discusses the endogeneity issue and the instrumental variables. Section 4.4.1 examines the relation between a CEO's on-the-job innovation performance and CEO outside directorships. Section 3.5 examines the impact of innovative CEO-directors appointment on a firm's innovation and operating performance. Section 3.6 concludes.

3.2 Literature Review and Hypotheses Development

3.2.1 Innovation leadership

There is wide coverage of innovation leadership in the media, popular writings, conferences and forums, and educational programs. Well-known think tanks (e.g., Mckinsey and Boston Consulting Group) have written extensively about innovation leadership. Prestigious educational institutions (e.g., Harvard, Oxford, and Stanford)

offer training programs on innovation leadership. There isn't a clear and unified definition of innovation leadership, however, despite its popularity and importance. In this paper, we use the term "innovation leadership" to refer to the ability of company CEOs to motivate and sustain technology innovations. Because of their prominent role, CEOs are naturally in the right position to influence their firms' innovation strategy, management, and outcome (Howell and Higgins (1990); Howell and Avolio (1993), among others). Several authors study this dimension of CEOs' ability and its impact on innovation. Yadav et al. (2007) maintain that CEOs have a positive and long-term impact on firms' innovation strategy, particularly through directing employees' attention to the focus on innovation. Makri and Scandura (2010) demonstrate that a firm's success in innovation relies on its CEO's ability to decern the market trends, build an environment supportive of innovation, and convert innovation into financial impact. Cho et al. (2016) show that the variation in a firm's innovation performance can be largely explained by CEO fixed effects, suggesting CEO innovation leadership is crucial in understanding the variation in innovation success. A few other studies examine what components of leadership are most crucial for innovation success. Chen et al. (2014a), Gumusluoğlu and Ilsev (2009), and Jung et al. (2003) posit that CEOs' transformational leadership has significant impact on driving organizational innovation.[5] Elenkov et al. (2005) and Elenkov and Manev (2005) further find the effect of leadership on innovation is conditional on the broader sociocultural environment.

Another strand of literature relates CEO personal traits to firm innovativeness. Custódio et al. (2017) find that CEO education and work experience enhance a firm's innovation activities. Galasso and Simcoe (2011) and Hirshleifer et al. (2012) find firms with overconfident CEOs have more patents, more citations, and a higher probability of innovation success. Faleye et al. (2014) find that firms with better-connected CEOs invest more in R&D, and receive more patents and citations. Sunder et al. (2017) posit that CEOs' risk-taking preference, reflected in the hobby of flying airplanes, leads to better innovation outcomes. Further, González-Uribe and Groen-Xu (2016) argue that CEO contract horizon also influences firm innovativeness — a significantly positive association exists between CEO contractual time horizon and patent citations

[5]Transformational leadership refers to the degree to which the leader is perceived to be confident, powerful, mission-oriented, inspirational and intellectually stimulating.

received by a firm.

Overall, the extant literature demonstrates that CEO innovation leadership has a substantial influence on firm innovation outcome. What is unknown however is the extent to which CEO innovation leadership spill over to benefit other firms and the broader economy. We hypothesize that the labor market plays an important role in transmitting innovation leadership across firm boundaries and benefit the broader economy.

3.2.2 Potential benefits of appointing innovative CEOs as outside directors

Extant literature suggests at least three potential benefits of appointing innovative CEOs as outside directors — advisory benefits, enhanced board monitoring, and certification effects. These benefits motivate firms to seek innovation leadership externally on the director labor market and complement the incumbent management's work.

A growing strand of literature highlights the advisory role of corporate boards and the importance of director expertise. Dalton et al. (1999) and Hermalin and Weisbach (1988) postulate that firms prefer to recruit outside directors who can bring valuable experience and expertise to counsel the incumbent management team. Consistent with this view, Coles et al. (2008) show that firms with greater advisory needs, measured by the complexity of a firm (i.e., firm size, leverage, and the number of business segments), have more outside directors on their boards. Faleye et al. (2013) find that advisory directors have more advanced education degrees, entrepreneurial background, CEO-level and board-level experience than other directors.[6] Firms with advisory directors on board also have better strategic outcomes, such as higher acquisition returns, better-quality corporate innovation, and higher firm value. Dass et al. (2014) further point out that firms tend to appoint outside directors from related industries when they face larger information gaps or have greater market power, and such appointments significantly improve firm performance and resilience to industry shocks. Balsmeier

[6]Faleye et al. (2013) define an advisory director as an independent director who serves on at least one advisory committee and not on any monitoring committee.

et al. (2014) study how outside directors influence firm innovation performance using a panel data set on the German companies. They find that appointing outside directors from innovative firms leads to improved patenting activities. Our study differs from their study in that we focus on how the labor market transmits innovation leadership across firm boundaries and benefit the broader economy. Based on these findings from the previous literature, we posit that innovative CEOs bring innovation leadership on board and advise the firms where they serve as outside directors, enhancing innovation strategy, management, and outcome.

Besides the advising benefit, innovative CEOs on board also enhance the effectiveness of board monitoring, especially in innovative firms. Jensen (1993) points out that lack of expertise to fully understand related information is one of the major hurdle preventing directors from monitoring incumbent managers effectively. The information gap between managers and board is likely to be greater in innovative firms, given the level of uncertainties about innovation activities and outcome. Innovative CEO-directors can help the board to understand innovation-related information better, which in turn increases the effectiveness of board monitoring. Adams and Ferreira (2007) further suggest that management-friendly boards are better at monitoring and advising incumbent managers. In particular, to receive valuable advice from outside directors, a CEO has to reveal necessary inside information to the board. Unfriendly outside directors, however, have a low tolerance for manager's poor performance (Weisbach, 1988), and the more information a CEO reveals to outside directors, the more likely this CEO be monitored more intensively by the board. Consequently, a CEO is more likely to share information with a friendly board or a board with particularly valuable expertise. In another study, Manso (2011) postulate that tolerance for failure is essential for innovation. He suggests that the appointment of friendly outside directors leads to better innovation outcomes. Kang, Liu, Low, and Zhang (2014) provide empirical evidence to support this insight by showing that firms with friendly boards have more patents and citations. In summary, unlike typical outside directors, innovative CEO-directors are more likely to understand the risk and difficulties of undertaking innovative projects and, therefore, more tolerant of the failure of innovation activities. Such greater tolerance and understanding leads to better information exchange between managers and directors, which in turn result in

better board monitoring.

Another possible motivation of appointing innovative CEO-directors is the certification benefit. Due to the limited number of talented CEOs available on the labor market, and because CEOs care about their reputation, if a firm successfully attracts an innovative CEO on board, the market would perceive the firm as good enough to attract talents. This certification effect is especially valuable for innovative firms because their value depends on intangible assets to a large extent. A few earlier studies highlight this view. For instance, Fich (2005) finds the stock market reacts positively to CEO-director appointments, and CEOs of well-performing firms are more popular on the directorship market. Ferris et al. (2003) contend that directors who serve larger and well-performing firms are more likely to hold outside directorships. More recently, Fahlenbrach et al. (2010) explicitly investigate the certification hypothesis of director appointment. They find the stock market reacts positively to CEO-director appointments but appointing firms do not experience better subsequent operating performance, which is consistent with the certification hypothesis.

3.2.3 Supply of innovative CEO-directors

As the firm leader, a CEO's time and effort are valuable and limited. Accepting outside directorships requires CEOs to put an extra amount of effort out of their own firms, and if CEOs accept outside directorships, in order to protect their reputation, they cannot considerably shirk their responsibility on the board. Consequently, holding too many outside directorships will reduce the time a CEO committed to her own firm, a rational CEO will accept outside directorships with his own firm's permission only when the total benefit from outside directorship jobs exceeds the opportunity cost of the time devoted to this job. Motivated by this insight, we predict that CEOs are more likely to serve on boards of firms with knowledge and information that are valuable to their main employing firms. For CEOs of innovative firms, outside directorship could be especially valuable, because it provides a possible channel to establish networks and keep a close eye on the external environment such as technology trends and industry dynamics (Faleye et al., 2014), which would eventually enhance a firm's ability to against industrial shocks and realize future growth opportunity.

Cultivating and promoting innovation is challenging and contains a lot of uncertainty, it may take many years to have a patent grant and even longer to translate innovation outcome into profits. As mentioned in Aghion et al. (2013) and Holmström (1999), concerns about the failure of innovation will reduce managers' motivation to promote innovation unless the external competition is very high. Meanwhile, Fama and Jensen (1983) demonstrate that outside directorships can be an independent certification and signal of the executive's managerial ability to internal and external markets. Masulis and Mobbs (2014) conclude that enhancing reputation is one of the most important incentives for accepting outside directorship jobs. Therefore, when intense product market competition forces CEOs to innovate, in order to secure their job position, rational CEOs should accept outside directorships to reveal a strong signal of their ability. Based on this career concern theory, we predict that CEOs of innovative firms are more likely to accept outside directorships in prestigious firms with good innovation outcome so that they can have more certification gains.

3.2.4 CEO on-the-job performance and outside directorships

Yermack (2004) suggests that the possibility of obtaining additional outside directorships is a significant reputation incentive for outside directors. The director labor market provides an important market-based institution for assessing CEOs' managerial skills, and at the same time, grant successful CEOs prestige and opportunities. A sizable literature documents that the director labor market reward well-performing CEOs. Fama and Jensen (1983) postulate that a CEO obtains outside directorships when other companies recognize her managerial skills reflected in her on-the-job performance. Kaplan and Reishus (1990) further posit that outside directorships bring CEOs prestige and visibility, signal the scope and quality of their managerial skills, and bring business and career opportunities. In line with this recognition theory, Brickley, Linck, and Coles (1999), Ferris et al. (2003) and Fich (2005) show that CEOs of firms with superior financial performance hold more outside directorships.CEOs who demonstrate their care about shareholders interests also achieve reputation gain on the director labor market. For instance, Coles and Hoi (2003) find that directors rejecting antitakeover provisions are more likely to obtain

additional outside directorships. Recent studies further find that the director labor market assigns a value to CEOs' human capital for certain experiences, for example, Harford and Schonlau (2013) find that CEOs who have made more acquisitions hold more outside directorships.

On the other hand, CEOs receive a reputational penalty when the director market perceive their behavior as being inconsistent with shareholders' interests. For example, CEOs lose outside directorships when their firms are not able to sustain the level of dividends (Kaplan and Reishus, 1990), are involved in financial-fraud lawsuits (Fich and Shivdasani, 2007), or have been taken over (Harford, 2003).

3.2.5 Hypotheses

The importance of innovation leadership has been reflected in the large volume of popular discussions. Extant studies have demonstrated that CEO on-the-job innovation performance reflects CEOs' expertise in innovation leadership. Meanwhile, previous literature suggests that firms actively participate in the director labor market to seek managerial expertise they need. The extant evidence largely supports the view that the director labor market is effective in rewarding managers who deliver superior on-the-job performance. At the center of our analysis is the idea that the labor market provides an effective institution for transmitting innovation leadership across firm boundaries. Therefore, we formulate the following hypotheses,

H1 (a): *A CEO's probability of holding outside directorships is positively related to her on-the-job innovation performance.*

H1 (b): *The number of outside directorships held by a CEO is positively related to her on-the-job innovation performance.*

We further hypothesize about how director labor market matches innovative CEOs to Boards. Fahlenbrach et al. (2010) posit a matching theory where better-skilled CEOs can choose from multiple outside-directorship invitations. CEOs prefer to hold outside directorships in more prestigious boards, in boards that offer better resources and opportunities or in boards that minimize CEOs' opportunity costs of taking outside directorships. Accepting outside directorships requires CEOs to

undertake extra effort outside of their firms. Holding too many outside directorships may also reduce the time a CEO can commit to her firm. Therefore, a rational CEO will only accept an outside directorship, with permission from her own firm's shareholders, when the total benefit from outside directorships exceeds the opportunity cost. From the perception of demand-side, as is discussed in 3.2.2, firms prefer to recruit outside directors whose skills and experiences are most valuable for the incumbent management. It is fair to argue that firms with more innovation activities and more innovation outcomes are those who need advice on innovation leadership the most. Therefore, we hypothesize that,

H2 (a): *Innovative CEOs are more likely to hold outside directorships in innovative firms.*

H2 (b): *Innovative CEOs are more likely to have outside directorships in firms that invest in R&D more intensively.*

CEO-directors from firms with technology similar to the appointing firms' arguably understand the appointing firms' demand better and are in a better position to advise on innovation. Similar technology also reduces a CEO-director's opportunity cost to provide advisory service. Therefore, a CEO is more likely to be matched to the board a firm with similar technology. On the other hand, however, the need to withhold technology secret from rivals may lead a firm to avoid appointing a CEO-director from firms with similar technologies. Consequently, we formulate the following hypothesis. To what extent this hypothesis hold is an empirical question, as is discussed above.

H2 (c): *Innovative CEOs are more likely to have outside directorships in firms that use similar technology.*

We discussed the benefits of appointing innovative CEO-directors in section 3.2.2. These benefits include improved advisory services, enhanced monitoring, and the certification effect. These benefits motivate firms to participate in the director labor market, recruiting innovation leadership that is not available from within the firm. We have the following hypothesis,

H3(a): A firm's innovation performance improves after appointing an innovative CEO-director.

If innovation eventually transforms into productivity, we expect the firms that appoint innovative CEO-directors to obtain better operating performance subsequently. Specifically, we hypothesize the following,

H3(a): A firm's operating performance improves after appointing an innovative CEO-director.

3.3 Sample and Data

3.3.1 Sample construction

Our sample consists of the firms ever appear in the S&P 1500 index, excluding financial (6000–6999) and utility (4900–4999) firms and firms headquartered outside of U.S.[7] We then add data from several databases to our sample. In particular, the BoardEX database provides data on CEO/director positions and characteristics. Standard and Poor's Execucomp provides CEO/director ownership data and option compensation data which we use to construct CEO overconfidence measure. We retrieve accounting data from Compustat and stock-return data from CRSP. We get patent data from the dataset used by Kogan et al. (2017), which provides detailed information on more than 4 million patents issued from 1926 to 2010.[8]. The number of patents filed (and eventually granted) drops dramatically after 2008 because many patent applications filed during these years were still under review. This introduces a truncation bias (see Hall et al. (2005)). Therefore, we end our sample in 2008 following the recommendation of Hall et al. (2005). Our final sample includes all firms in the intersection of BoardEx, Compustat, CRSP and patent database. We delete those firm-years with missing data for any variable required in our baseline regression (Table 3.3). The final sample consists of 5,415 firm-year observations for 1,234 CEOs at 814 firms during the period from 2000 to 2008.

[7]We require firms to be headquartered in the U.S. because we need to control for the local demand for outside directors in our analysis.

[8]We thank Noah Stoffman for making the data available at https://iu.app.box.com/v/patents.

3.3.2 Measures of innovation performance

As is explained in the introduction, we measure a CEO's strength of innovation leadership by her on-the-job innovation performance. Consistent with the previous literature, we rely on the patent data to construct various measures of innovation performance. In particular, we form three variables to measure different aspects of a CEO's firm's innovation performance.

We use the number of patent applications eventually granted (i.e., patent count) to measure the volume of a firm's innovation output. As is discussed above, we drop the patent applications filed in 2009 and 2010 to address the truncation bias.

To reflect the importance of a firm's innovation output, we use two measured based on the expected citation (Hall et al., 2005). Patent citations suffer a different type of truncation bias. In particular, patents keep receiving citations after being granted. Those patents granted in later years have fewer years to receive citations than those granted in earlier years. Therefore, we follow Hall et al. (2005) to adjust the citation of each patent by multiplying a weighting index (estimated from the empirical distribution of the total citations in the same technology class using untruncated data) to address the truncation bias. Hall et al. (2005) call this adjusted measure expected citation. We have two expected-citation-based measures. The first is the citation count, i.e., the total number of expected citations received by all patents filed by and eventually granted to a firm in a year. Because the expected citation contains information about both innovation volume and quality, we use it as a proxy for a firm's innovation power. The second measure is the number of expected citations per patent, which measures the average quality of patents filed by (and eventually granted to) a firm in a year.

We take the natural logarithm of the above three measures, following the previous literature. To avoid losing firm-year observations with zero patent or zero citation, we add one to the actual values when taking the natural logarithm.

3.3.3 Measure of technological proximity

Technological proximity measures the similarity or overlap of two firms' innovation output. Jaffe (1986) proposes a formula to calculate the technological proximity between two firms. This formula characterizes a firm's innovation output using the distribution of its patents in 426 technology classes defined by the USPTO. The technological proximity between firm i and firm j is given as the un-centered correlation between the two firms' technology activities:

$$\text{Technological Proximity}_{ij} = (T_i T_j')/(T_i T_i')^{1/2}(T_j T_j')^{1/2} \tag{3.1}$$

where T_i=(T_{i1}, T_{i2},..., T_{i426}) and $T_{i\tau}$ is the average share of patents of firm i in technology class τ over the thirty years prior to CEO-director appointment.

3.3.4 Number of outside directorships

Since the BoardEX keeps adding new firms in their database, the number of outside directorships recorded in the database may increase because more firms' board profiles are covered in the database in later years rather than the CEOs indeed hold more directorships. To address this bias, we only count a CEO's outside directorships in firms that ever appear in the S&P 1500 index because the coverage of S&P 1500 firms in the BoardEX is relatively stable.

3.3.5 Control variables

In our regression analysis, we control for a set of variables suggested by the previous literature. For brevity, we explain and justify these variables in Appendix A.

3.3.6 Instrumental variables

Endogeneity issues potentially introduce bias to the estimates of the association between CEO on-the-job innovation performance and her outside directorships. Unmeasured variables may affect innovation as well as the likelihood and number

of CEO outside directorships. For instance, CEOs with greater capability usually have better innovation performance (Chemmanur, Loutskina, and Tian, 2014; Cho et al., 2016; Custódio et al., 2017) and they may also have more outside directorships because of their greater capability. If the positive association between CEO innovation leadership and outside directorship is due to omitted variable(s), we cannot claim there is an effective market for innovation leadership. It is necessary to address such endogeneity in our research design. We control for several factors related to a CEO's ability, yet we cannot exhaust the factors that represent the entire spectrum of CEO capability. Another example of the omitted variable issue is that those CEOs who desire to be outside directors may intentionally boost innovation performance to attract attention from firms who are looking for outside directors. To address such endogeneity issue, we use two instruments: *ln(CP ratio)* is the natural logarithm of one plus the ratio of Catholic residents over Protestant residents in the county where a firm's headquarter is; *Urban industrial diversity* is defined as one minus the Herfindahl index of local employment across two-digit industries in the county where aaa firm's headquarter is.

3.3.6.1 Relevance of instruments

For an instrumental variable to be valid, it must affect firm innovation performance significantly. Regarding the instrument *ln(CP ratio)*, Chen et al. (2014b) show that local 'gambling' preference, measured by a county's Catholics-to-Protestants ratio, has a significant impact on local firms' innovation outcome. The association between religious belief and individuals' risk attitude is well established in prior studies (e.g., Hilary and Hui (2009), Kumar, Page, and Spalt (2011), and Shu, Sulaeman, and Yeung (2012)). In particular, Catholics tend to be less risk averse while Protestants exhibit greater risk aversion than the average population. Therefore, a higher Catholics-to-Protestants ratio in a county reflects a higher degree of local risk preference. Firms located in a risk-preferring county tend to invest more in innovation, take more radical innovation projects, and have better innovation performance.

Regarding our second instrument *Urban industrial diversity*, extant studies find that most innovations occur in cities, because of the vibrant flow of ideas and

information. Glaeser et al. (1992) find it is local industry diversification and local competition, rather than local specialization, that facilitates employment growth in industries. Their finding suggests that cross-industry knowledge diffusion is more important for urban growth than same-industry knowledge transfer. Duranton and Puga (2001) build a theoretical model to explain how urban industrial diversity fosters innovation. They show that, because of the uncertainties that innovations involve, a firm needs to experiment to learn the full potential of their projects, which requires the possession of knowledge about other industries. Industrial diversity in the urban area facilitates cross-industry knowledge transfer by reducing searching costs and enhancing the provision of various components required on new products.

Consistent with the discussion above, we show that both instruments have a strong and significant impact on firm innovation performance. In Panel C of Table 3.3, both *ln(CP ratio)* and *Urban industrial diversity* have significantly positive impact on patent count and citation count. For example, *ln(CP ratio)* has a positive coefficient (0.083) in the regression of patent count which is statistically significant at the 1% level (p-value = 0.000). The coefficient on *ln(CP ratio)* is statistically insignificant at the conventional level (p-value = 0.198) in the regression of citations per patent however. A possible explanation is that firms located in risk-preferring counties tend to undertake riskier innovation projects, and riskier projects are more likely to generate patent with extreme quality.

3.3.6.2 The exclusion criteria

A valid instrumental variable should also satisfy the exclusion criteria, i.e., the instrument should not affect CEO outside directorships other than through their effect on CEO innovation performance. Conceptually, we are not aware of any study that suggests a clear reason for our instruments to affect CEO outside directorships directly. However, one may be concerned that *ln(CP ratio)* may affect outside directorships through CEO overconfidence. Hirshleifer et al. (2012) and Galasso and Simcoe (2011) report a positive relation between CEO overconfidence and firm innovation performance. Meanwhile, overconfident CEOs may overestimate their capability and tend to accept more outside board seats. The potential overlap between CEO

overconfidence and local risk-taking preferences may violate the exclusion criteria of *ln(CP ratio)*. Previous studies document no clear evidence of a direct link between local risk-taking preference and CEO overconfidence. To further alleviate this concern, we control for CEO overconfidence explicitly in the robustness tests and our results persist.[9]

Regarding *Urban industrial diversity*, again we are aware of no prior study suggesting a direct link between *Urban industrial diversity* and CEO outside directorships. However, if *Urban industrial diversity* of a county is correlated with the county's size, it may affect CEO outside directorships because larger counties have greater demand for and supply of outside directors. Previous studies on urban diversity (e.g., Duranton and Puga (2000)) only show a weak association between the degree of industry diversity and county size, which alleviates the validity concern on *Urban industrial diversity*. To be sure, we also control for the number of local firms (Knyazeva, Knyazeva, and Masulis, 2013) in our regressions.

Although it is impossible to directly test the exclusion restriction empirically, we run a placebo test by including the instruments in the second stage regressions. If the instruments affect the dependent variable through channels other than influencing firm innovation performance (and these channels are not controlled for in the regression), we should observe statistically significant coefficients on the instruments in the second stage. The instruments do not have any statistically significant coefficients in the second stage regression. For brevity, we do not tabulate the full results of this placebo test.

[9]We follow Malmendier and Tate (2008) to define a CEO as overconfident if she has ever postponed the exercise of vested options that are at least 67% in the money.

3.4 Empirical results: CEO on-the-job innovation performance and outside directorships

3.4.1 Baseline results

In hypothesis H1, we predict a CEO's strength in innovation leadership increases the likelihood and number of her outside directorships. In Table 3.2, we separate the sender firms (i.e., CEOs' firms which sends the CEOs out to serve as outside directors) into two groups: one contains innovative firms (i.e., the firms with at least one patent during our sample period) and the other contains non-innovative firms (i.e., the firms without any patent during our sample period). We find that CEOs of innovative firms on average hold significantly more outside directorships than CEOs of non-innovative firms. The average number of outside directorships held by CEOs of innovative firms is 0.41 compared to 0.26 of the CEOs of non-innovative firms. The difference is significant at the 1% level. When we further sort all innovative firms into quartiles based on their patent count, we find the average number of CEO outside directorships increase monotonically from the lowest to the highest patent-count quartile. CEOs in the top quartile on average hold 0.59 outside directorships, which is 0.30 more than the average outside directorships held by CEOs in the bottom quartile. The difference in mean between the top and bottom quartiles is significant at the 1% level. The median is zero across all quartiles, suggesting less than half of the CEOs hold no outside directorships regardless of their innovation performance. The univariate results are overall consistent with hypothesis H1. However, at this stage, we cannot simply attribute a higher number of CEO outside directorships to firm innovation performance because we need to control for other factors that impact the number of CEO outside directorships.

Table 3.2 also presents the summary statistics for all other variables used in our analysis. We note that CEOs holding more outside directorships are younger and have a better educational background; they have been CEOs for fewer years; they tend to work in larger firms or firms with more growth opportunities; their firms on average hold more cash and invest more in R&D. Their firms also have more board members

and are more likely to have interlocked boards with other firms. These descriptive statistics are comparable to those presented in previous studies.

To analyze the relation between a CEO's on-the-job innovation performance and her outside directorships systematically, we estimate the following baseline model:

$$\begin{aligned} &\textit{Measures of CEO outside directorships}_{i,t+1} = \\ &\qquad \alpha + \beta_1 \textit{Innovtion performance}_{i,t} + \beta_2 \textit{Controls}_{i,t} \\ &\qquad + \sigma \textit{INDDUM}_i + \gamma \textit{YDUM}_i + \epsilon_{i,t}, \end{aligned} \tag{3.2}$$

where i indexes firms and t indexes years. The dependent variable is a measure of a CEO's outside directorships. We use both Probit and Tobit models to estimate Equation 3.2. When we use the Probit model to estimate the likelihood of a CEO holding outside directorships, the dependent variable is a binary variable equals one if a CEO holds at least one outside directorship in a year and zero otherwise. Following Booth and Deli (1996), we also use the Tobit model to estimate the number of outside directorships held by a CEO because the distribution of the dependent variable is left-censored.[10] *Innovation performance* is explained in section 3.3.2. *Controls* is a vector of control variables (see Appendix A). *YDUM* is a vector of year dummies, with each element indicating a year during the period 2000–2008. *INDDUM* is a vector of industry dummies defined using the Fama-French 49-industry classification. Definitions of all variables are in Table 3.1.

In Table 3.3, we present the regression coefficients of Equation 3.2, with and without using the IV approach. Panel A of Table 3.3 reports the estimates of Probit models. The dependent variable is one if a CEO holds at least one outside directorship in year *t+1* and zero if not. The results support hypothesis H1 (a) — the coefficients on all three innovation performance measures are positive and significant at the 5% level or above (except for the coefficient of patent count in the un-instrumented Probit model). The coefficients suggest a one-standard-deviation increase in $ln(1+Patentcount)$ / $ln(1+Citationcount)$ / $ln(1+Citationsperpatent)$ in year t leads to an increase of 1.35/1.86/1.73 percentage points in the probability of CEO holding outside directorships in year $t+1$. In Models (4)−(6) of Panel A, we

[10] We cannot use Poisson regressions or negative binomial regressions in this case because the number of outside directorships held by a CEO in each year is not independent over time.

estimate the regressions using the IV approach. In all three regressions, we continue to find a significantly (at the 5% level or above) positive coefficient of firm innovation performance on a CEO's probability of holding outside directorships. In particular, a one-standard-deviation increase in $ln(1 + Patentcount)$ / $ln(1 + Citationcount)$ / $ln(1+Citationsperpatent)$ in year t leads to an increase of 12.26/11.70/9.18 percentage points in the probability of CEO holding outside directorships in year $t + 1$. The magnitude of increase is sizable considering the unconditional probability of a CEO holding outside directorship is 25.61% in our sample.

We observe that the control variables have meaningful coefficients. For example, we find *ln(Total assets)*, *ln(Firm age)*, *CEO age*, *CEO education*, and board *Interlock* all significantly and positively impact the likelihood of CEO holding outside directorships, which is consistent with the prediction of previous literature discussed in Appendix A (Booth and Deli, 1996; Fahlenbrach et al., 2010). *Market-to-book*, *Return on assets* and *Sales growth* all have coefficients indistinguishable from zero, which is consistent with the twofold prediction of Booth and Deli (1996) and Fich (2005) (see Appendix A). *Leverage* has a significantly (at the 5% level) negative coefficient in all regressions, suggesting highly-leved firms need more CEO attention internally, maybe due to higher risk. *Board size* does not significantly impact the likelihood of a CEO holding outside directorship in any of the six regressions. It is possible *ln(Total assets)* already captures the size effect on CEO outside directorships. *ln(CEO tenure)* has a positive coefficient in all regressions as is predicted by Fahlenbrach et al. (2010), but these coefficients have a significance level of 10% level at the best. Similarly, the *ln(1+Number of local firms)* has a positive coefficient in all regressions as is suggested by Knyazeva et al. (2013), but they are statistically insignificant at the conventional level, maybe because our sample period is considerably shorter than theirs.

In Panel B of Table 3.3, we report the results of the Tobit model where the dependent variable is the number of CEO outside directorships. Consistent with H2 (a), the measures of CEO on-the-job innovation performance has a significantly (at the 5% level or above) positive coefficient in all regressions. A one-standard-deviation increase in *in ln(1 + Patent count) / ln(1 + Citation count) / ln(1 + Citations per patent)* in year t leads to an increase of 0.09/0.12/0.11 in the number of CEO outside

directorships in year $t+1$ (the mean number of CEO outside directorships is 0.32 in our sample). Models (4) – (6) show that the results do not change qualitatively after using the IV approach for the estimation. The effects of control variables are largely the same as those on the likelihood of CEO outside directorships presented in Penal A.

Overall, the results in Table 3.3 show that the strength of a CEO's innovation leadership increase the likelihood and the number of her outside directorships. These results are consistent with the notion that innovation leadership is a rare and valuable human capital. Our results suggest the director labor market facilitates the diffusion of innovation leadership from one firm to another. CEOs with outstanding innovation leadership serve on other firms board where they can share their expertise in motivating and sustaining innovation, which potentially benefits other firms and the broader economy.

3.4.2 Matching CEO innovation leadership to boards

Our second set of hypotheses posits that the director labor market provides a mechanism allocating human capital to the best uses. In particular, we predict CEOs of superior innovation leadership are more likely to hold outside directorships in firms with more innovation output (H2 (a))), with more R&D investment (H2 (b)) or with technologies more similar to the CEO's firm's technologies (H2 (c)). These predictions build on the matching theory of directors and boards (Adams, Akyol, and Verwijmeren, 2017; Booth and Deli, 1996; Fahlenbrach et al., 2010; Hermalin and Weisbach, 1998; Kaplan and Reishus, 1990), which we discuss in details in Section 3.2.5. In the current section, we estimate a set of multinomial Probit regressions to test these hypotheses.

In the multinomial Probit regressions, the dependent variable (Y) takes three values. It is zero if a CEO does not hold any outside directorships (the base case) in year $t+1$ and one (two) if the CEO holds outside directorship and the average firm where the CEO holds directorship has a citation count / R&D intensity / technological proximity to the CEO's firm that is below (above) the median of all firms having patents.

In Table 3.4, we show that CEOs with better on-the-job innovation performance are more likely to hold outside directorships on the boards of firms with better innovation output (Panel A), more R&D intensity (Panel B), and greater technology proximity to the CEO's firm (Panel C). For example, in Panel A, the coefficient on *ln(1 + Patent count)* is 0.100 in the un-instrumented regression where $Y = 2$, and statistically significant at the 1% level ($p = 0.002$). Thus, a one-standard-deviation increase in $ln(1 + Patentcount)$ leads to an increase of 1.82 percentage points in the probability an average CEO serving on the board of an above-median innovative firm rather than not serving on any outside board. This effect is sizable given that only 12.34% of our sample CEOs serve on above-median innovative firms' boards. In contrast, the coefficient on the $ln(1 + Patentcount)$ in the regression where $Y = 1$ is negative and statistically insignificant, which suggests that CEOs with better on-the-job innovation performance do not match to the below-median innovative firms more often than to the non-innovative firms. We can interpret the results in Panel B and C similarly. We re-estimate the multinomial Probit models using the IV approach in columns (4) through (6). Our findings persist in Panel A and C (i.e., the citation-count and technology proximity regressions), consistent with H1 (a) and H2 (c). In Panel B, the coefficients on the innovation performance measures are no longer significant in the regressions where $Y = 2$ under the IV approach. Therefore, we do not have robust evidence showing that the labor market matches CEOs exhibiting greater innovation leadership to those firms that invest more intensively in R&D.

Overall, our findings in this section show that the director labor market matches CEOs of greater innovation leadership to those firms with greater demand for advice on innovation leadership or to firms where CEOs incur lower opportunity cost to advise on innovation. These results demonstrate the director labor market is largely efficient matching the human capital on innovation leadership to firm boards.

3.4.3 Further robustness tests

3.4.3.1 Addressing reverse causality

A concern with the positive relation between CEO on-the-job innovation performance

and outside directorship is reverse causality. A firm may become more innovative because its CEO enhances her innovation leadership by serving on other firms' boards. Our IV approach address this concern to a good extent. To further mitigate such concern, we use the CEO's firm's innovation output at $t-2$ instead of that at t. As is presented in Panel A of Table 3.5, the significant positive coefficients on measures of lagged innovation output confirm that our main findings are not driven by reverse causality.

3.4.3.2 Self-citations

Hall et al. (2005) contends that self-citations are more valuable than external citations. They suggest that self-citations could reflect the strong competitiveness of a firm in a particular technology class, and a firm's ability to internalize knowledge spillover rather than external knowledge acquisition. Based on Hall et al. (2005), we do not exclude self-citations in our main analysis. However, other studies, such as Chemmanur et al. (2014), Hirshleifer et al. (2013) and Faleye et al. (2014), use external citations to measure the impact of patents. For robustness, we exclude self-citations from our analysis, and the results remain qualitatively similar (see Panel B of Table 3.5).

3.4.3.3 Control for CEO over-confidence, CEO ownership, and board ownership

Some CEO personal traits may affect both firm innovation performance and CEO outside directorship, namely, overconfidence, CEO ownership, and Board ownership. Overconfidence affects firm innovation performance according to Hirshleifer et al. (2012) and Galasso and Simcoe (2011). Meanwhile, an overconfident CEO is most likely to overestimate her capability and accept too many outside directorships consequently. Several studies (Booth and Deli, 1996; Fahlenbrach et al., 2010; Perry and Peyer, 2005) contends that CEO and board ownership affect the number of directorships held by CEOs. In particular, CEOs with low ownership may have lower incentive to maximize shareholders' value and are more willing to spend time on outside directorships. High board ownership enhances board monitoring, exerting

more pressure for CEOs to attend internal affairs if outside directorships do not bring sufficient resources and opportunities. Motivated by these thoughts, we further control for CEO overconfidence, CEO ownership and board ownership.[11] Because of data availability, the inclusion of these variables reduces our sample size by almost a half. Therefore, we did not control them in our baseline tests. In Panel C of Table 3.5, our results persist after controlling for these CEO traits.

3.4.3.4 High-impact patents and additional outside directorships

Often, innovations explore unchartered territories, and its economic value involves great uncertainty. Consequently, how the stock market reacts to a new patent issuance is unexpected to a considerable extent. The randomness of a patent's economic value measured by stock market reaction (Kogan et al., 2017) offers us a quasi-natural experiment to further identify the association between CEO innovation leadership and CEO outside directorship. We assume that the issuance of a patent with high stock-value impact (a high-impact patent) enhances the labor market's perception of a CEO's innovation leadership. When the patent's value impact is unexpectedly high, the perception of a CEO's innovation leadership experiences a positive shock.

We isolate those patents in the top 10% of economic value (Kogan et al., 2017) in a year (i.e., high-impact patents). We then select the CEO-years that issue high-impact patents. If a CEO's firm issue high-impact patents in multiple years, we keep the first year only. This procedure generates our treated sample. We then use the nearest-neighbor propensity score matching (with the caliper of 0.1, i.e., the maximum tolerable distance in the propensity score between the treated and control is 0.1 standard deviation of the treated firm's propensity score) to find up to five control-sample CEOs who had the same likelihood of issuing high-impact patents in the same year but happened not to issue any.[12] Our treated sample contains 171 CEOs (*High-impact innovation dummy* = 1) and control sample contains 174 CEOs (*High-impact innovation dummy* = 0). We apply the regression specification used by

[11] We follow Malmendier and Tate (2008) to define a CEO as overconfident if he has ever postponed the exercise of vested options that are at least 67% in the money.

[12] For brevity, we do not report the estimation results of the propensity scores. The results are available upon request.

Yermack (2004) to analyze how issuing a high-impact patent impact the change in a CEO's outside directorships in subsequent years. Specifically,

$$\Delta \textit{ Number of outside directorships}_{t:t+3} = \alpha + \beta_1 \textit{High-impact innovation dummy}_t + \beta_2 \textit{Controls}_t + \epsilon_t \tag{3.3}$$

where year t refers to the year when a firm issues at least one high-impact patent. *Controls* is a vector of control variables measured at year t (see Appendix A). We further control for the number of outside directorships already held by the CEO at year t because the marginal benefit and cost of accepting an additional outside directorship changes with the number of outside directorships a CEO has held. We also control for firm's patent count as we have shown that innovation quantity positively impact CEO outside directorships.

Table 3.6 reports the regression estimates of Equation 3.3. The coefficient on *High-impact innovation dummy* is 0.145 and significant at the 5% level (p-value = 0.028). Ceteris paribus, unexpected issuance of high-impact patents in year t increases a CEOs outside directorships by 0.145 in the next three years. The number of outside directorships at year t has a significant (at the level of 1%) negative coefficient, suggesting the reducing marginal benefit or increasing marginal cost of accepting an additional outside directorship (Fahlenbrach et al., 2010). These additional results further exclude the possibility that the positive relation between CEO innovation leadership and outside directorships is due to omitted variable.

3.5 The impact of appointing an innovative CEO-directors on firm performance

3.5.1 Potential impact of appointing innovative CEO-directors

Before moving on to explain our empirical findings on the impact of innovative CEO-directors on the appointing firm's performance, we first discuss the potential channels

through which innovative CEO-directors can benefit the firm.

First, the advisory benefits. A growing strand of literature has studied the advisory function of boards (e.g., Balsmeier et al. (2014), Coles et al. (2008), Dass et al. (2014), Faleye et al. (2013)). Dass et al. (2014) particularly point out that outside directors can bridge the information gap across different industries and provide valuable advice to incumbent management as well as facilitate the appointing firm's access to related contacts. With the unique amount of experience and expertise in both managing a company and innovative projects, innovative CEO-directors are able to provide valuable advice on a firm's innovation strategy in a way that other outside directors are not able to. The knowledge innovative CEO-directors have helps the firm overcome information challenges, for instance, identifying industry trends and customers' demand on the product market, directing a firm's innovation strategy, and advising on a firm's decisions of mergers and acquisitions, which can lead to enhanced innovation capability and better performance on the product market. Such expertise is particularly valuable for firms in innovative industries, where the information gap across firms is more severe and future demand is more difficult to predict. The advisory function of innovative CEO-directors can be fulfilled through serving on special board committees, such as R&D committee, and technology strategy and innovation committee, which becomes more prevalent in recent years.

Anecdotal cases support the notion that innovative CEO-directors are appointed to boards to enhance a firm's innovation capability. For example, as the CEO of a global top 20 innovative company, Cisco's CEO Chuck Robbins was appointed as an outside director at BlackRock. The CEO and Chairman of BlackRock, Larry Fink, stated that bringing Chuck Robbins to BlackRock would enhance the firm's strategic goal of applying advanced technology to transform how to invest, measure risk, and operate. Another example is the appointment of Tim Cook, Apple's CEO, as Nike's outside director. After appointing Tim Cook onto its board, Nike experienced a significant increase of patent counts in the following years. In 2016, Nike received a record-high 687 new patents in the company's history. In contrast, it received only 79 patents in 2005, the year Nike brought Tim Cook to its board. These two cases reflect the current trend in which companies actively seek innovation leadership through the

external labor market and are suggestive of a positive impact of innovative CEO-directors on the appointing firm's innovation performance. Whether this effect holds across a broad sample of firms is the focus of our empirical study in this section.

Second, enhanced monitoring. In addition to the direct advisory benefits for appointing firms, innovative CEO-directors are able to help bridge the information gap between managers and the board, which enables more effective monitoring of the appointing firm's management. This effect is especially valuable for innovative firms because they face greater information gap between managers and the board. Previous literature has highlighted that lack of expertise to fully understand related information is one of the major difficulties that directors face (Jensen, 1993). With their experience of producing and sustaining innovation, innovative CEO-directors can better understand the uncertainty and complexity associated with innovative projects and are likely more "friendly" to managers. In other words, they have higher tolerance for a CEO's short-term failure, which is essential for a firm's innovation performance (Kang et al., 2014; Manso, 2011). Appointing innovative CEO-directors is also in line with the final proxy disclosure enhancement rules released by the SEC in 2009, which requires firms to "disclose for each director and any nominee for director the particular experience, qualifications, attributes or skills that qualified that person to serve as a director of the company, and as a member of any committee that the person serves on or is chosen to serve on, in light of the company's business".[13]

Last, certification benefits. Prior studies have shown that the stock market reacts more positively to CEO-director appointments (Fahlenbrach et al., 2010; Fich, 2005), which suggests that such appointments certify the appointing firm's quality. This certification effect is especially valuable for innovative firms because they face greater information asymmetry between managers and investors, which may induce managers to sacrifice long-term value for short-term profits to maintain a fair market value of their companies Fang, Tian, and Tice (2014). Another channel in which this certification effect can benefit firms is to attract institutional investors. Dahya and Herron (2017) find that institutional investors follow directors to the new firms in which they obtain additional directorships. By appointing innovative CEO-directors,

[13]U.S. Securities and Exchange Commission (SEC) Release NOS. 33-9089; 34-61175; IC-29092; File No. S7-13-09, p.29.

firms are able to potentially attract more institutional investors, which can lead to better innovation performance Aghion et al. (2013).

3.5.2 The impact on appointing firms' innovation performance

In this section, we test whether firms benefit from acquiring innovation leadership in the labor market, using a difference-in-difference approach. All firms used in our analysis have at least one patent during our sample period. We exclude firms with no patent because they may appoint an innovative CEO-director for reasons other than acquiring innovation leadership. Our treated sample contains firms appointing an innovative CEO-director in a year (i.e., CEOs of firms having at least one patent during our sample period); and our control sample consists of firms appointing a non-innovative CEO-director (CEOs of firms with zero patent throughout our sample period). We use the nearest-neighbor propensity score matching approach to find up to five control firms for each treated firm (imposing a caliper of 0.1). We estimate the propensity score using a model that predicts a firm's propensity to appoint an innovative CEO-director in a year. Appendix B provides more details on the sample construction. Our regression specification follows that of Bena and Li (2014) and Seru (2014).[14] Specifically,

$$\begin{aligned} \textit{Innovation performance}_{i,t} = \alpha + \beta_1 \textit{After}_{i,t} + \beta_2 \textit{After}_{i,t} \times \textit{Treat}_{i,t} \\ + \beta_3 \textit{Controls}_{i,t} + \textit{Firm FE}_i + \textit{YDUM}_t + \epsilon_{i,t}, \end{aligned} \tag{3.4}$$

where the subscripts refer to firm i and year t ($t = -3, -2, -1, 2, 3, 4$). We leave a two-year gap (year 0 and year 1) between the pre-appointment years and the post-appointment years considering it takes time for a firm to convert innovation input to patenting output. *After* is an indicator variable that is equal to one for all the years after the CEO-director appointment and zero otherwise. *Treat* is an indicator variable that equals one for treated firms and zero for the control firms. We include firm fixed effect ($Firm\ FE_i$) to control for any time-invariant heterogeneity across firms. We

[14] We cannot estimate the coefficients on $\textit{Treat}_{i,t}$ or $\textit{Treat}_{i,t} \times \textit{High Innovativeness/Proximity/R\&D}_{i,t}$ as both terms are subsumed by firm fixed effects.

also include year fixed effects ($YDUM_t$) to control for possible temporal trends that affect the difference in innovation output between the treated and control firms.

Panel A of Table 3.7 reports the OLS regression estimates of Equation 3.4. The coefficients on the interaction term $After \times Treat_{i,t}$ is positive and significant at the 10% level in the regressions of *ln(Patent count)* (0.147) and *ln(Citation count)* (0.264). The coefficient on $After \times Treat_{i,t}$ is also positive (0.078) in the *ln(Citations per patent)* regression but statistically insignificant at the conventional level. The results persist qualitatively when we include the control variables in the regressions (column 4-6 in Table 3.7).[15] These results suggest that appointing innovative CEO-directors, on average, marginally improves a firm's innovation output.

In Panel B, C, and D, we use a triple-difference approach to further examine how the treatment effect varies according to the appointing firms' or sender firms' characteristics. In Panel B, we sort all sender firms in the treated group into a high innovation-output group and a low innovation-output group, according to the median of citation count. We form a dummy variable equals one for the high innovation-output group and zero for the low innovation-output group. In Panel B of Table 3.7, we add the interaction term $After_{i,t} \times Treat_{i,t} \times High\ innovation\ output_{i,t}$ to Equation 3.4. We find a significantly (at the 1% level) positive coefficient on this triple-interaction term in all the six regressions. For example, the coefficient in the regression of *ln(1+Patent count)* is 0.251, indicating the average number of patent count increases by 30.47 a year in the three years post-appointment if a firm appoints a CEO-director whose on-the-job innovation performance is above the sample median. The coefficient on $After_{i,t} \times Treat_{i,t}$ is insignificant however, indicating the positive effect of CEO-director appointment is mainly from those CEO-directors whose has above-median on-the-job innovation performance.

In Panel C of Table 3.7, we form a dummy variable which is one if the technological proximity between the sender firm and the appointing firm is larger than the sample median and zero otherwise. We add a triple-interaction term $After_{i,t} \times Treat_{i,t} \times High\ Proximity_{i,t}$ to Equation 3.4. The coefficient on $After_{i,t} \times Treat_{i,t} \times High\ Proximity_{i,t}$ is significantly (at the 5% level or higher) positive in the

[15] For brevity, we do not report the coefficients of the control variables.

regressions of *ln(1+Citation count)* and *ln(1+Citations per patent)*. For example, in the regression of *ln(1+Citations per patent)*, the coefficient on the triple-interaction term is 0.507, indicating the average number of citations per patent increase by 14.23 a year in the three years post-appointment if a firm appoints a CEO-director from a firm whose technological proximity is greater than the sample median. The coefficient is insignificant at the conventional level in the regressions of *ln(1+Patent count)*, however. Combined, these results suggests appointing CEO-directors from firms with higher technology overlap enhances patent quality rather than quantity. This is consistent with the argument of Bena and Li (2014) that a smaller information gap enables better knowledge sharing and mutual citation, thus enhances patent quality.

In Panel C of Table 3.7, we form a dummy variable which is one if the appointing firm's R&D investment measured before the appointment is above the sample median and zero otherwise. We include a triple interaction term $After_{i,t} \times Treat_{i,t} \times High\ R\&D_{i,t}$ in Equation 3.4. The triple interaction term has a significant coefficient (at the 1% level) in the regression of citation per patent, but not in other regressions. This result suggests R&D intensive firms need advice on patent quality more than patent quantity.

In summary, we find a firm benefits from appointing an innovative CEO-directors regarding subsequent innovation performance.[16] Such benefit motivates firms to acquire innovation leadership in the labor market. Not all firms benefit the same way though. We find the appointing firms benefit more when a CEO-director demonstrates stronger innovation leadership, the sender firm and the appointing firm have greater technology overlap, and the appointing firm invests in R&D more intensively. These results also suggest further research can be fruitful on what determines the extent to which firms benefit from acquiring innovation leadership in the labor market. We are not able to exhaust the possible determinants in the current study for the sake of focus.

[16]Balsmeier et al. (2014) has similar findings. But they do not study how labor market matches innovation leadership to firm boards and how innovative CEO-directors impact appointing firms operating performance.

3.5.3 Impact on appointing firms' operating performance

We have shown that innovation leadership acquired in the labor market significantly enhances the appointing firm's subsequent innovation performance. If innovation eventually translates to productivity, we should expect the appointment of an innovative CEO-directors improve the appointing firm's subsequent operating performance too. In this subsection, we use the same sample to examine how firms' operating performance change after the appointment of an innovative CEO-director. We follow Healy, Palepu, and Ruback (1992) and specify the regressions as follows,

$$\begin{aligned} \textit{Post-appointment operating performance}_i = & \beta\ \textit{Pre-appointment operating performance}_i \\ & + \theta\ \textit{YDUM}_i + \gamma\ \textit{INDDUM}_i + \alpha + \epsilon_i \end{aligned} \tag{3.5}$$

where i indexes firms; *Pre-appointment operating performance* is the appointing firm's operating performance averaged over the years -3 to -1, year 0 is the appointment year. *Post-appointment operating performance* is the operating performance averaged over event years +2 to +4 (or +2 to +6). We analyze operating performance up to year +6 because it may take several years to see the impact of enhanced innovation on productivity. *YDUM* is a vector of binary variables indicating years. *INDDUM* is a vector of binary variables indicating industries defined using the Fama-French 49 industries. According to Healy et al. (1992), β captures the persistence of pre-appointment operating performance. α captures any post-event abnormal operating performance due to the appointment of an innovative CEO-director.

Barber and Lyon (1996) point out that when studying operating performance, it is important to adjust for abnormal firm characteristics. Such adjustment removes the effects of firm characteristics on post-event abnormal operating performance, which attributes any post-event abnormal operating performance to the event. Following Barber and Lyon (1996), we use *Return on assets* (*ROA*) to measure operating performance and then adjust *ROA* by two methods. First, we adjust a firm's *ROA* by the median *ROA* of firms in the same size decile and Fama-French 49 industry. Second, we adjust a firm's *ROA* by the *ROA* of a matching firm that is from the same Fama-French 49 industry, has *ROA* in year -3 within $\pm$ 10% of the appointing firm's, and then has *Total assets* closest to the appointing firm's.

In Panel A of Table 3.8, we report the regression estimates of post-appointment operating performance during the years from +2 to +4. As is reported in Model (1) and (2), the regressions using un-adjusted ROA show that the abnormal operating performance is positive and marginally significant (at the 10% level) for both the treated and the control appointing firms. The constant term for the treat firm is higher (0.133) than that for the control firms (0.077), but they are insignificantly different according to a Wald test (p-value = 0.497). When we adjust the ROA further by firm characteristics including size, industry and past performance, the discrepancy of abnormal operating performance between the treated and the control firms becomes more pronounced. As is shown in Model (5) and (6), the treated firms on average have a significantly positive (at the 1% level) abnormal operating performance of 11.5% a year. In contrast, the control firms on average have a significant (at the 1% level) negative abnormal operating performance of -4.2% a year. The difference between the two groups is both statistically and economically significant (The p-value from a Wald test is 0.000.). The negative performance from appointing a non-innovative CEO-director might be due to agency issues un-related to innovation. We also observe that the coefficient on pre-appointment operating performance for the treated firms (0.668) is much smaller than that for the control firms (0.829), suggesting that appointing an innovative CEO-director change a firm's operating performance more dramatically than appointing a non-innovative CEO-director. In Panel B, we estimate the same set of regressions using the 5-year average operating performance (year +2 to +6), and the results are largely the same.

Overall, our results show that innovation leadership also enhances the appointing firms' subsequent operating performance, demonstrating that firms benefit from acquiring innovation leadership on the director labor market.

3.6 Conclusion

Despite the importance of innovation leadership and its popularity in the media and popular discussions, extant literature is agnostic about whether, how and to what extent the benefit of CEO innovation leadership diffuse across firm boundaries and

benefit the broader economy. We fill this gap. We find the director labor market facilitates the diffusion of innovation leadership by matching innovative CEOs (as is demonstrated by their on-the-job innovation performance) to firms that need advice on innovation leadership the most and to firms where the opportunity cost for CEO-directors are the least. Firms benefit from acquiring innovation leadership in the labor market — both their innovation and operating performance improve after appointing an innovative CEO-director. Our results survive a battery of robustness checks.

Extant literature has examined how certain CEO characteristics or expertise enhance a firm's innovation performance (Chen et al., 2014a; Custódio et al., 2017; Elenkov et al., 2005; Elenkov and Manev, 2005; Faleye et al., 2014; Galasso and Simcoe, 2011; Gumusluoğlu and Ilsev, 2009; Hirshleifer et al., 2012; Jung et al., 2003; Makri and Scandura, 2010; Sunder et al., 2017; Yadav et al., 2007). Compared to these studies, we look across firm boundaries and ask whether a CEO's innovation leadership generates benefits beyond the CEO's firm and whether there exists a sustainable mechanism that facilitates such positive externality. Although certain concerns may discourage firms or CEOs from participating in the labor market (e.g., leakage of technology secret through the boardroom and high opportunity costs for CEO's), our results suggest that these concerns do not jeopardize the effectiveness of labor market in matching innovation leadership to boards.

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Table 3.1: Variable definition

Variable	Definition
Innovation related variables	
Citation count	Total number of citations summed across all patents applied for and eventually granted during the year. Citation count is adjusted for truncation bias following Hall et al., (2005).
Citations per patent	Citation count / Patent count
Patent count	Number of patents applied for and eventually granted in a year.
Technological proximity	$T_iT'_j/(T_iT'_i)^{1/2}(T_jT'_j)^{1/2}$ where T_i=(T_{i1}, T_{i2},..., T_{i426}) and $T_{i\tau}$ is the average share of patents of firm i in technology class τ over 30 years prior to the appointment (Jaffe, 1986).
High-impact innovation dummy	A binary variable taking a value of one if at least one patent in the top 10% of all granted patents in terms of economic value (measured following Kogan et al. (2017)) is issued to a firm in a year and zero otherwise.
CEO related variables	
CEO age	–
CEO education	Number of qualifications a CEO has.
CEO overconfidence	An indicator variable equals one for all years since a CEO,for the first time, held options that are at least 67% in the money and zero otherwise (Hirshleifer et al., 2012).
CEO ownership	Percentage of common stock owned by a CEO.
CEO tenure	The number of years a CEO has been in office.
Number of outside directorships	The total number of outside directorships a CEO holds in S&P 1500 firms in a year.
Firm characteristics	
Board ownership	The percentage of total number of shares outstanding all officers and directors own in a firm (including the CEO).
Board size	Number of directors on the board of a CEO's firm.
Cash / Total Assets	Cash / Total Assets
CAPEX	Capital expenditures/lagged total assets
Capital intensity	Net property, plant, and equipment/sales
CEO duality	A binary variable taking a value of one if a CEO is also the chairman of the board and zero otherwise.
Dividend payout ratio	Dividends paid to common and preferred shareholders/operating income before depreciation
Firm age	The number of years a firm being included in the CRSP-Compustat merged database.
Interlock	The number of firms with which a firm share at least one common director.
R&D	R&D expenditures/lagged assets. Missing values are substituted with zero.
R&D Capital	$R\&D_{i,t-1} + 0.8 \times R\&D_{i,t-2} + 0.6 \times R\&D_{i,t-3} + 0.4 \times R\&D_{i,t-4} + 0.2 \times R\&D_{i,t-5}$
Return on assets (ROA)	Operating income before depreciation/lagged assets
Sales growth	Current sales/lagged sales − 1
Leverage	(long-term debt+short-term debt)/ Total Assets
Market-to-book	(total assets − book equity + market value of equity − deferred taxes) / total assets
Number of local firms	The number of U.S. non-financial and non-utility firms headquartered within sixty miles of the firm's headquarters, excluding firms in the same 4-digit SIC industry.
Instrumental variables	
CP ratio	The Catholics-to-Protestants ratio in the county where a firm is headquartered.
Urban industrial diversity	One minus the Herfindahl index of local employment across two-digit industries in the county where a firm is headquartered.

Table 3.2: Descriptive statistics

This table reports the summary statistics of the panel data used to estimate the effect of innovation performance on the number of outside directorships a CEO holds. The dependent variables are measured at year t, and all independent variables are measured at year t-1. We separate the sender firms (i.e., firms where CEOs hold their CEO positions) according to whether they have ever had a patent during our sample period. We also sort the sender firms with at least one patent into quartiles by patent count. All non-binary independent variables are winsorized at the 1st and 99th percentile. Variable definitions are in Table 3.1. Two-sample t-test (Wilcoxon-Mann-Whitney tests) is conducted to test the statistical significance of the differences in means (medians) of sub samples. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	A: Sender firms without any patent		B: Sender firms with at least 1 patent				B: Quartiles of sender firms with at least 1 patent									
					Difference		Q1 Low patent count		Q2		Q3		Q4 High of patent count		Q4 High − Q1 Low	
	Mean	Median	Mean	Median			Mean	Median	Mean	Median	Mean	Median	Mean	Median		
Dependent variable																
Number of outside directorships	0.26	0.00	0.41	0.00	0.15***	0.00***	0.29	0.00	0.33	0.00	0.47	0.00	0.59	0.00	0.30***	0.00***
Innovation outcome																
Patent count	–	–	27.54	6.00	–	–	1.14	1.00	4.45	4.00	15.14	14.00	107.96	73.00	106.82***	72.00***
Citation count	–	–	710.75	124.92	–	–	28.60	15.18	115.84	83.88	426.23	312.64	2746.81	2010.35	2718.21***	1995.17***
Citations per patent	–	–	2.88	3.06	–	–	2.35	2.66	3.04	3.04	3.17	3.13	3.24	3.27	0.89***	0.61***
Innovation efficiency																
Patent count/R&D Capital	–	–	0.14	0.04	–	–	0.04	0.01	0.21	0.04	0.19	0.08	0.18	0.09	0.14***	0.08***
Citation count /R&D Capital	–	–	4.25	0.71	–	–	1.35	0.09	6.77	0.63	4.91	1.63	5.35	1.95	4.00***	1.86***
Citations per patent /R&D Capital	–	–	0.08	0.01	–	–	0.10	0.01	0.15	0.03	0.04	0.02	0.01	0.00	−0.09***	−0.01***
Firm characteristic																
Total Assets (millions $)	3779.76	1052.27	8045.12	1639.74	4265.36***	587.47***	4005.04	1005.09	5147.57	1062.76	6918.10	1585.43	18798.66	7063.40	14793.62***	6058.31***
Market-to-book	2.04	1.64	2.43	1.95	0.39***	0.31***	2.22	1.85	2.40	1.89	2.49	1.97	2.71	2.24	0.49***	0.39***
R&D / Total Assets	0.02	0.00	0.06	0.04	0.04***	0.04***	0.05	0.03	0.06	0.04	0.06	0.05	0.08	0.06	0.03***	0.03***
Return on assets	0.18	0.17	0.16	0.16	−0.02***	−0.01***	0.16	0.16	0.16	0.15	0.15	0.15	0.17	0.16	0.01	0.00
Cash / Total Assets	0.13	0.07	0.20	0.13	0.07***	0.06***	0.17	0.10	0.21	0.13	0.20	0.14	0.22	0.16	0.05***	0.06***
Leverage	0.17	0.16	0.15	0.14	−0.02***	−0.02***	0.16	0.13	0.15	0.13	0.17	0.14	0.14	0.14	−0.02*	0.01
CAPEX	0.07	0.04	0.05	0.04	−0.02***	0.00***	0.05	0.04	0.05	0.03	0.05	0.04	0.05	0.04	0.00	0.00
Dividend Payout Ratio	0.06	0.00	0.07	0.00	0.01*	0.00***	0.06	0.00	0.06	0.00	0.08	0.00	0.09	0.07	0.03***	0.07***
Sales growth	0.15	0.11	0.14	0.10	−0.01	−0.01***	0.15	0.11	0.17	0.12	0.14	0.09	0.12	0.08	−0.03**	−0.03***
Capital intensity	0.42	0.18	0.26	0.18	−0.16***	0.00	0.29	0.17	0.24	0.17	0.24	0.19	0.26	0.21	−0.03*	0.04***
Firm age	23.42	18.00	28.34	23.00	4.92***	5.00***	26.32	20.50	26.69	20.00	28.19	23.00	33.49	33.00	7.17***	12.50***
Number of local firms	151.19	113.00	189.63	158.50	38.44***	45.50***	172.06	125.50	173.32	127.50	202.98	201.00	219.71	256.00	47.65***	130.50***
Obs	3,325		2,090				688		470		495		437			

Table 2−Continued

	A: Sender firms without any patent		B: Sender firms with at least 1 patent				B: Quartiles of sender firms with at least 1 patent									
					Difference		Q1 Low of patent count		Q2		Q3		Q4 High of patent count		Q4 High − Q1 Low	
	Mean	Median	Mean	Median			Mean	Median	Mean	Median	Mean	Median	Mean	Median		
CEO characteristics																
CEO age	54.93	55.00	54.36	55.00	−0.57***	0.00**	54.44	54.00	54.15	54.00	54.77	55.00	53.97	55.00	−0.47	1.00
CEO tenure	11.33	8.80	8.71	6.40	−2.62***	−2.40***	9.61	7.30	9.15	7.00	8.15	5.90	7.43	5.40	−2.18***	−1.90***
CEO education	1.69	2.00	2.07	2.00	0.38***	0.00***	1.94	2.00	2.00	2.00	2.15	2.00	2.27	2.00	0.33***	0.00***
Board characteristics																
Board size	8.88	9.00	9.27	9.00	0.39***	0.00***	8.89	9.00	8.93	9.00	9.21	9.00	10.29	10.00	1.40***	1.00***
CEO duality	0.72	1.00	0.72	1.00	0.00	0.00	0.69	1.00	0.69	1.00	0.73	1.00	0.78	1.00	0.09***	0.00***
Interlock	0.06	0.00	0.10	0.00	0.04***	0.00***	0.07	0.00	0.13	0.00	0.09	0.00	0.13	0.00	0.06***	0.00***
Appointing firm characteristics																
Patent count	9.12	0.00	59.05	4.00	49.93***	4.00***	55.24	0.00	26.48	2.00	49.92	6.00	91.32	15.00	36.08**	15.00***
Citation count	239.73	0.00	1445.80	83.95	1206.07***	83.95***	1243.04	0.00	576.99	34.27	1285.51	146.02	2313.94	391.97	1070.90***	391.97***
Citations per patent	8.70	0.00	15.65	11.67	6.95***	11.67***	12.19	0.00	11.88	7.28	18.07	13.73	18.71	16.97	6.52***	16.97***
Total Assets (millions $)	20005.60	4774.07	32656.46	8429.05	12650.86***	3654.98***	29335.21	5716.20	24770.58	6550.00	33496.69	9125.00	39755.19	11551.00	10419.98*	5834.80***
Market-to-book	1.80	1.53	2.08	1.79	0.28***	0.26***	1.91	1.59	1.87	1.57	2.07	1.86	2.37	2.16	0.46***	0.57***
Obs	722		672				164		127		182		199			

Table 3.3: CEO on-the-job innovation performance and CEO outside directorships: panel regressions

This table reports the estimates of coefficients and relevant statistics from the Probit and Tobit estimations, with and without using the IV approach. In Panel A, we present the Probit regression estimates, where the dependent variable equals one if a CEO holds at least one outside directorship in year t+1 and zero if not. In Panel B, we present the Tobit regression estimates, where the dependent variable is the number of outside directorships held by a CEO in year t+1. In each panel, Columns (1)−(3) report uninstrumented results, and Columns (4)−(6) report the results instrumented by *ln(CP ratio)* and *Urban industrial diversity*. In Panel C, we present the first-stage regression estimates of the instrumented model, where the dependent variable is a firm's innovation performance in year t. For all panels, the independent variables are measured in year t. Variable definitions are in Table 3.1. Standard errors are robust to heteroskedasticity and within industry and year clustering. Industry classification is based on the Fama-French 49-industry classification. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

Panel A: Probit regressions (coefficients are reported)						
Dependent variable	= 1 if a CEO holds any outside directorship in year t+1, 0 otherwise					
				Instrumented		
	(1)	(2)	(3)	(4)	(5)	(6)
ln(1 + Patent count)	0.038*			0.424***		
	(0.065)			(0.009)		
ln(1 + Citation count)		0.027**			0.210***	
		(0.017)			(0.007)	
ln(1 + Citations per patent)			0.044**			0.323**
			(0.017)			(0.011)
ln(Total assets)	0.220***	0.218***	0.224***	0.055	0.080	0.130***
	(0.000)	(0.000)	(0.000)	(0.476)	(0.217)	(0.010)
Market-to-book	0.042*	0.039*	0.042*	−0.024	−0.019	−0.001
	(0.075)	(0.092)	(0.070)	(0.478)	(0.536)	(0.958)
Return on assets	−0.240	−0.224	−0.232	0.078	0.096	0.037
	(0.387)	(0.420)	(0.402)	(0.801)	(0.757)	(0.901)
Cash / Total Assets	−0.067	−0.077	−0.067	−0.312	−0.321	−0.259
	(0.715)	(0.675)	(0.711)	(0.145)	(0.130)	(0.191)
Leverage	−0.359**	−0.366**	−0.371**	−0.310*	−0.358**	−0.392**
	(0.037)	(0.033)	(0.030)	(0.078)	(0.036)	(0.018)
CAPEX	0.270	0.255	0.280	−0.344	−0.311	−0.154
	(0.548)	(0.570)	(0.533)	(0.513)	(0.549)	(0.754)
Dividend Payout Ratio	−0.241	−0.237	−0.221	−0.261	−0.189	−0.095
	(0.263)	(0.271)	(0.304)	(0.224)	(0.371)	(0.656)
Sales growth	0.124	0.120	0.113	0.188*	0.146	0.105
	(0.270)	(0.286)	(0.314)	(0.086)	(0.181)	(0.343)
Capital intensity	−0.106	−0.101	−0.106	0.052	0.038	−0.003
	(0.108)	(0.127)	(0.110)	(0.627)	(0.700)	(0.974)
ln(Firm age)	0.263***	0.262***	0.262***	0.226***	0.229***	0.230***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(CEO age)	0.597***	0.594***	0.595***	0.667***	0.655***	0.639***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
ln(CEO tenure)	0.018	0.019	0.019	0.037*	0.036*	0.030
	(0.394)	(0.357)	(0.369)	(0.091)	(0.094)	(0.148)
CEO education	0.129***	0.128***	0.129***	0.092***	0.095***	0.102***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Board size	−0.006	−0.006	−0.006	−0.005	−0.003	−0.001
	(0.573)	(0.580)	(0.597)	(0.626)	(0.749)	(0.902)
CEO duality	0.062	0.063	0.063	0.057	0.065	0.070
	(0.206)	(0.204)	(0.202)	(0.224)	(0.167)	(0.138)
Interlock	0.884***	0.880***	0.879***	0.836***	0.829***	0.833***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+Number of local firms)	0.033*	0.033*	0.033*	0.022	0.023	0.025
	(0.059)	(0.061)	(0.062)	(0.202)	(0.183)	(0.155)
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes	Yes	Yes	Yes
Obs	5,415	5,415	5,415	5,415	5,415	5,415

Table 3.3−Continued

Panel B: Tobit regressions (coefficients are reported)						
Dependent variable	Number of outside directorships					
				Instrumented		
	(1)	(2)	(3)	(4)	(5)	(6)
ln(1 + Patent count)	0.064**			0.650**		
	(0.012)			(0.015)		
ln(1 + Citation count)		0.043***			0.322**	
		(0.002)			(0.010)	
ln(1 + Citations per patent)			0.071***			0.498**
			(0.003)			(0.012)
ln(Total assets)	0.290***	0.287***	0.297***	0.065	0.101	0.175***
	(0.000)	(0.000)	(0.000)	(0.531)	(0.231)	(0.003)
Market-to-book	0.053*	0.050	0.053*	−0.042	−0.035	−0.009
	(0.088)	(0.109)	(0.078)	(0.415)	(0.442)	(0.824)
Return on assets	−0.300	−0.275	−0.290	0.153	0.184	0.097
	(0.429)	(0.468)	(0.443)	(0.738)	(0.683)	(0.822)
Cash / Total Assets	−0.091	−0.102	−0.085	−0.480	−0.492	−0.396
	(0.699)	(0.664)	(0.716)	(0.137)	(0.120)	(0.171)
Leverage	−0.421*	−0.430*	−0.437*	−0.378	−0.446*	−0.494**
	(0.079)	(0.071)	(0.066)	(0.138)	(0.072)	(0.041)
CAPEX	0.032	0.013	0.064	−0.860	−0.810	−0.562
	(0.959)	(0.983)	(0.918)	(0.279)	(0.295)	(0.436)
Dividend Payout Ratio	−0.308	−0.303	−0.275	−0.359	−0.249	−0.101
	(0.281)	(0.289)	(0.336)	(0.247)	(0.401)	(0.730)
Sales growth	0.166	0.158	0.147	0.272*	0.205	0.140
	(0.257)	(0.278)	(0.313)	(0.082)	(0.173)	(0.350)
Capital intensity	−0.120	−0.113	−0.121	0.110	0.090	0.029
	(0.176)	(0.203)	(0.171)	(0.482)	(0.528)	(0.819)
ln(Firm age)	0.335***	0.334***	0.333***	0.302***	0.303***	0.302***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(CEO age)	0.925***	0.923***	0.925***	1.083***	1.056***	1.027***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(CEO tenure)	0.031	0.033	0.032	0.062*	0.060*	0.052*
	(0.258)	(0.226)	(0.239)	(0.059)	(0.056)	(0.085)
CEO education	0.187***	0.186***	0.188***	0.146***	0.149***	0.157***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Board size	−0.009	−0.009	−0.008	−0.011	−0.008	−0.005
	(0.539)	(0.541)	(0.561)	(0.496)	(0.606)	(0.759)
CEO duality	0.057	0.056	0.057	0.056	0.067	0.075
	(0.394)	(0.398)	(0.393)	(0.416)	(0.330)	(0.275)
Interlock	1.086***	1.080***	1.078***	1.067***	1.041***	1.036***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+Number of local firms)	0.035	0.035	0.035	0.026	0.027	0.029
	(0.133)	(0.140)	(0.139)	(0.288)	(0.270)	(0.233)
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes	Yes	Yes	Yes
Obs	5,415	5,415	5,415	5,415	5,415	5,415

Table 3.3−Continued

Panel C: Relevance of instruments: first-stage results of 2SLS			
Dependent Variable:	ln(1 + Patent count)	ln(1 + Citation count)	ln(1 + Citations per patent)
	(1)	(2)	(3)
ln(CP ratio)	0.083***	0.115***	0.025
	(0.000)	(0.000)	(0.198)
Urban industrial diversity	3.540***	9.418***	6.689***
	(0.000)	(0.000)	(0.000)
ln(Total assets)	0.370***	0.637***	0.267***
	(0.000)	(0.000)	(0.000)
Market-to-book	0.158***	0.297***	0.139***
	(0.000)	(0.000)	(0.000)
Return on assets	−0.689***	−1.516***	−0.850***
	(0.000)	(0.000)	(0.000)
Cash / Total Assets	0.655***	1.382***	0.726***
	(0.000)	(0.000)	(0.000)
Leverage	−0.097	−0.004	0.089
	(0.418)	(0.986)	(0.509)
CAPEX	1.496***	2.914***	1.445***
	(0.000)	(0.000)	(0.000)
Dividend Payout Ratio	0.136	−0.104	−0.354*
	(0.402)	(0.751)	(0.077)
Sales growth	−0.177***	−0.147	0.037
	(0.004)	(0.216)	(0.625)
Capital intensity	−0.388***	−0.726***	−0.352***
	(0.000)	(0.000)	(0.000)
ln(Firm age)	0.061**	0.126**	0.083***
	(0.013)	(0.011)	(0.007)
ln(CEO age)	−0.254**	−0.454*	−0.232
	(0.042)	(0.072)	(0.138)
ln(CEO tenure)	−0.057***	−0.103***	−0.046***
	(0.000)	(0.000)	(0.008)
CEO education	0.062***	0.117***	0.061***
	(0.000)	(0.000)	(0.000)
Board size	0.015**	0.021	0.007
	(0.037)	(0.127)	(0.406)
CEO duality	0.003	−0.033	−0.039
	(0.932)	(0.588)	(0.345)
Interlock	0.081*	0.232***	0.154***
	(0.055)	(0.005)	(0.004)
ln(1+Number of local firms)	−0.052***	−0.094***	−0.045***
	(0.000)	(0.000)	(0.007)
Year effect	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes
Obs	5,415	5,415	5,415

Table 3.4: Matching innovation leadership to boards: multinomial probit regressions

This table reports the results from a set of multinomial probit regressions estimating the matching between innovative CEOs and boards. The dependent variable is zero if a CEO does not hold any outside directorships (the base case), one if the CEO holds outside directorship(s) in one or more firms (i.e., in the appointing firms) and the average citation count of these appointing firms (in Panel A), average R&D intensity (in Panel B) or the average technological proximity between these appointing firms and the CEO's firm (in Panel C) is below the median of all firms with at least one patent, two if the CEO holds outside directorship(s) in one or more firms (i.e., in the appointing firms) and the average citation count of these appointing firms (in Panel A), average R&D intensity (in Panel B) or the average technological proximity between these appointing firms and the CEO's firm (in Panel C) is above the median of all firms with at least one patent. In all panels, the dependent variable is measured at year $t+1$ and all independent variables are measured at year t. Control variables are included in the regressions but their coefficients are not reported for brevity. Control variables include *ln(Total assets)*, *Market-to-book*, *Return on assets*, *Cash / Total Assets*, *Leverage*, *CAPEX*, *Dividend Payout Ratio*, *Sales growth*, *Capital intensity*, *ln(Firm age)*, *ln(CEO age)*, *ln(CEO tenure)*, *CEO education*, *Board size*, *CEO duality*, *Interlock*, and *ln(1 + Number of local firms)*. Variable definitions are in Table 3.1. Standard errors are robust to heteroskedasticity and within industry and year clustering. Industry classification is based on the Fama-French 49-industry classification. The *p*-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

							Instrumented					
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2
	(1)		(2)		(3)		(4)		(5)		(6)	
Panel A: Dependent variable defined based on the appointing firms' citation count												
ln(1 + Patent count)	−0.024	0.100***					0.148	1.046***				
	(0.420)	(0.002)					(0.656)	(0.009)				
ln(1 + Citation count)			−0.010	0.074***					0.103	0.354**		
			(0.537)	(0.000)					(0.486)	(0.030)		
ln(1 + Citations per patent)					−0.010	0.127***					0.220	0.419*
					(0.689)	(0.000)					(0.343)	(0.073)
Panel B: Dependent variable defined based on the appointing firm's R&D intensity												
ln(1 + Patent count)	0.022	0.089***					0.170	0.053				
	(0.522)	(0.003)					(0.307)	(0.698)				
ln(1 + Citation count)			0.004	0.066***					0.100	0.009		
			(0.807)	(0.000)					(0.198)	(0.893)		
ln(1 + Citations per patent)					−0.013	0.116***					0.212	−0.012
					(0.663)	(0.000)					(0.114)	(0.914)
Panel C: Dependent variable defined based on the technological proximity between the sender firm and the appointing firm												
ln(1 + Patent count)	−0.160***	0.145***					−0.495***	0.545***				
	(0.000)	(0.000)					(0.001)	(0.001)				
ln(1 + Citation count)			−0.076***	0.105***					−0.210***	0.249***		
			(0.000)	(0.000)					(0.002)	(0.001)		
ln(1 + Citations per patent)					−0.106***	0.184***					−0.305***	0.418***
					(0.000)	(0.000)					(0.010)	(0.001)
Control variables	Yes		Yes		Yes		Yes		Yes		Yes	
Year effect	Yes		Yes		Yes		Yes		Yes		Yes	
Industry effect	Yes		Yes		Yes		Yes		Yes		Yes	
Obs	5,415		5,415		5,415		5,415		5,415		5,415	

Table 3.5: Robustness tests

This table reports the estimates of a set of Tobit regression for robustness checking of how a CEO's on-the-job innovation performance impact the number of her outside directorships. The dependent variable is the number of directorships a CEO holds in year $t+1$. All independent variables are measured in year t, except the innovation performance measure in panel A which is measured at year $t-2$. The innovation performance measure is *ln(1 + Patent count)* in model (1) and (4), *ln(1 + Citation count)* in model (2) and (5), *ln(1 + Citations per patent)* in model (3) and (6). Control variables are included in the regressions but not reported for brevity. Control variables include *ln(Total assets)*, *Market-to-book*, *Return on assets*, *Cash / Total assets*, *Leverage*, *CAPEX*, *Dividend Payout Ratio*, *Sales growth*, *Capital intensity*, *ln(Firm age)*, *ln(CEO age)*, *ln(CEO tenure)*, *CEO education*, *Board size*, *CEO duality*, *Interlock*, and *ln(1 + Number of local firms)*. Variable definitions are in Table 3.1. Standard errors are robust to heteroskedasticity and clustered by industry and year. Industry classification is based on the Fama-French 49-industry classification. The *p*-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

	Dependent variable = Number of outside directorships					
				instrumented		
Firm innovativeness measure	Patent count	Citation count	Citations per patent	Patent count	Citation count	Citations per patent
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Addressing reverse causality						
Firm innovativeness at $t-2$	0.072***	0.056***	0.103***	0.687**	0.291**	0.456**
	(0.005)	(0.000)	(0.000)	(0.049)	(0.043)	(0.037)
Obs	5,415	5,415	5,415	5,415	5,415	5,415
Panel B: Remove self-citations						
Firm innovativeness	–	0.039***	0.065***	–	0.314**	0.474**
	–	(0.007)	(0.009)	–	(0.038)	(0.034)
Obs	–	5,415	5,415	–	5,415	5,415
Panel C: Control for CEO ownership, board ownership and CEO overconfidence						
Firm innovativeness	−0.019	−0.003	0.008	2.692***	0.885***	1.140***
	(0.585)	(0.882)	(0.801)	(0.010)	(0.002)	(0.001)
CEO overconfidence	−0.150**	−0.148**	−0.146**	0.179	0.060	−0.016
	(0.039)	(0.042)	(0.044)	(0.357)	(0.625)	(0.863)
CEO ownership	−0.212	−0.212	−0.205	−0.010	0.307	0.457
	(0.839)	(0.839)	(0.843)	(0.994)	(0.786)	(0.672)
Board ownership	−1.149	−1.143	−1.139	−0.097	−0.551	−0.807
	(0.136)	(0.138)	(0.139)	(0.928)	(0.529)	(0.321)
Obs	2,890	2,890	2,890	2,890	2,890	2,890
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.6: High-impact innovation and CEO outside directorships

This table reports OLS regression estimates of how high-impact patents impact the change in the number of CEO outside directorships. The dependent variable is the change in the number of a CEO's outside directorship from year t to year $t+3$. *High-impact innovation dummy* equals one if a CEO's firm receives at least one patent in year t which is in the top 10% of the economic value (measured following Kogan et al. (2017)) and zero otherwise. The sample has 171 CEO-years with high-impact patents. For each CEO with high-impact patent, we select up to five matching CEOs from firms without any high-impact patent in year t but have similar propensity score of having a high-impact patent. After we remove duplicate selections in the pool of matching CEOs, we have 174 control firms. All independent variable are measured in year t. Variable definitions are in Table 3.1. Standard errors are robust to heteroskedasticity. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

Dependent variable:	Δ Number of outside directorships$_{t:t+3}$
High-impact innovation dummy	0.145**
	(0.028)
Number of outside directorships$_t$	−0.264***
	(0.000)
ln(1 + Patent count)	0.043*
	(0.058)
ln(Total assets)	−0.056*
	(0.099)
Market-to-book	−0.009
	(0.664)
Return on assets	−0.325
	(0.256)
Cash / Total Assets	−0.655***
	(0.001)
Leverage	0.109
	(0.573)
CAPEX	1.640**
	(0.044)
Dividend Payout Ratio	−0.391
	(0.362)
Sales growth	−0.171
	(0.168)
Capital intensity	−0.285*
	(0.052)
ln(Firm age)	−0.010
	(0.842)
ln(CEO age)	0.110
	(0.651)
ln(CEO tenure)	−0.062**
	(0.038)
CEO education	−0.030
	(0.293)
Board size	0.004
	(0.825)
CEO duality	−0.006
	(0.930)
Interlock	0.046
	(0.670)
ln(1+Number of local firms)	0.028
	(0.315)
Constant	0.364
	(0.693)
Obs	345
Adj. R^2	0.145

Table 3.7: Post director-appointment innovation performance: a difference-in-difference analysis

This table presents the estimates (based on OLS regressions) of how appointing an innovative CEO-director influences a firm's subsequent innovation performance. Regressions are estimated on a panel data set aligned according to the director-appointment year (year 0) and include year t ($t = -3$, -2, -1, 2, 3, 4). Treated firms are those that appoint an innovative CEO-director (a director who is the CEO of a firm that hold at lease one patent during our sample period). For each treated firm, we select a control firm, using propensity score matching, from the pool of firms that appoint a director who is the CEO of a firm that never hold any patent during our sample period. The propensity score measures a firm's probability of appointing an innovative CEO-director in a year. The dependent variable is the appointing firm's innovation performance in year t. *After* is a dummy variable equals one for years after the appointment and zero otherwise. *Treat* is an indicator variable equals one for a treated firm and zero for a control firm. *High Innovativeness* is a dummy variable equals one if the sender firm's (i.e., the CEO's firm) innovation outcomes in the three years prior to the appointment is greater than the sample median of all sender firms in the treated group and zero otherwise. *High proximity* is a dummy variable equals one if the technological proximity between the sender firm and the appointing firm is greater than the sample median of the treated group and zero otherwise. *High R&D* is a dummy variable equals one if the appointing firm's R&D intensity over the three years prior to appointment are greater than the median of all appointing firms in the treated group and zero otherwise. Control variables include *ln(Total assets)*, *Market-to-book*, *Return on assets*, *Cash / Total Assets*, *Leverage*, and *R&D*. Variable definitions are in Table 3.1. Standard errors are robust to heteroskedasticity and within firm and year clustering. Industry classification is based on the Fama-French 49-industry classification. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

Dependent variable:	ln(1+Patent count)	ln(1+Citations count)	ln(1+Citations per patent)	ln(1+Patent count)	ln(1+Citations count)	ln(1+Citations per patent)
	(1)	(2)	(3)	(4)	(5)	(6)
	control variables not included			control variables included		
Panel A: The impact of innovative CEO-directors on the appointing firm's innovation performance						
After × Treat	0.147*	0.264*	0.078	0.128*	0.244*	0.081
	(0.059)	(0.071)	(0.469)	(0.096)	(0.092)	(0.447)
After	−0.180	−0.515**	−0.375**	−0.166	−0.494**	−0.367**
	(0.165)	(0.035)	(0.042)	(0.191)	(0.042)	(0.047)
Adj. R^2	0.917	0.869	0.568	0.919	0.869	0.571
Panel B: Sender firm's innovativeness and post-appointment innovation performance						
After × Treat × High innovation output	0.251***	0.643***	0.480***	0.249***	0.677***	0.518***
	(0.008)	(0.000)	(0.000)	(0.010)	(0.000)	(0.000)
After × Treat	0.034	−0.026	−0.138	0.015	−0.064	−0.154
	(0.713)	(0.892)	(0.342)	(0.876)	(0.736)	(0.287)
After	−0.188	−0.536**	−0.390**	−0.173	−0.511**	−0.380**
	(0.142)	(0.026)	(0.033)	(0.169)	(0.033)	(0.037)
Adj. R^2	0.918	0.871	0.575	0.920	0.871	0.579
Panel C: Technological proximity and post-appointment innovation performance						
After × Treat × High Proximity	0.030	0.475***	0.507***	0.049	0.465**	0.478***
	(0.762)	(0.007)	(0.000)	(0.632)	(0.010)	(0.000)
After × Treat	0.133	0.040	−0.160	0.105	0.029	−0.141
	(0.117)	(0.816)	(0.239)	(0.217)	(0.871)	(0.308)
After	−0.181	−0.518**	−0.378**	−0.166	−0.497**	−0.370**
	(0.165)	(0.032)	(0.038)	(0.190)	(0.039)	(0.042)
Adj. R^2	0.917	0.870	0.576	0.919	0.870	0.577
Panel D: Appointing firm's R&D intensity and post-appointment innovation performance						
After × Treat × High R&D expense	0.006	0.168	0.254*	−0.025	0.138	0.259*
	(0.955)	(0.364)	(0.058)	(0.815)	(0.466)	(0.056)
After × Treat	0.145	0.186	−0.039	0.139	0.181	−0.037
	(0.107)	(0.307)	(0.779)	(0.121)	(0.321)	(0.790)
After	−0.181	−0.521**	−0.383**	−0.165	−0.498**	−0.375**
	(0.165)	(0.033)	(0.038)	(0.193)	(0.040)	(0.042)
Adj. R^2	0.917	0.869	0.569	0.919	0.868	0.572
Control variables	No	No	No	Yes	Yes	Yes
Firm effect	Yes	Yes	Yes	Yes	Yes	Yes
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
No. of Treatment Events	94	94	94	94	94	94
No. of Control Events	58	58	58	58	58	58
Obs	912	912	912	912	912	912

Table 3.8: Post director-appointment operating performance

This table reports the estimates (based on OLS regressions) of how director appointment impact a firm's operating performance. Treated firms are those that appoint an innovative CEO-director (a director who is the CEO of a firm that hold at lease one patent during our sample period). For each treated firm, we select a control firm, using propensity score matching, from the pool of firms that appoint a director who is the CEO of a firm that never hold any patent during our sample period. The propensity score measures a firm's probability of appointing an innovative CEO-director in a year. The dependent variable is the appointing firm's annual operating performance averaged over three years post appointment (year 2 through 4; year 0 is the appointing year) or five years (year 2 through 6) after appointment. The independent variable is the appointing firm's annual operating performance averaged over three years (year −3 through −1) or five years (year −5 through −1) before appointment. In model (1) and (2), operating performance is measured by unadjusted *ROA* (defined in 3.1). In model (3) and (4), operating performance is measured by *ROA* adjusted by the median *ROA* of other firms in the same Fama-French 49 industry and size (measured by *Total assets*) decile as the appointing firm. In model (5) and (6), operating performance is measured by *ROA* adjusted by the median *ROA* of other firms from the same Fama-French 49 industry, with an *ROA* within ± 10% of the appointing firm, and with size closet to the appointing firm. We also report the *p*-values of Chow tests (testing the significance of structural difference) and Wald test (testing the statistical equality of the constant term) between the regression on the treated firms and that on the control firms. Standard errors are robust to heteroskedasticity and within industry and year clustering. Industry classification is based on the Fama-French 49-industry classification. The *p*-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

Measure of operating performance:	ROA		Size, industry-adjusted ROA		Size, performance, industry-adjusted ROA	
	(1)	(2)	(3)	(4)	(5)	(6)
	Treat	Control	Treat	Control	Treat	Control
Panel A: Post-appointment 3-year average operating performance						
Constant	0.113*	0.077*	0.021	−0.059***	0.115***	−0.042**
	(0.076)	(0.091)	(0.387)	(0.000)	(0.002)	(0.011)
Pre-event operating performance	0.548***	0.591***	0.523**	0.481*	0.668**	0.829**
	(0.004)	(0.007)	(0.020)	(0.058)	(0.018)	(0.035)
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes	Yes	Yes	Yes
Obs	94	58	94	58	88	52
Adj. R^2	0.606	0.353	0.296	0.104	0.490	0.272
Test of the equality between two regressions						
Structural difference (Chow test) *p*-value	(0.000)***		(0.000)***		(0.000)***	
Equality of the constant term (Wald test) *p*-value	(0.497)		(0.000)***		(0.000)***	
Panel B: Post-appointment 5-year average operating performance						
Constant	0.131*	0.072	0.045	−0.065***	0.112**	−0.042***
	(0.070)	(0.103)	(0.107)	(0.000)	(0.026)	(0.003)
Pre-event operating performance	0.467**	0.501**	0.463*	0.477*	0.490	1.068***
	(0.038)	(0.019)	(0.061)	(0.055)	(0.149)	(0.002)
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes	Yes	Yes	Yes
Obs	94	58	94	58	88	52
Adj. R^2	0.567	0.347	0.279	0.040	0.358	0.317
Test of equality across two regressions						
Structural difference (Chow test) *p*-value	(0.000)***		(0.000)***		(0.000)***	
Equality of the constant term (Wald test) *p*-value	(0.318)		(0.000)***		(0.000)***	

Appendix A: Control variables

We control for several firm characteristics that affect the number of outside directorships, according to previous literature. First, Booth and Deli (1996) argue that larger firms have more external contracting relationships and, thus, benefit more from building well-bonded relationships by sending their CEOs to other firms' boards. From the demand side, firms prefer to appoint CEOs of large firms as their directors because these large firms' CEOs provide more resources and stronger certification. Therefore, CEOs of large firms should hold more outside directorships. Second, Booth and Deli (1996) and Fich (2005) find that CEOs of firms with more growth opportunities hold fewer outside directorships because their time is used better in their own firms and the opportunity cost of holding outside directorships is higher. It is reasonable, therefore, to expect that the CEOs of firms with more capital expenditures or higher sales growth to have fewer outside directorships. On the other hand, however, since the value of high-growth firms are more dependent on intangibles, CEOs of these firm may be more eager to accept external directorships to certify their expertise (Fama and Jensen, 1983). The net effect of capital expenditures and sales growth on a CEO's outside directorship, therefore, is undetermined. Third, CEOs of well-performing firms are more likely to be appointed as outside directors. Ferris et al. (2003) and Fich (2005) provide empirical evidence supporting this view. Fourth, Fahlenbrach et al. (2010) argue that CEOs working at older and more mature firms might have delegated more of their authority to younger managers, and therefore are more likely to accept outside directorships. Therefore, we control for firm size, firm age, capital expenditures, sales growth, market-to-book and return on assets. Fifth, Knyazeva et al. (2013) demonstrate that the local supply of prospective directors has an important effect on a firm's director appointment. We then further include a measure of the size of the local director pool, to control for the local supply of directors. We also control for several other characteristics of a CEO's firm, including cash, leverage, dividend and capital intensity, to further rules out the alternative effects on CEOs' outside directorships.

In the previous literature, CEO characteristics are also shown to affect their popularity on the labor market and their willingness to serve on another firm's board. CEO age

and education is a proxy for CEO knowledge and experience. CEO tenure measures the cost to the sender firm (i.e., a CEO's firm where she holds the CEO position). For CEOs with longer tenure, this cost decreases because they may have delegated more tasks to younger managers or their prospective successors (Booth and Deli, 1996).

We also control for several board characteristics. Following Booth and Deli (1996), we control for board size, director ownership, CEO duality and the number of board interlocks. Board size reflects the complexity of a firm's external contracting relationships, and thus firms with larger boards would benefit more from outside directorships their CEOs hold. Larger boards may monitor less (Yermack, 1996), decreasing their CEOs' restriction of holding outside directorships. Higher director ownership motivates the board to supply stricter supervision, which in turn increases CEOs' restrictions of taking outside directorships. CEOs who are also chairmen usually have greater power, and they have fewer restrictions to accept outside directorships; meanwhile, external firms are more willing to have such CEOs on board because of their importance in their firms. Therefore, CEO duality should increase the number of directorships a CEO holds. Finally, the number of board interlocks reflects a firm's tendency to build reciprocal relationships with other firms; it should be positively related to the number of CEO outside directorships.

BoardEX records a firm's new directors at the end of a fiscal year. To ensure that all explanatory variables capture the information before director appointment, we measure a CEO's number of directorships at year $t + 1$ and measure all explanatory variables at year t. Furthermore, we winsorize all non-binary variables at the first and the ninety-ninth percentiles in case outliers drive our results. We present all variable definitions in Table 1.

Appendix B: Construction of the treated and control sample used in Section 3.5

In this appendix, we explain the sample construction of the treated and control groups in Section 3.5. We begin with the 550 CEOs who have ever hold one or more outside directorships during our sample period 2000–2008 (out of the 1,234 CEOs in our entire sample). We use the BoardEx database to find the firms that appoint these CEOs as directors and record the time of appointment. We then remove the appointing firms that do not have the required data at the time of appointment. We further remove the appointing firms that do not have any patent in our entire sample period because these firms may appoint directors for reasons other than obtaining innovation leadership. These steps result in 205 appointments. Out of the 205 appointments, 132 cases have CEO-directors from innovative firms (i.e., firms have at least one patent during our sample period) which form our treated sample. From the remaining 73 cases where CEO-directors are from non-innovative firms (i.e., firms that never have any patent in our sample period), we select up to five control appointing firms using propensity score matching (the nearest-neighborhood caliper is 0.1, i.e., a matching firm's propensity score cannot be different from the treated firm's by more than 0.1 standard deviation of the treated firm's propensity score). The propensity score measures an appointing firm's probability of appointing an innovative CEO-director. We estimate a logistic model on the 205 CEO-director appointments to get each appointing firm's propensity score (we report the regression estimates in the table below). For 38 treated firms, we cannot find a matching firm according to the 0.1 nearest-neighborhood caliper. We further remove duplicates in the pool of selected matching firms. In our final sample, we have 94 treated firms and 58 control firms.[17]

[17] If we do not remove the duplicating control firms, we get more significant results.

Appendix C: Related regulations and constraints on CEOs accepting outside directorships

In this appendix, we discuss related regulations and constraints on CEOs accepting outside directorships and how they affect our empirical findings.

The only restriction enforced by law on CEO outside directorships is that CEOs cannot serve on competing firms' boards for antitrust considerations, according to Section 8 of the Clayton Act of 1914. To alleviate the impact of this rule on our baseline results, we further control for the number of local firms with the same 4-digit SIC industry because it can affect the local demand for CEO-directors. Our main findings remain the same.

Another potential concern on CEO accepting outside directorships is the maximum number of outside directorships they should hold. Corporate governance activists criticize that individuals holding too many directorships would affect their performance both in their primary employing firms and the firms in which they serve as outside directors. This is because effective board monitoring requires a commitment of time and effort, holding too many outside directorships would distract directors' attention and shirk their responsibilities. Lipton and Lorsch (1992) show that, in order to fulfill their responsibilities, directors devote at least 100 hours a year. Although there are no compulsory rules limiting the number of directorships held by an individual, many institutional investors and shareholder activists (e.g., the Council of Institutional Investors, and the National Association of Corporate Directors) do suggest that directors with full-time roles should not serve on more than three or four other boards. In opposite, the empirical studies (e.g., Ferris et al. (2003) and Perry and Peyer (2005)) do not find evidence that suggests holding multiple directorships is harmful to the appointing firm or the executive's primary employing firm.

Given the argument above, simply using the number of outside directorships may not fully reflect a CEO's attractiveness on the director labor market because CEOs may face more intense monitoring from shareholders or find it too costly if they accept too many outside directorships. In our sample, the maximum number of outside directorships held by a CEO is four, which actually confirms this argument. To

address this concern, we also take into account the quality of outside directorships when examining a CEO's attractiveness on the director labor market. Our main findings still hold after using different measures on the quality of outside directorships (see details in Section 3.4.2).

Table A1: Propensity score matching

Panel A of Table A1 reports the estimates of the logistic regression used to get the propensity score of appointing an innovative CEO-director (refer to Section 3.5). Standard errors are robust to heteroskedasticity. Industry classification is based on the Fama-French 49-industry classification. The p-values are in parentheses. All independent variables are defined in Table 3.1 and measured prior to appointment. Panel B presents the summary statistics of the treated and control firms. Two sample t-test (Wilcoxon-Mann-Whitney tests) are conducted to test whether the significance in means (medians) between the treated and control sample. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and * respectively.

Panel A: The estimates of the logistic regression used to get the propensity scores	
Dependent variable:	=1 if a firm appoints an innovative CEO-director, 0 otherwise
ln(1 + Patent count)	-0.248
	(0.126)
ln(Total assets)	0.327*
	(0.052)
Leverage	-1.133
	(0.546)
Cash / Total Assets	0.464
	(0.845)
Market-to-book	0.218
	(0.119)
R&D	7.761
	(0.463)
Return on assets	-1.244
	(0.806)
Obs	205
Pseudo R^2	0.141

Panel B: Summary statistics of the treated and control firms						
Variables	Treat		Control		Difference	
	Mean	Median	Mean	Median	Mean	Median
ln(1 + Patent count)	3.09	3.15	3.30	3.27	−0.20	−0.12
ln(Total assets)	8.58	8.58	8.53	8.49	0.05	0.09
Leverage	0.22	0.21	0.24	0.22	−0.02	−0.01
Cash / Total Assets	0.11	0.04	0.09	0.04	0.02	0.00
Market-to-book	2.66	2.05	2.36	1.76	0.30	0.29
R&D	0.05	0.03	0.04	0.02	0.01	0.01
Return on assets	0.21	0.20	0.20	0.19	0.00	0.01
Obs	94		58			

Chapter 4

Are CEOs judged on their social performance?

4.1 Introduction

In recent years, ever-increasing emphasis on corporate responsibilities for environmental, social and governance issues has taken business decisions beyond the conventionally perceived scope of capitalism. In aggregate, these responsibilities are referred to as Corporate Social Responsibilities (CSR). CSR is becoming an integral part of corporate decision making. The Financial Times reported that in 2014 U.S. and U.K. companies in the Fortune Global 500 list spent a total of $15.2 billion on CSR activities.[1] Institutional investors have begun to integrate CSR criteria into their investment processes (Edmans, 2011; Renneboog, Ter Horst, and Zhang, 2008a,b) while activist groups have emerged to pressurize companies into the better delivery of CSR (Barko, Cremers, and Renneboog, 2017). Despite the unprecedented attention on CSR, the extent to which company Chief Executive Officers (CEOs) are held responsible for poor delivery of CSR or rewarded for outstanding CSR performance remains unresolved. Moreover, the extent to which market-based institutions (the director labor market in particular) promote the social consciousness of CEOs' is not clear either.

[1] See https://www.ft.com/content/95239a6e-4fe0-11e4-a0a4-00144feab7de.

In this paper, we study how on-the-job social performance impacts a CEO's reputation and career, in the context of director labor market. According to Fama and Jensen (1983), individuals obtain outside directorships when their management skills, as demonstrated by on-the-job performance in their firms, are recognized externally. Kaplan and Reishus (1990) postulate that outside directorships enhance a CEO's prestige, certify her management expertise and lead to more career opportunities. Consistent with this view, several studies find that CEOs who deliver better financial performance hold more outsider directorships (Ferris, Jagannathan, and Pritchard, 2003; Fich, 2005; Yermack, 2004). On the downside, managers lose their outside directorships when they fail to sustain the level of dividends (Kaplan and Reishus, 1990), commit financial fraud (Fich and Shivdasani, 2007), restate earnings as a consequence of aggressive accounting policies (Desai, Hogan, and Wilkins, 2006) or make bad investment decisions (e.g., takeovers) (Harford, 2003; Coles and Hoi, 2003; Lehn and Zhao, 2006). These studies demonstrate that the labor market for outside directors is an effective institution which motivates CEOs to conduct their fiduciary duty to shareholders, and at the same time reflects the CEOs' prestige and expertise. Based on the contract theory and the theory of firms, companies can do well by doing good. Specifically, the contract theory views a company as a nexus of contracts between shareholders and stakeholders (Alchian and Demsetz, 1972; Coase, 1937; Cornell and Shapiro, 1987; Hill and Jones, 1992; Jensen and Meckling, 1976). The valuable resources held by the stakeholders are essential for shareholders' value maximization (Cornell and Shapiro, 1987; Hill and Jones, 1992). An important component of a CEO's human capital therefore is her skill to manage CSR activities appropriately to engage stakeholders. Such a skill is not easily acquired because it requires outstanding wisdom and experience to understand stakeholders' preferences, the balance between stakeholder interests and shareholder interests, and the optimal way to mobilize internal and external resources to do well by doing good. The relation with stakeholders is also complicated – apart from those explicit contractual relations, CEOs have to be mindful of the implicit commitments reflected in various sorts of social responsibilities. Violation of CSR has forced famous companies to pay heavy prices (e.g., the Volkswagen CO_2 emissions cover up, the anti-climate lobbying by Exxon Mobil, and the earnings overstatement of Toshiba due to its broken corporate

culture).[2] Given the complexity and importance of managing CSR appropriately, CEOs with better on-the-job CSR performance should have greater prestige on the labor market for outside directors. The prediction is complicated by a different thought however. In particular, a CEO may pursue CSR for her own benefits at the expense of shareholders (Bénabou and Tirole, 2010). Self-centered manager may spend corporate resources on CSR just to enhance their own role without benefiting shareholders. To the extent this is the case, we should observe CEOs with better on-the-job CSR performance hold less outside directorships.

Following Deng, Kang, and Low (2013), we employ an adjusted CSR score, constructed from the MSCI ESG Stats (formerly KLD) database, to measure a firm's CSR performance. This database is widely used in the CSR literature and covers a very comprehensive set of dimensions to CSR. The comprehensiveness of this database represents a good advantage over alternative databases. MSCI ESG Stats produces CSR scores for both strengths in CSR (positive scores) and controversies (negative scores). The positive scores measure good CSR practice by managers; the negative scores measure violations of national or international laws, regulations or commonly accepted global norms. We perform our initial analysis using the net adjusted CSR score (the strength score net of the controversies score), and proceed to analyze the effects of the strength and controversies scores separately.

Our baseline analysis reveals a strong positive relation between CSR performance and a CEO's outside directorships. In particular, the CEOs of firms with higher net adjusted CSR scores are more likely to be appointed as outside directors, and they hold significantly more outside directorships. A one-standard-deviation increase in the net adjusted CSR score leads to a 1.6% increase in the probability of a CEO having outside directorships and a 0.067 increase in the number of outside directorships held by a CEO. This effect is economically significant given that the proportion of CEOs holding outside directorships in our sample is 28.6% and the average number of outside directorships held by a CEO is 0.376. When we analyze the strength score and controversy score separately, we find that CEOs with more CSR controversies incur a greater reputational penalty, resulting in fewer outside directorships. In contrast,

[2]The Guardian: https://www.theguardian.com/sustainable-business/2015/dec/30/vw-exxon-lobbying-brazil-mining-tragedy-toshiba-corporate-scandals-greenwashing-climate-change

a higher strength score significantly enhances a CEO's reputation, showing that the labor market for outside directors rewards superior CSR performance. A concern with our baseline analysis is that there may be unobserved variables that affect both CSR performance and CEO outside directorships. Such an endogeneity issue would bias our estimates. To address this concern and examine the robustness of this finding, we use two instrumental variables: firms' initial CSR as measured in the first year of data coverage and, following Attig, El Ghoul, Guedhami, and Suh (2013), Benlemlih and Bitar (2015), Bhandari and Javakhadze (2017), and Deng et al. (2013), county-level Democratic votes. Allowing for endogeneity and controlling for other factors such as industry and year fixed effects as well as a set of firm and CEO characteristics does not change our results.

According to Booth and Deli (1996), Kaplan and Reishus (1990), and Fahlenbrach, Low, and Stulz (2010), the number of outside directorships reflects a CEO's reputation on the labor market as well as her willingness to accept outside directorships. Serving on external boards comes at a cost, requiring both time and effort. Therefore, CEOs trade off the costs and benefits when assuming outside directorships. Other things being equal, a CEO would accept a directorship in more prestigious firms. Consistent with this argument, we show that CEOs with higher CSR scores are more likely to serve on the boards of larger, more profitable (as measured by Return on Assets (ROA)) or more socially responsible firms. When we analyze the strength and controversy scores separately, we find a CEO with a higher strength score is more likely to be an outside director of a firm that is larger, more profitable or more socially responsible. The controversy score has the opposite effect, reducing the likelihood of a CEO holding directorships with larger, more profitable and more socially responsible firms. These findings lend further support to the reputational effect of one-the-job CSR performance on CEOs' outside directorships.

As is mentioned earlier, Bénabou and Tirole (2010) caution that the pursuit of CSR may be driven by a CEO's private interests and therefore harmful to shareholders. A CEO may use company resources to boost CSR performance and reap the rewards for reputation and social status for her own benefit. When a firm is poorly governed, the outcome of superior CSR performance is more likely to be associated with agency

conflicts. For example, Cespa and Cestone (2007) find that inefficient managers may use CSR to gain stakeholders' support and entrench themselves. Slack governance leaves a scope for self-interested CEOs to exploit such possibilities without being internally penalized. Therefore, the question we ask here is whether the labor market for outside directors incorporates agency concerns when forming judgement on a CEO's CSR performance. We hypothesize that the positive effect of CSR on CEO outside directorships is only present when the CEO's own firm is well governed. To test this, we use the fraction of independent directors and the *E*-index (Bebchuk, Cohen, and Ferrell, 2009) as proxies for corporate governance quality. We find that when a firm is not well governed, the positive CSR effect on CEO outside directorships disappears. This suggests that the director labor market is mindful about possible agency issues related to CSR. This evidence is in line with the recent views on the CSR-related agency conflicts (Ferrell, Liang, and Renneboog, 2016; Krüger, 2015; Masulis and Reza, 2014).

A final question we ask is whether firms have the right incentive to hire outside directors from the pool of CEOs with good CSR performance. Our results on the whole show that the stock market responds more positively when a firm appoints an outside director who is the CEO of a more socially responsible firm. Therefore, firms benefit from having a socially responsible external CEO on its board, consistent with the notion that the labor market for outside directors is a sustainable market-based institution for promoting CSR. This effect vanishes, however, when the CEO's own firm is weakly governed. This suggests those firms hiring on the director labor market are conscious about the possible agency issues associated with CSR (Ferrell, Liang, and Renneboog, 2016; Krüger, 2015; Masulis and Reza, 2014).

We contribute to three strands of literature. First, building on the arguments of Fama and Jensen (1983); Kaplan and Reishus (1990) that individuals obtain outside directorships when their management expertise demonstrated in their own firms are recognized externally, we show that a CEO's superior CSR performance is rewarded on the labor market for outside directors and inferior CSR performance is penalized. The contract theory and the theory of firms postulate that a company is a nexus of implicit or explicit contracts between shareholders and stakeholders

where the stakeholders possess resources essential for the company's success (Alchian and Demsetz, 1972; Coase, 1937; Cornell and Shapiro, 1987; Hill and Jones, 1992; Jensen and Meckling, 1976). Our results demonstrate that the capability of managing stakeholder relationships properly is a valuable human capital for CEOs.[3] Second, previous studies demonstrate that the director labor market provides an external market-based institution to motivate good managerial practice and discipline misconduct (Ferris, Jagannathan, and Pritchard, 2003; Fich, 2005; Yermack, 2004; Kaplan and Reishus, 1990; Fich and Shivdasani, 2007; Desai, Hogan, and Wilkins, 2006; Harford, 2003; Coles and Hoi, 2003; Lehn and Zhao, 2006). Our results suggest the same market can be relied upon to motivate CEOs to be socially more responsible. In this sense, the labor market for outside directors parallels those institutions based on shareholders' pressure (institutional investors or activist groups, for example) or on legislation and regulation. Third, our paper ties to the view of Bénabou and Tirole (2010) that CSR activities can be motivated by the private benefits of managers'. We find that the positive effect of CSR on a CEO's outside directorships is conditional on the robustness of the CEO's firm's governance. The director labor market does not reward high CSR performance if such performance is likely an outcome of a CEO's pursuit of private interests at the expense of shareholders. This finding links to the recent literature on agency problems relating to and arising from CSR (Ferrell, Liang, and Renneboog, 2016; Krüger, 2015; Masulis and Reza, 2014).

The rest of the paper is organized as follows. Section 4.2 reviews the relevant literature and develops our main hypotheses. Section 4.3 describes the sample selection criteria and the variables of interest. Section 4.4 reports results on the effect of CSR performance on CEO outside directorships. Section 4.5 investigates the stock market reaction to director appointments. Section 4.6 concludes.

[3]The notion that performance is a signal of skills is in line with Hermalin and Weisbach (1998).

4.2 Literature review and hypothesis development

4.2.1 Motives for corporate social responsibility

Despite the growing attention on CSR, the motives behind it remain vague. Broadly speaking, there are two opposing views: the shareholder value-maximizing view and the agency view. Friedman (1970) claims that the one and only one social responsibility of business is to increase its profits within the rules of the game. There is broad scope for interpreting "the rules of the game", however. Unlike the conventionally perceived scope of capitalism, contract theory and the theory of firms (Alchian and Demsetz, 1972; Coase, 1937; Cornell and Shapiro, 1987; Hill and Jones, 1992; Jensen and Meckling, 1976) suggest that companies can do well by doing good. According to this view, a company is a nexus of contracts among the shareholders and the stakeholders. The stakeholders possess the resources essential for the company's success. An important element of a CEO's ability is her capability to maximize shareholder value by appropriately managing the relationships with stakeholders. The relationships with the stakeholders can be complicated and subtle. Some of the explicit relationships are reflected in the terms of explicit contracts. Many other relationships, however, are complicated and implicit (for example, good faith from employees and loyalty from customers). Through fulfilling their CSR commitments, firms establish a good reputation among stakeholders and receive their good faith. Consequently, the stakeholders are more willing to contribute key resources towards a firm's success. This shareholder-value-maximization view asserts that CEOs commit resources to CSR in order to enhance shareholder value. Several studies provide evidence consistent with this view. Deng et al. (2013) find acquiring firms with better CSR performance have better merger performance. Flammer (2015) uses a Regression Discontinuity Design (RDD) and find firms adopting closely-passed CSR proposals experience a positive stock market response at announcement and superior operating performance subsequently. That said, some studies find that CSR impacts firm value only under certain conditions. Lins, Servaes, and Tamayo (2017) find that firms with higher CSR scores fare better during the 2008-2009 financial crisis. They conclude that good CSR reflects the trust between a firm and its stakeholders and shareholders,

which benefits the firm when the overall trust on the markets is low. Servaes and Tamayo (2013) find that the positive impact of CSR on firm value is conditioned on high customer awareness. They maintain that customer awareness provides a channel through which CSR is recognized by customers, in turn impacting firm value. Edmans (2011) postulates that firm value, to a considerable extent, relies on employee satisfaction. Recent work by Bénabou and Tirole (2010) and Ferrell et al. (2016) finds that CSR enhances firm value in well-governed firms.

Contrary to the shareholder value-maximizing view, the agency view argues that managers invest in CSR to pursue their own private benefits. They use CSR either to establish and strengthen their personal relationships with stakeholders or to enhance their personal public image and prestige, at the expense of shareholders. Under the agency view, CSR is not undertaken by managers to maximize the shareholder value but to enhance the CEO's private benefits and opportunities. Bénabou and Tirole (2010) postulate that a firm is likely to have agency problems when its CSR engagement is determined by insiders' personal benefits. Cheng, Hong, and Shue (2016) and Masulis and Reza (2014) use the 2003 Tax Reform Act as a quasi-natural experiment to study the relation between CSR and corporate governance. This reform, which reduced the maximum personal dividend tax rate from 35% to 15%, considerably increased the after-tax dividend income from insider ownership and aligned insider interests better with those of other shareholders.[4] They find that after the reform, firms with moderate levels of insider ownership (which are most likely to be affected by the tax reform) significantly reduce their spending on CSR. Their findings suggest corporate expenditure on CSR is related to agency costs – when CSR is more costly for insiders (i.e., after the 2003 tax reform), they reduce CSR spending. Adding to this, Krüger (2015) reports a negative stock market response to positive CSR news, showing shareholders are concerned about possible agency problems associated with CSR spending.

[4]See Chetty and Saez (2005) for a detailed discussion of the 2003 dividend tax cut and its impact on corporate behavior.

4.2.2 Reputation, discipline and the director labor market

The labor market for outside directors values the potential director's skills, experience, and expertise while at the same time bringing the prestige and opportunities that CEOs cherish. A sizable literature demonstrates that the director labor market rewards well-performing managers. Fama and Jensen (1983) posit that an individual obtains outside directorships when her management skills, demonstrated in her on-the-job performance, are recognized by other firms. Those who hold or intend to hold outside directorships have strong incentives to develop their reputations as decision-control experts. Kaplan and Reishus (1990) suggest that outside directorships can bring top managers prestige and visibility, certify the scope and quality of their managerial skills and offer them extensive business networks, in turn leading to further resources and career opportunities. Consistent with this recognition theory, Ferris et al. (2003) show that superior firm financial performance significantly enhances the number of directorships subsequently held by a director. Fich (2005) also finds that the CEOs of better-performing firms hold more outside directorships and are more likely to be outside directors of firms with high growth or more institutional ownership. Harford and Schonlau (2013) find that the labor market not only cares about merger performance but also about merger experiences – CEOs who have done more deals hold more directorships. Yermack (2004) offers evidence showing that company directors care about their reputation. His evidence suggests that the possibility of obtaining additional outside directorships is a significant performance incentive for company directors. Further, directors leave their post in under-performing firms pro-actively to protect their reputation.

The labor market also disciplines managers by means of *ex post* settling up. The *extant* literature shows that poor on-the-job performance severely damages a CEO's reputation on the director labor market (Fama and Jensen, 1983; Lehn and Zhao, 2006). Kaplan and Reishus (1990) use dividend payment as a measure of performance and find executives who are not able to sustain the level of dividends lose outside directorships in the subsequent years. Gilson (1990) finds that directors who resign from bankrupt firms lose their directorships in other firms. Harford (2003) observes that executives and directors are rarely retained after their companies have been taken

over and they rarely obtain outside directorships elsewhere subsequently. Fich and Shivdasani (2007) examine a sample of firms facing financial-fraud lawsuits and find outside directors of these firms lose their directorships with other firms. Coles and Hoi (2003) find that outside directors' poor decisions with regard to opting out of state-level anti-takeover provisions subsequently lead to the loss of their outside directorships.

Overall, the above evidence demonstrates that the labor market for outside directors is an institution responsive to the candidate directors' on-the-job performance. CEOs care about their reputation and related opportunities (Yermack, 2004; Coles and Hoi, 2003), and the labor market provides incentive and discipline for CEOs to deliver satisfactory on-the-job performance.

4.2.3 Potential benefits of appointing socially responsible CEOs as outside directors

There are three potential benefits of appointing external CEOs as outside directors, namely advisory benefits, enhanced board monitoring, and certification effects. In this section, we further discuss how a CEO's expertise in managing CSR can benefit the appointing firm through these three channels.

In recent years, the unprecedented attention on CSR has taken a firm's business decisions beyond the conventionally perceived scope of capitalism. According to the contract theory, a company is a nexus of contracts between shareholders and stakeholders (Alchian and Demsetz, 1972; Coase, 1937; Cornell and Shapiro, 1987; Hill and Jones, 1992; Jensen and Meckling, 1976). Therefore, managing a firm's CSR activities appropriately to engage stakeholders can potentially enhance firm value. Such skills are not easily acquired because they involve an in-depth understanding of the subtle demands of stakeholders, of the balance between the stakeholders' interests and those of the shareholders, and of how to mobilize resources towards maximizing shareholder value through engaging with stakeholders. Therefore, the incumbent management needs external advice on CSR related decisions. Socially responsible CEOs have gained valuable skills in managing environmental, social and governance (ESG) risk and conducting good CSR practice through their experience at their own

firms. Appointing such CEOs onto the board helps the appointing firm acquire scarce CSR expertise and in turn enhances firm value.

Existing literature argues that the positive impact of CSR on firm value is conditioned on the strength of a firm's corporate governance (e.g., Ferrell et al. (2016), Krüger (2015), and Masulis and Mobbs (2014)). When a firm is not well governed, managers may invest in CSR to pursue their own private benefits, for instance, to enhance their personal public image, or to establish their personal relationships with stakeholders. Therefore, by appointing socially responsible CEOs onto the board, a firm can enhance its board monitoring on CSR related activities and lead to better value impact of CSR engagements. For example, socially responsible CEO-directors help the board better understand CSR criteria and enable the board to integrate CSR criteria into the assessment of executive performance as well as compensation decisions.

The last possible benefit of appointing socially responsible CEO-directors is the certification benefit. Because the number of socially responsible CEOs available on the labor market is limited and these CEOs particularly care about their reputation, the appointment of such CEOs can certify a firm's quality and performance, especially in the CSR aspect. This enhanced reputation can provide firm with improved trustworthiness between a firm and both its stakeholders and investors (Lins et al., 2017). In addition, given the recent trend of integrating CSR criteria into institutional investors' investment process (see Edmans (2011), Renneboog et al. (2008a), and Renneboog et al. (2008b)) and the anecdotal evidence that institutional investors follow outside directors they trust to make investment decisions (Dahya and Herron, 2017), the appointment of socially responsible CEO-directors can also facilitate the firm attracting external investors.

4.2.4 Hypotheses

If the labor market for outside directors is an effective external institution that rewards CEO skills and penalizes misconduct, and if the capability of engaging stakeholders via CSR is a valuable management skill for shareholders' value maximization, there should be a positive relation between a CEO's on-the-job CSR performance and the

likelihood and number of her outside directorships. In particular,

H1 (a): *A CEO's probability of holding outside directorships is positively related to her own firm's CSR performance.*

H1 (b): *The number of outside directorships held by a CEO is positively related to her own firm's CSR performance.*

Booth and Deli (1996) and Kaplan and Reishus (1990) maintain that outside directorships reflect a CEO's reputation on the labor market as well as her willingness to accept outside directorships. Fahlenbrach et al. (2010) also formulates a matching theory where better-skilled CEOs have more opportunities to choose from and, ultimately, they are matched to more prestigious firms as outside directors. We use the average size (total assets), profitability (ROA), and CSR performance (the adjusted CSR score) of those firms where CEOs hold outside directorships to measure the prestige attached to CEO directorships. We hypothesize that,

H1 (c): *The prestige of the outside directorships held by a CEO is positively related to her own firms' CSR performance.*

The discussions in section 4.2.1, taken together, suggest that the agency problem may inflate the CEO's on-the-job CSR performance. The extent to which CSR is aligned with shareholders' interests are *ex ante* undetermined because of such agency costs. The relation between the CEO's on-the-job CSR score and her outside directorships, therefore, is conditioned on the strength of her own firm's corporate governance. Stronger corporate governance indicates that CSR is better aligned with shareholders' interests. This leads to the following hypothesis:

H2 (a): *The positive relation between a firm's CSR performance and the probability of its CEO holding outside directorships is stronger when this firm has better governance.*

H2 (b) *The positive relation between a firm's CSR performance and the number of its CEO's outside directorships is stronger when this firm has better governance.*

4.3 Data and sample

4.3.1 The panel data

We use a panel data set to estimate the likelihood and the number of CEO outside directorships. We obtain the information on CEOs and directors from the BoardEX database. The BoardEx database provides detailed information on individuals, such as age, education, employment history, and their roles on the board. Our initial sample consists of the firms that have ever been a constituent of the S&P 1500 index during the period 2000–2010 and have been included in the BoardEX database, excluding financial and utilities firms (SIC codes 6000−6999 and 4900−4999).[5] We also require all the firm characteristics and stock price data used in our analyses to be available from Compustat and the Centre for Research in Security Prices (CRSP). This gives an initial sample of 9,211 firm-year observations. We then gather data on firm-level CSR performance from the MSCI ESG Stats (formerly KLD) Database, which leaves 5,842 firm-year observations. Finally, we exclude the firms that are headquartered outside of the U.S. as we need U.S. county-level Census data to construct our instrumental variables. Our final sample consists of 775 firms, 5,595 firm-year observations and 1,259 CEOs.

4.3.2 Data on outside director appointments

We collect a sample of events where firms appoint external CEOs as their outside directors. We use this sample to analyze the stock market reaction to the appointment of outside directors. We first use the director tenure information from the BoardEX database to find the appointment year. This yields 448 director appointments during 2000−2010. We then require all data needed for our analyses to be available from the MSCI ESG Stats, BoardEx, Compustat and CRSP databases for the period covering three years before to three years after the appointment. The data required

[5]Our sample ends in 2010 as we need to control for the effect of firm innovativeness on CEO outside directorships (Gao, Garrett, and Xu, 2016). We rely on the patent data compiled by Kogan, Papanikolaou, Seru, and Stoffman (2017), which, compared to alternative data sources, offers the neatest matching between the patents and the companies covered in CRSP. Their data ends in 2010.

for the analysis include firm characteristics (CSR ratings, total assets, return on assets, the E-index, and patent count), board characteristics (committee composition, and director tenure), and CEO characteristics (age, education, and tenure). This leaves 336 director appointments. We collect the exact announcement days from the BoardEx announcement database and Factiva.[6] We eliminate those events in which the appointment day is neither in BoardEx nor in Factiva. We further exclude those appointment announcement days that coincide with other major corporate events such as mergers and acquisitions, seasoned equity offerings, dividend announcements, financial report announcements and the announcement of executives or other directors. This selection process offers a final sample of 95 appointments.

4.3.3 Measures of firm CSR performance

We measure a firm's CSR performance using the scores constructed from the MSCI ESG Stats database. This database provides ratings on environmental, social and governance (ESG) matters for the (approximately) 3,000 largest U.S. firms. It has been widely used in academic studies on CSR (see, among others, Di Giuli and Kostovetsky (2014); Hong, Kubik, and Scheinkman (2012); Krüger (2015); Lins et al. (2017); Servaes and Tamayo (2013); Deng et al. (2013)). MSCI ESG Stats evaluates a firm's CSR performance using seven major categories: environment, community, diversity, employee relations, human rights, product and corporate governance. We focus on the first five categories which can be thought of as the social and environmental categories. Following Lins et al. (2017) and Servaes and Tamayo (2013), we exclude the "product" and "governance" categories since several elements in the product category (product quality, safety, and innovation) are outside the scope of CSR. The "governance" category is excluded because the MSCI ESG Stats database measures of governance do not strictly deal with CSR issues; they also differ from the traditional concept of corporate governance (see also Hong et al. (2012) and Krüger (2015)).[7]

MSCI ESG Stats provides both strength scores and controversy scores for each CSR

[6]The BoardEx announcement dataset contains the days on which the directors appointments are announced.

[7]As a robust check, we repeat our analysis, including the "product" and "governance" categories in our tests. Our findings remain qualitatively unchanged.

category.[8] As the number of strengths and controversies for most categories varies over time and across categories, it is difficult to compare the CSR performance over time or across categories. A simple sum of net scores (i.e., strengths minus controversies) across the five CSR categories does not therefore suit our purpose. Following Deng et al. (2013), Lins et al. (2017) and Servaes and Tamayo (2013), we construct an adjusted CSR measure that takes into account strengths, controversies and the change in the maximum number of strengths and controversies of each category over time. In particular, we first scale the strength and controversy scores for each of the five categories by their respective total number of strengths and controversies in a year. This approach gives an equal weight to each category, allowing us to compare the CSR performance across years and categories. Then, to construct the net adjusted CSR score (Net Adjusted CSR Score), we subtract the scaled controversy score from the scaled strength score of each category and sum up the net scores of the five categories. We also use the sum of adjusted strength scores (Adjusted CSR Score (Strength)) and the controversy scores separately (Adjusted CSR Score (Controversy)) to examine their respective impact on CEO directorships, which gives us more nuanced evidence about the reward and penalty imposed by the director labor market on CEOs' CSR performance.

4.3.4 Measures of a CEO's outside directorships

We use the number count of the outside directorships held by a CEO to proxy for her attractiveness and prestige on the labor market for outside directors. The data is from BoardEx. We first identify all the CEOs of U.S. firms that have ever appeared in the S&P 1500 index. If a CEO appears on the board of any other S&P 1500 firms as an outside director in a given year, we add one to the number of outside directorships for this CEO in that year. One possible issue is that BoardEX keeps adding new companies to the database. Thus, the number of outside directorships recorded in the database may increase because more firms are covered in the database rather than a

[8] In addition to the seven major categories, ESG Stats also provides controversy scores on six industries that they consider controversial: alcohol, gambling, firearms, military, nuclear, and tobacco. We do not include these in our tests because they are industry-specific measures. However, we control for industry effects in all our tests. When we include these six additional controversy scores in our tests, our findings remain qualitatively unchanged.

CEO gaining more outside board memberships. To overcome this, we only include a CEO's outside board membership for firms that have ever appeared in the S&P 1500 index.

4.4 CSR performance and CEO outside directorships: the baseline results

4.4.1 Main analysis

Our primary hypothesis says there is a positive relation between CSR performance and the likelihood and number of a CEO's outside directorships. This positive relation builds on the argument that a CEO's experience and expertise in engaging stakeholders are essential human capital valued on the director labor market. Since the stakeholders possess valuable resources that a firm requires for its success, a CEO's expertise adds value for the shareholders.

In Table 4.2, we present summary statistics for the variables used in our analysis. Our univariate tests show that 36.3% of the CEOs from the firms with a positive Net Adjusted CSR Score hold outside directorships and, on average, they hold 0.463 outside directorships each. In contrast, only 25.3% of the CEOs from those firms with a zero or negative Net Adjusted CSR Score hold outside directorships, which is significantly lower, and these CEOs on average only hold 0.339 outside directorships, also significantly less. This preliminary univariate result is in line with our hypothesis. In Table 4.2, we further show that the firms with better CSR performance are larger, more mature, with more growth opportunities and less financially distressed (with more cash holdings and lower leverage). This is similar to the findings of Ferrell et al. (2016), Hong et al. (2012) and Liang and Renneboog (2017), among others. Similar to Borghesi, Houston, and Naranjo (2014), we observe that younger and better-educated CEOs have better CSR performance. The firms with positive net adjusted CSR scores also have smaller boards and a higher incidence of CEO duality, hinting not all activities that enhance CSR are in line with shareholders interests (Bénabou and Tirole, 2010; Cheng et al., 2016; Masulis and Reza, 2014; Krüger, 2015).

To better quantify the relation between CSR performance and CEOs' outside directorships, we estimate the following baseline model:

$$\begin{aligned} &\textit{Measures of CEO outside directorships}_{i,t+1} = \\ &\qquad \alpha + \beta_1 \textit{Net Adjusted CSR Score}_{i,t} + \beta_2 \textit{Controls}_{i,t} \\ &\qquad + \sigma \textit{INDDUM}_i + \gamma \textit{YDUM}_i + \epsilon_{i,t}, \end{aligned} \tag{4.1}$$

where i indexes firms and t indexes years. The dependent variable is a measure of a CEO's outside directorships. We use both Probit and Tobit models to estimate equation (4.1). We use the Probit model to estimate the likelihood of a CEO holding outside directorships. The dependent variable is a binary variable which is one if a CEO holds at least one outside directorship in a year and zero otherwise. Following Booth and Deli (1996), we also use the Tobit model to estimate the number of outside directorships held by a CEO, because the distribution of the dependent variable is left-censored.[9] *Controls* is a vector of control variables, *YDUM* is a vector of year dummy variables, with each element indicating a year during the period 2000–2010, and *INDDUM* is a vector of industry dummy variables defined using the Fama-French 12-industry classification. Definitions of all the variables can be found in Table 4.1.

We control for a variety of variables that previous studies have identified as important factors affecting a CEO's outside directorships. Booth and Deli (1996) find that the CEOs from larger firms or those firms with fewer growth opportunities hold more outside directorships. They postulate that larger firms benefit more from building well-bonded relationships through having their CEOs on other firms' boards. The CEOs of larger firms are also more attractive on the labor market because they are in a better position to certify the quality of the appointing firms or provide resources or information to these firms. The CEOs of firms with fewer growth opportunities hold more outside directorships because they have lower opportunity cost attached to devoting their effort elsewhere.

Other firm characteristics such as firm age, location and governance structure have also been shown to influence outside directorships. Fahlenbrach et al. (2010) argue

[9]We cannot use Poisson regressions or negative binomial regressions in this case because the number of outside directorships held by a CEO in each year is not independent over time.

that the CEOs of more mature firms have delegated more of their authority to younger managers and, therefore, are more likely to accept outside directorships. This is because they have lower opportunity costs in relation to their time. Knyazeva, Knyazeva, and Masulis (2013) observe that the number of qualified local firms has a strong impact on a firm's board appointment process. It imposes lower costs on a CEO to serve on the board of a local firm because of the lower costs related to information acquisition, commuting and coordination. For the same reasons, the cost on a firm is also lower when it has outside directors from the locale. Therefore, the CEOs of firms located close to a larger pool of qualified firms are likely to have more outside directorships. In terms of the governance structure, Booth and Deli (1996) suggest that board size, CEO duality and the number of board interlocks play important roles in deciding a CEO's outside directorships. Board size and CEO duality (i.e., the CEO also serves as the chairman) are measures of monitoring intensity and the strength of shareholder rights. The number of board interlocks reflects a firm's tendency to build bonded relationships with other firms.

The *extant* literature also underscores the impact of expertise on a CEO's outside directorships (Coles, Daniel, and Naveen, 2008; Dalton, Daily, Johnson, and Ellstrand, 1999; Hermalin and Weisbach, 1988). It shows that those CEOs with special expertise are particulary sought after as outside directors to provide monitoring or counseling. For instance, recent literature highlights the importance of industrial expertise (Dass, Kini, Nanda, Onal, and Wang, 2014; Faleye, Hoitash, and Hoitash, 2018; Masulis, Ruzzier, Xiao, and Zhao, 2012; Wang, Xie, and Zhu, 2015), innovation leadership (Gao et al., 2016), financial expertise (Güner, Malmendier, and Tate, 2008), and political experience (Goldman, Rocholl, and So, 2009).

A firm's CSR performance may be related to unobserved variables that also affect CEO outside directorships, therefore leading to a spurious correlation. To address this potential endogeneity issue, we adopt an instrumental variable approach. Following several previous studies (for example Attig et al. (2013), Benlemlih and Bitar (2015), and Bhandari and Javakhadze (2017)), we instrument the Net Adjusted CSR Score by the initial level of a firm's Net adjusted CSR Score calculated from the MSCI ESG Stats database in the first year of coverage. This initial level satisfies the relevance

criteria because firms invest in CSR with a long-term perspective (Bénabou and Tirole, 2010). Krüger (2015) also finds the CSR score constructed from the MSCI ESG Stats database are autocorrelated over time. This score not only incorporates the latest CSR information but also contains information from previous years. As a result, a firm's initial level of Net Adjusted CSR Score should be positively correlated with the current Net Adjusted CSR Score. Our statistical test in Table 4.4 verifies the relevance of the initial level – in Model 3 of Table 4.4 where we estimate the first stage of the IV regression, the Initial Net Adjusted CSR Score has a coefficient of 0.657 and is significant at the 1% level. The Adjusted R^2 of Model 3 is as high as 0.443. In un-tabulated results, we use the Cragg-Donald Wald F-test to test for weak identification. The test statistics are higher than the critical value of a 10% maximal IV relative bias in all specifications, rejecting the null hypothesis that our instrument is weak. In terms of the exclusion criteria, it is hard to argue the labor market for outside directors emphasizes a firms's initial CSR level when hiring or firing an outside director, given the market has the current CSR score. Therefore, this IV is likely to affect a CEO's outside directorships only through the current Net Adjusted CSR Score, satisfying the exclusion criterion.

In Panel A of Table 4.3, we report our regression estimates from Equation (4.1), with and without using the IV approach. Models 1 and 2 present the estimates from the Probit model and the Tobit model respectively, without using the IV approach. We find the coefficient on the Net Adjusted CSR Score is positive and significant at the 1% level in both models. the estimates show that a one standard deviation increase in the Net Adjusted CSR Score leads to a 1.6% increase in a CEO's probability of holding outside directorships and a 0.067 increase in the number of outside directorships held by a CEO. This effect is economically significant given that the proportion of CEOs holding outside directorships in our sample is 28.6% and the average number of outside directorships held by a CEO is 0.376.

In Models 3 through 5, we report results from the Probit model and the Tobit model estimated using the IV approach. We find that the positive relation between CSR performance and the measures of CEO outside directorships is robust to controlling for the potential endogeneity bias discussed above. In Models 4 and 5, the magnitudes

of the coefficient on the Net Adjusted CSR Score is similar to those reported under Models 1 and 2 respectively. The significance level of the coefficient is at 1%.

To further validate our results, we repeat the IV procedure using an alternative IV – Democratic votes. Democratic votes is defined as the percentage of vote for Democratics during previous presidential elections in the county where a firm's headquarters is located. The county-level presidential election data is obtained from the United States Census Bureau website. We use Democratic votes because, as suggested by Di Giuli and Kostovetsky (2014) and Rubin (2008), firms located in Democratic-leaning counties or states tend to have a higher commitment to CSR. We measure Democratic votes at the county level because we believe the rural areas have a stronger communal effect (Vercammen and Fulton, 1990). In Panel B of Table 4.3, we present the results based on this alternative IV. In the first-stage regression, Democratic votes has a significantly (at the 1% level) positive coefficient of 0.129. In the second-stage regressions, we obtain the results that are qualitatively the same as those reported in Models 4 and 5 of Penal A of Table 4.3.

4.4.2 Do CEOs with better CSR performance hold outside directorships in more prestigious firms?

The appointment of an outside director is the outcome of a matching process occurring between the individuals and firms (Hermalin and Weisbach, 1998) . Booth and Deli (1996) and Kaplan and Reishus (1990) also point out that outside directorships are determined not only by a CEO's skills and reputation but also by her opportunity cost of serving on another firm's board. Therefore better skilled CEOs are likely to join more prestigious boards (which offer better reputation and opportunities) to compensate for their opportunity costs due to less time spent in their own firms (Fahlenbrach et al., 2010). According to Booth and Deli (1996), Kaplan and Reishus (1990), and Fahlenbrach et al. (2010), the simple count of outside directorships neglects the level of prestige associated with each directorship. Thus, our analysis in Section 4.4.1 cannot fully establish the association between CSR performance and the prestige attached to a CEO's outside directorships.

In this section, we use the appointing firm's size (measured by total assets), profitability (measured by the return on assets, ROA) and CSR performance (adjusted CSR score) to proxy for the level of prestige attached to each outside directorship. We use a set of multinomial Probit regressions to establish the relation between the CEO's on-the-job CSR performance and the prestige attached to the directorships held by this CEO. In the multinomial Probit regressions, the dependent variable is zero if a CEO does not hold any outside directorships (the base case), one if the CEO holds outside directorship(s) and the average total assets or ROA or adjusted CSR of the appointing firms is less than the sample median, and two if the average is higher than the sample median. The results are presented in Table 4.4. In Models 1 through 3, we show that the CEOs of those firms with a higher Net Adjusted CSR Score tend to hold outside directorships on the boards of larger, better performing or more socially responsible firms, rather than holding no outside directorships. For example, in Model 1, the coefficient on the Net Adjusted CSR Score is 0.321 in the regression of $Y = 2$ (i.e., holding directorships with large firms), and statistically significant at the 1% level ($p = 0.000$). A one standard deviation increase in the adjusted CSR score leads to an increase of 2.38% in the probability that a CEO serves on the board of a large firm relative to holding no directorships. This effect is economically large given that only 13.54% of our sample CEOs serve on large firms' boards. The coefficient on the Net Adjusted CSR Score in the regression of $Y = 1$ (i.e., holding directorships with small firms) is positive but statistically insignificant. Therefore, the tendency for a socially more responsible CEO to hold directorships with small firms is not significantly higher than her probability of holding no directorships. The results from Models 2 and 3 can be interpreted in a similar fashion. In Models 4 through 6, we re-estimate these multinomial Probit models using the IV approach, where the initial level of Net Adjusted CSR Score is the instrument. Our findings remain qualitatively the same. Overall, these results show that those CEOs with better CSR performance hold directorships on more prestigious boards.

4.4.3 Analysis on the effects of strength and controversy scores

We have shown that the CEOs from firms with a higher Net Adjusted CSR Score are more prestigious on the labor market. In this section, we proceed to examine whether it is the strengths or the controversies that cause our previous results. To do this, we decompose the Net Adjusted CSR Score into the Adjusted CSR Score (Strength) and the Adjusted CSR Score (Controversy), and re-estimate our models in section 4.4.1 and 4.4.2. The only change here is that we use the Adjusted CSR Score (Strength) and the Adjusted CSR Score (Controversy) instead of the Net Adjusted CSR Score. Table 4.5 reports the results from these Probit and Tobit regressions.

In Panel A and B of Table 4.5, we include Adjusted CSR Score (Strength) and Adjusted CSR Score (Controversy) separately in the regressions while in Panel C we include them together. The results in Panel B indicate that the CEOs of those firms with more CSR controversies receive reputational penalties on the labor market – a higher Adjusted CSR Score (Controversy) is associated with a lower likelihood of a CEO holding outside directorships (the Probit model) or less outside directorships (the Tobit model). Specifically, the coefficient on Adjusted CSR Score (Controversy) is negative and significant at the 1% level in both the Probit model (-0.165) and the Tobit model (-0.270). These coefficients do not change qualitatively when we use the IV approach (-0.477 in the instrumented Probit model and -0.763 in the instrumented Tobit model). In Panel A, The coefficient on the Adjusted CSR Score (Strength) is positive but insignificant. When we use the IV approach, with the initial level of Adjusted CSR Score (Strength) as the instrument, the coefficient on the Adjusted CSR Score (Strength) is 0.265 and significant at the 5% level in the Probit model (Model 3). The coefficient is 0.234 and marginally significant at the 10% in the instrumented Tobit model (Model 4). In Panel C, we note the coefficient on the Adjusted CSR Score (Strength) is 0.321 under the instrumented Probit model and 0.311 under the instrumented Tobit model, both being significant at the 1% level. At the same time, the coefficient on the Adjusted CSR Score (Controversy) is -0.534 and -0.815 under the instrumented Probit and instrumented Tobit model respectively, both being significant at the 1% level. Taken together, the results in Table 4.5 confirm

the view that the labor market for outside directors rewards superior CSR performance as well as penalizes inferior CSR performance.

In Table 4.6, we present the results from the multinomial Probit regressions. Again, we use the appointing firm's size, profitability (ROA) and CSR performance as proxies for the level of prestige associated with outside directorships. We estimate both instrumented (Models 1-3) and uninstrumented models (Models 4-6). A careful inspection of the results reveals several differences in terms of the statistical significance between the instrumented and non-instrumented results, although largely the coefficients have the same sign. For example, in Model 1 of Panel A (the uninstrumented Probit model relating to size), the coefficient on Adjusted CSR Score (Strength) is positive (0.191) for large appointing firms but insignificant at conventional levels; the same coefficient is positive (0.573) and statistically significant at the 1% level in Model 4 (the instrumented Probit model). This confirms our earlier concern that endogeneity may introduce bias to our estimates. To ensure our interpretations are robust to the potential endogeneity bias, we focus on the results from the instrumented multinomial Probit regressions. In Model 4, we find the Adjusted CSR Score (Strength) significantly and positively impacts outside directorships with large firms and the Adjusted CSR Score (Controversy) has a significantly negative impact. These results persist whether or not we include the strength scores and controversy scores separately or jointly in the regressions. To see this, look at Model 4 in Panel C. The coefficient on the Adjusted CSR Score (Strength) is 0.646 and statistically significant at the 1% level while the coefficient on the Adjusted CSR Score (Controversy) is -0.800 and significant at the 1% level. In Model 5 and 6, we find similar results for the appointing firms with higher profitability (ROA) and higher CSR performance. In summary, the results in this section reveal that both the CSR strength and controversies are important and significant factors for a CEO's reputation and attractiveness on the director labor market. Further, more prestigious firms (larger, more profitable and more socially responsible) are more sensitive to a CEO's CSR skills when selecting their outside directors. This is probably due to these more prestigious firms have more stakes in having good relationships with their stakeholders. Since we rely on the IV approach, our results suggest the causality goes from a CEO's CSR skills to outside directorships.

4.4.4 Corporate governance and the effect of firm CSR performance on CEO outside directorships

As explained earlier in Section 4.2.1, a CEO may reap private benefits from investing in CSR (Bénabou and Tirole, 2010; Cheng et al., 2016; Masulis and Reza, 2014; Krüger, 2015). Our second hypothesis (H2) claims that the positive effect of a CEO's CSR performance on her outside directorships is conditional on the strength of her own firm's corporate governance. If the labor market for outside directors is instituted to enhance the appointing firms' shareholder value, firms hiring on this market would be cautious about the co-existence between a CEO's superior CSR performance and a weak corporate governance system. To test H2, we include a Weak Governance Dummy and interact it with the Net Adjusted CSR Score in our Probit and Tobit models. Following several earlier studies (Bebchuk et al., 2009; Gompers, Ishii, and Metrick, 2003; Jensen, 1993; Masulis and Reza, 2014; Perry and Peyer, 2005), we use the fraction of independent directors and the E-index as proxies for the strength of the CEO's own-firm corporate governance. The Weak Governance Dummy is one if a firm's fraction of independent directors is in the bottom tercile of the sample firms or if a firm's E-index is in the top tercile and zero otherwise. The model specification is as follows:

$$\begin{aligned} \textit{Measures of CEO outside directorships}_{i,t+1} = \\ \alpha + \beta_1 \textit{Net Adjusted CSR Score}_{i,t} \times \textit{Weak Governance Dummy}_{i,t} \\ + \beta_2 \textit{Net Adjusted CSR Score}_{i,t} + \beta_3 \textit{Weak Governance Dummy}_{i,t} \\ + \beta_4 \textit{Controls}_{i,t} + \sigma \textit{INDDUM}_i + \gamma \textit{YDUM}_i + \epsilon_{i,t}, \end{aligned} \tag{4.2}$$

where i indexes firms and t indexes years. When we use the Probit models to estimate Equation (4.2), the dependent variable is a binary variable indicating whether a CEO holds any outside directorships (one) or not (zero) . When we use the Tobit models, the dependent variable is the number of outside directorships held by a CEO. The other variables are defined earlier (see also Table 4.1.) To address the endogeneity of the interaction term, we instrument the interaction term Net Adjusted CSR Score ×

Weak Governance Dummy using the interaction of the initial level of the Net Adjusted CSR Score and the Weak Governance Dummy, as suggested by Wooldridge (2010).

We report the results in Table 4.7. We find the coefficient on the interaction term Net Adjusted CSR Score × Weak Governance Dummy is negative and significant at the 5% level or higher in all regressions. For example, in Model 4, the coefficient on Net Adjusted CSR Score × Weak Governance Dummy is −0.453 and statistically significant at the 1% level. The coefficient on Net Adjusted CSR Score itself is 0.532 and significant at the 1% level. The sum of these two coefficients is 0.075 and statistically weakly according to an F-test (not tabulated). This means a CEO's CSR performance has no effect on her outside directorships when her own firm is insufficiently governed. The strength of corporate governance plays an important role in determining the relation between CSR performance and a CEO's outside directorships. When a firm is well-governed, superior CSR performance is in line with the shareholders' interests and signals good management skills which are rewarded on the labor market for outside directors. In contrast, when firms are poorly governed superior CSR performance is likely the manifestation of agency problems and firms hiring on the director labor market exercise caution against this possibility.

4.5 The stock market reaction to director appointments

The evidence uncovered thus far suggests that superior CSR performance enhances a CEO's attractiveness and prestige on the market for outside directors. This is in line with the view that CSR performance is a signal of a CEO's unobservable skills in engaging stakeholders. Such skills are not easily acquired because they involve an in-depth understanding of the subtle demands of stakeholders, of the balance between the stakeholders' interests and those of the shareholders, and of how to mobilize resources towards maximizing shareholder value through engaging with stakeholders. Such skills are valued and in demand on the labor market for outside directors. To further confirm that better CEO on-the-job CSR performance indeed add value to those appointing

firms, we extend our analysis to examine how the stock market reacts to outside-director appointments. To do this, we follow an event study approach. In particular, we compute the cumulative abnormal returns ($CARs$) for the appointing firm over a 3-day event window (-1, $+1$) around the appointment day (day 0). We estimate the market model parameters using an estimation period from 250 days to 20 days before day 0.[10] We require there to be no missing returns in the event window (-1, $+1$) and at least 100 non-missing returns in the parameter estimation window.

Panel B of Table 4.2 presents the mean and median of the 3-day (-1, $+1$) $CARs$ for the appointing firms and the CEOs' own firms. The sample only contains 95 appointments because of the restrictions discussed in Section 4.3.2. For the sub-sample where CEOs' own firms have a Net Adjusted CSR Score greater than zero, the mean CAR is 0.591% (median 0.789%). These are much larger than the mean (0.000) and median (0.114) of the sub-sample of firms with a Net Adjusted CSR Score no greater than zero. These $CARs$ are not significantly different from zero however. The differences between the two sub-samples are not statistically significant either. This may be due to the small sample size or because we have not controlled for other factors that impact CARs.

In Table 4.9, we report the results from multivariate regressions, controlling for a comprehensive set of determinants of CAR. We use this set of regressions to examine how the CSR performance of a CEO's own firm relates to the appointing firms' $CARs$, *ceteris paribus*. We follow the previous literature and control for a comprehensive set of factors to rule out their influence on the results. Among the control variables are the characteristics of the CEOs' own-firms, namely, profitability (measured by ROA), size (measured by the natural logarithm of total assets) (Fahlenbrach et al., 2010) and innovativeness (measured by the natural logarithm of one plus the patent count)(Gao et al., 2016). We also include the appointing firm's size (Booth and Deli, 1996) and ROA (Hermalin and Weisbach, 1988) as well as the CEO's tenure and education. These regressions are estimated using the weighted-least-squares procedure (WLS) because we find evidence of heteroscedasticity in the variance of the $CARs$, which can be of particular concern for a small sample.The weights are the reciprocals of the variance of the residuals from the market model used to compute the $CARs$. To address possible

[10]Our results are robust to using a (-2, $+2$) event window or to using the value weighted CRSP all-share index as the benchmark.

endogeneity, we instrument the Net Adjusted CSR Score using the initial level of the Net Adjusted CSR Score, as in previous sections. The interaction term of the CEOs' own firms' Net Adjusted CSR Score and Strong Governance Dummy is instrumented by the interaction between the CEOs' own firms' Initial Net Adjusted CSR Score and Strong Governance Dummy.

In Models 1 and 4, we do not find a significant coefficient on CEO's on-the-job Net Adjusted CSR Score. In Model 2 and 3, however, we find the coefficient is significantly (at the 1% level) positive on the interaction term between the CEO's own-firm Net Adjusted CAR Score and the Strong Governance Dummy (0.173 when the strength of corporate governance is measured by the fraction of independent directors on the board and 0.184 when measured by the E-index). In Model 5, we repeat the estimation of Model 2 using the IV approach. The interaction term has a positive coefficient of 0.465 and is significant at the 1% level. Similarly, Model 6 repeats the estimation of Model 3 using the IV approach. The coefficient on the interaction term remains positive at 0.058 although statistically insignificant at conventional levels. Overall, we find some evidence consistent with the idea that a firm adds value for shareholders when appointing onto its board a CEO with better CSR performance. This finding is conditional on the CEO's own firm having a robust corporate governance system in place. These results are largely in line with Fahlenbrach et al. (2010) and Fich (2005) who find investors react positively to the appointment of external CEOs as outside directors. These results demonstrate that CEOs' expertise to engage stakeholders are valued externally on the market.

4.6 Conclusion

We examine whether a CEO's on-the-job CSR performance impact her reputation and career. At the heart of our analysis are two important assumptions: 1) a CEO's expertise in managing stakeholder relationship through CSR is valuable human capital and 2) those firms hiring on the labor market for outside directors aim to maximize their shareholders' value. We find a CEO's on-the-job CSR performance impacts her reputation and career. Our results imply a CEO's expertise in engaging stakeholders

through CSR is a valuable human capital. Our findings are also in line with the view that firms can "do well by doing good", a view rooted in the notions of contract theory and the theory of firms. In particular, a company is a nexus of contracts between the shareholders and the stakeholders and the stakeholders possess the valuable resources a company needs for its success (Alchian and Demsetz, 1972; Coase, 1937; Cornell and Shapiro, 1987; Hill and Jones, 1992; Jensen and Meckling, 1976). We further find the positive relation between a CEO's CSR performance and her outside directorships is conditioned on the strength of her own firm's corporate governance. This suggests those companies hiring on the labor market are mindful of the possible agency problems associated with CSR (Bénabou and Tirole, 2010; Cheng et al., 2016; Masulis and Reza, 2014; Krüger, 2015).

On policy implications, our results show that the labor market for outside directors is an effective market-based institution that provides incentives for CEOs' CSR commitment. CEOs' on-the-job social performance has meaningful impact on their reputation and opportunities on the labor market. Such a market-based institution parallels those institutions based on shareholder pressure, legislation or regulation. Therefore, the authorities may want to focus on ensuring accurate and timely CSR disclosure, reducing the search costs on the director labor market and safeguarding the fairness of the director-hiring process, a combination of which will lead to a well-functioning director labor market as an effective institution to promote CSR.

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Table 4.1: Variable Definitions

Variable	Definition	Source
CSR related variables		
Net Adjusted CSR Score	The sum of the adjusted scores across the five CSR categories from MSCI ESG Stats (community, diversity, employee relations, environment and human rights.) For each category, we construct an adjusted score by adding the adjusted strengths and subtracting the adjusted controversies. The adjusted score of strengths (controversies) for each category is computed by scaling the raw strengths (controversies) by the total number of strengths (controversies) for that category in that year.	MSCI ESG Stats
Adjusted CSR Score (strength/controversy)	The sum of adjusted strengths/controversies over the five CSR categories from MSCI ESG Stats (community , diversity, employee relations, environment and human rights.) For each category, the adjusted strengths/controversies is computed by scaling the raw strengths/controversies by the total number of strengths/controversies for that category in that year.	MSCI ESG Stats
CEO characteristics		
CEO age	–	BoardEx
CEO-Chairman duality	A dummy variable taking the value of one if a CEO is also the chairman of the board and zero otherwise.	BoardEx
CEO education	A CEO's number of qualifications at the undergraduate level and above.	BoardEx
Major committee dummy	A dummy variable taking the value of one if a CEO is appointed as an outside director serving on the audit or compensation committees and zero otherwise.	BoardEx
Outside directorships dummy	A dummy variable taking the value of one if a CEO holds outside directorship(s) in at least one of the S&P 1500 firms in a year, and zero otherwise.	BoardEx
Number of outside directorships	The total number of outside directorships held by a CEO in S&P 1500 firms during the year.	BoardEx
Firm characteristics		
Board size	The number of directors on the CEO's own board.	BoardEx
CAPEX	Capital expenditures/lagged total assets.	Compustat
Capital intensity	Net property, plant, and equipment/sales.	Compustat
Cash	Cash and marketable securities/total assets.	Compustat
Dividends	Dividends paid to common and preferred shareholders/operating income before depreciation.	Compustat
E-index	The entrenchment index defined in Bebchuk et al. (2009).	RiskMetrics
Firm age	The number of years in the CRSP-Compustat merged database.	Compustat
Patent count	The natural logarithm of one plus the number of eventually granted patents applied by the firm in a given year (Kogan et al., 2017).	
The Fraction of independent directors	The number of independent directors to the total number of directors on a firm's board.	BoardEx
Interlock	The number of board interlocks a firm has with other firms.	BoardEx
Leverage	(long-term debt + short-term debt)/total assets.	Compustat
Market-to-book	(total assets − book equity + market value of equity − deferred taxes) / total assets.	Compustat
The number of local firms	The number of U.S. nonfinancial and nonutility firms headquartered within sixty miles of the firm's headquarters, excluding firms in the same 4-digit SIC industry (Knyazeva et al., 2013).	Compustat
Return on assets (ROA)	Operating income before depreciation/lagged total assets.	Compustat
Sales growth	Current sales/lagged sales − 1.	Compustat
Strong/Weak governance dummy	A dummy variable equal to one if the value of proxies for a firm's governance quality is in the top/bottom tertile (the bottom/top tertile for the *E*-index) of all sample firms and zero otherwise.	RiskMetrics
Total assets	Book value of assets.	Compustat
Instrumental variables		
Democratic votes	The percentage of votes that the Democratic party received in the previous presidential elections from the county where a firm's headquarters is located.	US Census Bureau
The initial level of the *Net Adjusted CSR Score*	The *Net Adjusted CSR Score* of a firm in the first year recorded in the database.	MSCI ESG Stats

Table 4.2: Summary statistics

This table reports summary statistics for the variables used in our analyses. In Panel A, we present the summary statistics of the variables used in the panel regressions. In Panel B, we report the summary statistics of the 3-day (−1,+1) cumulative abnormal returns associated with the events in which the firms appoint external CEOs as their outside directors. The announcement day is day 0. Sub-sample A includes all firm-years with a zero or negative Net Adjusted CSR Score, while sub-sample B includes all firm-years with a positive Net Adjusted CSR Score. Variable definitions are in Table 4.1. A *t*-test (Wilcoxon-Mann-Whitney test) is conducted to test whether the mean (median) of sub-sample B is significantly different from that of sub-sample A. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Panel A: Summary statistics for the variables used in the panel data models

	Full sample (N = 5,590)		Subsample A: *Net Adjusted CSR Score*≤0 (N = 3,935)		Subsample B: *Net Adjusted CSR Score*>0 (N = 1,655)		Difference (B − A)	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Outside directorships dummy	0.286	0.000	0.253	0.000	0.363	0.000	0.109***	0.000***
Number of outside directorships	0.376	0.000	0.339	0.000	0.463	0.000	0.124***	0.000***
Net Adjusted CSR Score	−0.112	−0.100	−0.301	−0.286	0.338	0.250	0.638***	0.536***
Total assets (Mil.)	6164.370	1591.920	4436.750	1265.390	10272.040	2950.500	5835.290***	1685.110***
Market-to-book	2.128	1.718	2.029	1.642	2.364	1.933	0.335***	0.292***
Return on assets	0.170	0.158	0.165	0.153	0.183	0.167	0.018***	0.014***
Sales growth	0.120	0.093	0.126	0.099	0.108	0.083	−0.018***	−0.016***
Cash	0.159	0.093	0.156	0.089	0.167	0.108	0.011**	0.019***
Dividend	0.077	0.011	0.070	0.000	0.094	0.051	0.024***	0.051***
Leverage	0.197	0.187	0.199	0.190	0.195	0.177	−0.004	−0.013
Capital intensity	0.378	0.179	0.409	0.181	0.305	0.176	−0.104***	−0.005**
CAPEX	0.059	0.038	0.060	0.038	0.056	0.038	−0.004**	0.001
Firm age	26.537	21.000	24.888	19.000	30.458	27.000	5.570***	8.000***
Patent count	22.399	0.000	9.544	0.000	52.963	1.000	43.418***	1.000***
CEO tenure	10.568	7.800	10.920	8.200	9.731	7.200	−1.189***	−1.000***
CEO age	55.865	56.000	55.880	56.000	55.828	56.000	−0.052	0.000
CEO education	1.887	2.000	1.849	2.000	1.979	2.000	0.130***	0.000***
Number of local firms	157.313	117.000	147.274	115.000	181.182	135.000	33.908***	20.000***
Interlock	0.069	0.000	0.060	0.000	0.092	0.000	0.032***	0.000***
Board size	9.281	9.000	8.960	9.000	10.045	10.000	1.086***	1.000***
CEO-Chairman duality	0.689	1.000	0.674	1.000	0.726	1.000	0.051***	0.000***

Panel B: Summary statistics for CARs of appointing firms

	Full sample (N = 95)		Subsample A: *Net Adjusted CSR Score*≤0 (N = 59)		Subsample B: *Net Adjusted CSR Score*>0 (N = 36)		Difference (B − A)	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Appointing firm CAR(−1, +1) (%)	0.224	0.444	0.000	0.114	0.591	0.789	0.591	0.675
p-value	(0.571)	(0.691)	(0.999)	(0.821)	(0.352)	(0.814)	(0.470)	(0.659)

Table 4.3: CSR performance and CEO outside directorships: panel regressions

This table reports the results from the Probit and Tobit estimations, with and without using the IV approach. In Panel A, we report both the un-instrumented results and the results instrumented by the initial level of the Net Adjusted CSR Score measured in the first year of data coverage. In Panel B, we report the results instrumented by Democratic Votes. In Models (1) and (4), the dependent variable is one if a CEO holds at least one outside directorship in year $t+1$ and zero if not. In Models (2) and (5), the dependent variable is the number of outside directorships held by a CEO in year $t+1$. All independent variables are lagged by one year relative to the dependent variable. The dependent variable in Model (3) is the Net Adjusted CSR Score in year t. The instrumented second-stage results are reported in Models (4) and (5) of Panel A and Models (7) and (8) of Panel B. The variable definitions are in Table 1. The standard errors are robust to heteroskedasticity and within industry and year clustering. The industry classification is based on the Fama-French 12-industry specification. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Panel A: Uninstrumented results and results instrumented with initial CSR score.

	Probit	Tobit		IV-Probit	IV-Tobit
			First stage	Second stage	Second stage
	(1)	(2)	(3)	(4)	(5)
Net Adjusted CSR Score	0.166***	0.214***		0.442***	0.579***
	(0.003)	(0.004)		(0.000)	(0.000)
Initial Net Adjusted CSR Score			0.657***		
			(0.000)		
ln(Total assets)	0.232***	0.327***	0.010	0.224***	0.318***
	(0.000)	(0.000)	(0.242)	(0.000)	(0.000)
Market-to-book	−0.034	−0.037	0.005	−0.038	−0.042
	(0.150)	(0.313)	(0.256)	(0.116)	(0.257)
Return on assets	0.108	−0.055	0.236***	0.013	−0.184
	(0.693)	(0.887)	(0.000)	(0.962)	(0.635)
Sales growth	−0.074	−0.079	−0.047***	−0.052	−0.054
	(0.480)	(0.609)	(0.007)	(0.611)	(0.721)
Cash	0.010	0.012	0.066*	0.007	0.008
	(0.955)	(0.961)	(0.052)	(0.966)	(0.974)
Dividends	−0.231	−0.467*	−0.065**	−0.242	−0.484*
	(0.189)	(0.067)	(0.032)	(0.174)	(0.062)
Leverage	−0.329**	−0.525***	−0.121***	−0.299**	−0.495**
	(0.013)	(0.007)	(0.000)	(0.023)	(0.012)
Capital intensity	−0.125**	−0.155**	0.005	−0.131***	−0.165**
	(0.021)	(0.046)	(0.608)	(0.009)	(0.022)
CAPEX	0.573	0.668	0.085	0.502	0.585
	(0.209)	(0.317)	(0.319)	(0.269)	(0.385)
ln(Firm age)	0.260***	0.345***	−0.001	0.258***	0.344***
	(0.000)	(0.000)	(0.911)	(0.000)	(0.000)
ln(1 + Patent count)	0.014	0.002	0.032***	−0.001	−0.020
	(0.490)	(0.952)	(0.000)	(0.954)	(0.459)
ln(CEO tenure)	0.069***	0.106***	0.004	0.067***	0.104***
	(0.002)	(0.000)	(0.302)	(0.002)	(0.000)
ln(CEO age)	0.678***	1.001***	−0.013	0.693***	1.022***
	(0.001)	(0.001)	(0.648)	(0.001)	(0.000)
CEO education	0.118***	0.168***	0.003	0.118***	0.169***
	(0.000)	(0.000)	(0.605)	(0.000)	(0.000)
ln(1 + Number of local firms)	0.023	0.032	−0.002	0.020	0.029
	(0.135)	(0.147)	(0.408)	(0.189)	(0.200)
Interlock	1.154***	1.236***	−0.003	1.149***	1.234***
	(0.000)	(0.000)	(0.826)	(0.000)	(0.000)
Board size	−0.020	−0.025	0.012***	−0.025**	−0.032*
	(0.131)	(0.168)	(0.000)	(0.050)	(0.071)
CEO-Chairman duality	0.001	−0.008	−0.016*	0.004	−0.005
	(0.985)	(0.904)	(0.057)	(0.930)	(0.944)
Industry and year effects	Yes	Yes	Yes	Yes	Yes
Observations	5,590	5,590	5,590	5,590	5,590
Adjusted R^2	0.181	0.116	0.443	-	-

Table 4.3 (Continued)

Panel B: Results instrumented by Democratic votes			
		IV-Probit	IV-Tobit
	First stage	Second stage	Second stage
	(6)	(7)	(8)
Net Adjusted CSR Score		2.010***	3.168*
		(0.000)	(0.066)
Democratic votes	0.129***		
	(0.000)		
ln(Total assets)	0.027**	0.116	0.237***
	(0.013)	(0.101)	(0.002)
Market-to-book	0.011**	−0.049**	−0.074*
	(0.026)	(0.019)	(0.081)
Return on assets	0.334***	−0.545*	−1.032
	(0.000)	(0.074)	(0.176)
Sales growth	−0.081***	0.098	0.161
	(0.001)	(0.357)	(0.477)
Cash	0.025	−0.067	−0.107
	(0.530)	(0.608)	(0.672)
Dividend	0.036	−0.245	−0.583*
	(0.342)	(0.125)	(0.068)
Leverage	−0.137***	0.026	−0.099
	(0.000)	(0.889)	(0.770)
Capital intensity	0.015	−0.117***	−0.191***
	(0.471)	(0.002)	(0.003)
CAPEX	0.248**	−0.043	−0.074
	(0.027)	(0.910)	(0.918)
ln(Firm age)	0.007	0.176***	0.316***
	(0.428)	(0.000)	(0.000)
ln(1 + Patent counts)	0.054***	−0.086**	−0.149
	(0.000)	(0.021)	(0.122)
ln(CEO tenure)	0.006	0.041	0.090***
	(0.205)	(0.114)	(0.010)
ln(CEO age)	−0.049	0.580***	1.119***
	(0.188)	(0.001)	(0.001)
CEO education	−0.002	0.092***	0.174***
	(0.742)	(0.001)	(0.000)
ln(1 + Number of local firms)	0.000	0.006	0.015
	(0.912)	(0.687)	(0.609)
Interlock	0.004	0.855***	1.225***
	(0.799)	(0.000)	(0.000)
Board size	0.020***	−0.053***	−0.085**
	(0.000)	(0.000)	(0.019)
CEO-Chairman duality	−0.022**	0.040	0.052
	(0.046)	(0.322)	(0.502)
Year and industry effects	Yes	Yes	Yes
Observations	5,590	5,590	5,590
Adjusted R^2	0.209	-	-

Table 4.4: CSR performance and CEO outside directorships: multinomial Probit regressions

This table reports the results from multinomial Probit regressions, with and without using the IV approach. The dependent variable is zero if a CEO doesn't hold any outside directorship in year $t+1$, one if the average total assets (in Models 1 and 4), ROA (in Models 2 and 5) or Net Adjusted CSR Score (in Models 3 and 6) of the appointing firms is lower than the sample median, and two if it is higher than the sample median. All independent variables are lagged by one year relative to dependent variable. In Models (4)−(6), the Net Adjusted CSR Score is instrumented by its initial level measured in the first year of data coverage. The variable definitions are in Table 1. The standard errors are robust to heteroskedasticity and within industry and year clustering. The industry classification is based on the Fama-French 12-industry specification. The *p*-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

							Instrumented					
	Size		ROA		CSR		Size		ROA		CSR	
	(1)		(2)		(3)		(4)		(5)		(6)	
	Small	Large	Low	High	Low	High	Small	Large	Low	High	Low	High
	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2
Net Adjusted CSR Score	0.015	0.321***	0.091	0.209**	0.132	0.240***	0.080	0.639***	0.257*	0.409***	0.181	0.606***
	(0.858)	(0.000)	(0.293)	(0.012)	(0.106)	(0.007)	(0.549)	(0.000)	(0.069)	(0.003)	(0.179)	(0.000)
ln(Total assets)	0.120***	0.531***	0.284***	0.293***	0.271***	0.359***	0.118***	0.524***	0.281***	0.289***	0.270***	0.350***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-book	−0.042	−0.078	−0.091**	−0.036	−0.047	−0.033	−0.043	−0.084*	−0.093**	−0.038	−0.048	−0.036
	(0.262)	(0.118)	(0.049)	(0.374)	(0.221)	(0.468)	(0.254)	(0.098)	(0.045)	(0.347)	(0.218)	(0.437)
Return on assets	−0.532	1.408**	0.018	0.220	−0.481	1.009**	−0.549	1.313**	−0.034	0.154	−0.489	0.873*
	(0.223)	(0.012)	(0.971)	(0.636)	(0.296)	(0.039)	(0.210)	(0.019)	(0.946)	(0.742)	(0.291)	(0.075)
Sales growth	−0.045	−0.229	−0.104	0.008	0.036	−0.328*	−0.039	−0.223	−0.090	0.017	0.039	−0.307
	(0.786)	(0.248)	(0.558)	(0.964)	(0.829)	(0.091)	(0.817)	(0.260)	(0.611)	(0.922)	(0.816)	(0.114)
Cash	−0.155	0.086	−0.030	−0.048	0.068	−0.242	−0.154	0.114	−0.033	−0.048	0.067	−0.250
	(0.568)	(0.808)	(0.921)	(0.873)	(0.800)	(0.481)	(0.572)	(0.747)	(0.913)	(0.873)	(0.805)	(0.467)
Dividends	−0.794***	0.169	−0.447	−0.198	−0.350	−0.485	−0.791**	0.157	−0.457	−0.204	−0.353	−0.502
	(0.010)	(0.575)	(0.128)	(0.508)	(0.206)	(0.128)	(0.010)	(0.603)	(0.120)	(0.496)	(0.202)	(0.115)
Leverage	−0.670***	−0.065	−0.222	−0.578**	−0.654***	−0.329	−0.661***	−0.045	−0.207	−0.559**	−0.648***	−0.306
	(0.003)	(0.810)	(0.349)	(0.018)	(0.004)	(0.216)	(0.004)	(0.868)	(0.384)	(0.023)	(0.004)	(0.253)
Capital intensity	−0.062	−0.366***	−0.135	−0.123*	−0.062	−0.379***	−0.061	−0.373***	−0.137	−0.129*	−0.062	−0.389***
	(0.422)	(0.000)	(0.137)	(0.099)	(0.420)	(0.000)	(0.426)	(0.000)	(0.132)	(0.081)	(0.421)	(0.000)
CAPEX	1.115*	0.977	−0.609	2.273***	0.450	1.855**	1.090	0.897	−0.667	2.248***	0.439	1.754**
	(0.098)	(0.275)	(0.452)	(0.001)	(0.511)	(0.023)	(0.105)	(0.321)	(0.413)	(0.001)	(0.520)	(0.034)
ln(Firm age)	0.336***	0.365***	0.383***	0.277***	0.339***	0.374***	0.335***	0.364***	0.384***	0.275***	0.338***	0.374***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1 + Patent counts)	0.026	−0.035	0.006	0.049*	−0.001	0.036	0.023	−0.055**	−0.003	0.037	−0.003	0.013
	(0.292)	(0.186)	(0.800)	(0.056)	(0.969)	(0.175)	(0.357)	(0.046)	(0.900)	(0.156)	(0.917)	(0.646)
ln(CEO tenure)	0.019	0.138***	0.107***	0.026	0.061*	0.110***	0.019	0.136***	0.106***	0.026	0.062*	0.110***
	(0.573)	(0.001)	(0.003)	(0.450)	(0.070)	(0.004)	(0.570)	(0.001)	(0.004)	(0.462)	(0.068)	(0.005)
ln(CEO age)	1.016***	0.973***	1.011***	0.867***	1.260***	0.357	1.020***	0.964***	1.027***	0.875***	1.261***	0.363
	(0.000)	(0.003)	(0.001)	(0.003)	(0.000)	(0.258)	(0.000)	(0.004)	(0.000)	(0.003)	(0.000)	(0.251)
CEO education	0.144***	0.157***	0.191***	0.110***	0.174***	0.116***	0.144***	0.163***	0.192***	0.112***	0.174***	0.122***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1 + Number of local firms)	0.035	0.003	0.019	0.034	0.010	0.033	0.034	0.003	0.018	0.033	0.010	0.031
	(0.140)	(0.914)	(0.428)	(0.163)	(0.650)	(0.217)	(0.146)	(0.917)	(0.453)	(0.181)	(0.657)	(0.251)
Interlock	1.610***	1.568***	1.450***	1.535***	1.550***	1.585***	1.613***	1.571***	1.453***	1.540***	1.554***	1.588***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Board size	−0.044**	−0.001	−0.011	−0.017	−0.049***	0.013	−0.046***	−0.007	−0.014	−0.021	−0.050***	0.005
	(0.012)	(0.954)	(0.550)	(0.344)	(0.004)	(0.521)	(0.010)	(0.727)	(0.441)	(0.243)	(0.004)	(0.787)
CEO-Chairman duality	−0.076	0.186**	0.077	−0.094	−0.107	0.189**	−0.076	0.191**	0.079	−0.091	−0.107	0.194**
	(0.292)	(0.026)	(0.316)	(0.216)	(0.133)	(0.026)	(0.296)	(0.023)	(0.306)	(0.228)	(0.133)	(0.023)
Industry and year effects	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	5,590		5,590		5,590		5,590		5,590		5,590	

Table 4.5: The effects of CSR strengths and controversies on CEO outside directorships: Probit and Tobit regressions

This table reports the results from the Probit and Tobit estimations of the effects of the Adjusted CSR Score (Strength) and Adjusted CSR Score (Controversy), with and without using the IV approach. In Models (1) and (3), the dependent variable is a dummy variable that is one if a CEO holds at least one outside directorship in year $t+1$ and zero if not. In Models (2) and (4), the dependent variable is the number of outside directorships held by a CEO in year $t+1$. All the independent variables are lagged by one year relative to the dependent variable. In Models (3) and (4), the Adjusted CSR Score (Strength) or the Adjusted CSR Score (Controversy) is instrumented by its initial level measured in the first year of data coverage. The variable definitions are in Table 1. The standard errors are robust to heteroskedasticity and within industry and year clustering. The industry classification is based on the Fama-French 12-industry specification. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

	Probit	Tobit	IV-Probit	IV-Tobit
	(1)	(2)	(3)	(4)
Panel A: CSR strengths				
Adjusted CSR Score (Strength)	0.082	0.030	0.265**	0.234*
	(0.294)	(0.743)	(0.014)	(0.077)
Adjusted R^2	0.180	0.115	-	-
Panel B: CSR controversies				
Adjusted CSR Score (Controversy)	−0.165***	−0.270***	−0.477***	−0.763***
	(0.008)	(0.002)	(0.000)	(0.000)
Adjusted R^2	0.181	0.116	-	-
Panel C: CSR strength and controversy				
Adjusted CSR Score (Strength)	0.105	0.066	0.321***	0.311**
	(0.181)	(0.476)	(0.005)	(0.021)
Adjusted CSR Score (Controversy)	−0.177***	−0.278***	−0.534***	−0.815***
	(0.005)	(0.002)	(0.000)	(0.000)
Adjusted R^2	0.181	0.116	-	-
Control variables	Yes	Yes	Yes	Yes
Industry and year effects	Yes	Yes	Yes	Yes
Observations	5,590	5,590	5,590	5,590

Table 4.6: The effects of CSR strengths and controversies on CEO outside directorships: multinomial Probit regressions

This table reports the results from the multinomial regressions for the Adjusted CSR Score (Strength) and the Adjusted CSR Score (Controversy), with and without using the IV approach. The dependent variable is zero if a CEO doesn't hold any outside directorship in year $t+1$, one if the average total assets (in Models 1 and 4), ROA (in Models 2 and 5) or the Net Adjusted CSR Score (in Models 3 and 6) of the appointing firms is less than the sample median, and two if it is higher than the sample median. All the independent variables are lagged by one year relative to the dependent variable.In Models (4)−(6), the Adjusted CSR Score (Strength) or the Adjusted CSR Score (Controversy) is instrumented by its initial level measured in the first year of data coverage. The variable definitions are in Table 1. The standard errors are robust to heteroskedasticity and within industry and year clustering. The industry classification is based on the Fama-French 12-industry specification. The *p*-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

							Instrumented					
	Size		ROA		CSR		Size		ROA		CSR	
	(1)		(2)		(3)		(4)		(5)		(6)	
	Small	Large	Low	High	Low	High	Small	Large	Low	High	Low	High
	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2	Y=1	Y=2
Panel A: CSR strengths												
Adjusted CSR Score (Strength)	−0.255**	0.191	−0.095	0.149	0.129	0.018	−0.171	0.573***	0.174	0.481***	0.217	0.443***
	(0.031)	(0.121)	(0.408)	(0.193)	(0.269)	(0.887)	(0.394)	(0.000)	(0.304)	(0.007)	(0.257)	(0.002)
Panel B: CSR controversies												
Adjusted CSR Score (Controversy)	−0.170	−0.298***	−0.186**	−0.186*	−0.102	−0.310***	−0.441**	−0.692***	−0.403**	−0.439**	−0.374**	−0.716***
	(0.117)	(0.002)	(0.048)	(0.055)	(0.248)	(0.009)	(0.017)	(0.000)	(0.027)	(0.016)	(0.015)	(0.001)
Panel C: CSR strengths and controversies												
Adjusted CSR Score (Strength)	−0.236**	0.237*	−0.072	0.178	0.144	0.062	−0.127	0.646***	0.218	0.532***	0.261	0.515***
	(0.048)	(0.056)	(0.535)	(0.124)	(0.229)	(0.617)	(0.534)	(0.000)	(0.205)	(0.004)	(0.179)	(0.001)
Adjusted CSR Score (Controversy)	−0.153	−0.333***	−0.179*	−0.211**	−0.119	−0.316***	−0.423**	−0.800***	−0.441**	−0.527***	−0.419***	−0.803***
	(0.171)	(0.001)	(0.064)	(0.032)	(0.202)	(0.006)	(0.022)	(0.000)	(0.017)	(0.006)	(0.008)	(0.000)
Control variables	Yes		Yes		Yes		Yes		Yes		Yes	
Industry and year effects	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	5,590		5,590		5,590		5,590		5,590		5,590	

Table 4.7: Corporate governance and the effects of CSR performance on CEO outside directorships

This table reports the results from Probit (in Panel A) and Tobit (in Panel B) regressions, including an interaction term between the Net Adjusted CSR Score and the Weak Governance Dummy. In Panel A, the dependent variable is a dummy variable that is one if a CEO holds at least one outside directorship in year $t+1$ and zero if not. In Panel B, the dependent variable is the number of outside directorships held by a CEO in year $t+1$. All the independent variables are lagged by one year.In Models (3)−(4), the Net Adjusted CSR Score is instrumented by its initial level measured in the first year of data coverage, and the interaction term, Net Adjusted CSR Score × Weak Governance Dummy is instrumented by the initial Net Adjusted CSR Score × the Weak Governance Dummy, following Wooldridge (2010). The variable definitions are in Table 1. The standard errors are robust to heteroskedasticity and within industry and year clustering. The industry classification is based on the Fama-French 12-industry specification. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Panel A: The Probit regression results				
			Instrumented	
	(1)	(2)	(3)	(4)
Governance proxy:	*E*-index	Independent directors (%)	*E*-index	Independent directors (%)
Net Adjusted CSR Score	0.185***	0.205***	0.473***	0.532***
	(0.002)	(0.001)	(0.000)	(0.000)
Weak governance dummy	−0.369**	−0.261**	−1.195**	−0.453***
× Net Adjusted CSR Score	(0.017)	(0.022)	(0.014)	(0.004)
Weak governance dummy	0.176**	−0.514***	0.067	−0.537***
	(0.013)	(0.000)	(0.416)	(0.000)
Adjusted R^2	0.160	0.197	-	-
Panel B: The Tobit regression results				
			Instrumented	
	(1)	(2)	(3)	(4)
Governance proxy:	E-index	independent directors (%)	E-index	independent directors (%)
Net Adjusted CSR Score	0.237***	0.259***	0.595***	0.676***
	(0.002)	(0.001)	(0.000)	(0.000)
Weak governance dummy	−0.468***	−0.356**	−1.475**	−0.611***
× Net Adjusted CSR Score	(0.010)	(0.018)	(0.017)	(0.003)
Weak governance dummy	0.284***	−0.707***	0.152	−0.735***
	(0.001)	(0.000)	(0.123)	(0.000)
Adjusted R^2	0.101	0.127	-	-
Control variables	Yes	Yes	Yes	Yes
Year and industry effects	Yes	Yes	Yes	Yes
Observations	4,350	5,590	4,350	5,590

Table 4.8: CSR performance and the stock market returns on the appointing firms upon director appointment

This table reports the effects of the CEO's on-the-job CSR performance on the appointing firms' abnormal returns upon director appointment. The Weighted Least Squares (WLS) regressions are estimated with and without instrumental variables. The weights in the regressions are the inverse of the variance of the residuals from the market model used to compute the abnormal returns upon director appointments. The dependent variable is the appointing firm's cumulative abnormal returns ($CARs$) measured over the event window $(-1, +1)$. In models (4)−(6), the Net Adjusted CSR Score is instrumented by its initial level measured in the first year of data coverage, and the interaction term, the Net Adjusted CSR Score × Strong Governance Dummy, is instrumented by the initial Net Adjusted CSR Score × Strong Governance Dummy. Both the Net Adjusted CSR Score and the Strong Governance Dummy belong to the CEOs' own firms. The variable definitions are in Table 1. We indicate in the parentheses whether the variables belong to the CEO's own firms (CEO firms) or to the appointing firms. The standard errors are robust to heteroskedasticity. The industry classification is based on the Fama-French 12-industry specification. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Dependent variable:	Appointing-firm CAR(−1, +1)					
				Instrumented		
	(1)	(2)	(3)	(4)	(5)	(6)
Governance proxy:		independent directors (%)	E-index		independent directors (%)	E-index
Net Adjusted CSR Score	−0.022	−0.035*	−0.041	0.079	−0.039	0.036*
(CEO firms)	(0.338)	(0.070)	(0.160)	(0.270)	(0.663)	(0.088)
Net Adjusted CSR Score (CEO firms) ×		0.173***	0.184**		0.465***	0.058
Strong Governance Dummy (CEO firms)		(0.000)	(0.014)		(0.005)	(0.349)
Strong Governance Dummy (CEO firms)	−0.060**	−0.030	0.049**	−0.075***	−0.023	−0.000
	(0.027)	(0.106)	(0.040)	(0.009)	(0.414)	(0.990)
ln(Total assets) (appointing firms)	−0.001	0.005	−0.016*	0.004	0.010	−0.009
	(0.898)	(0.328)	(0.066)	(0.545)	(0.171)	(0.473)
ln(Total assets) (CEO firms)	0.027**	0.018**	0.032**	0.033**	0.026***	0.006
	(0.014)	(0.025)	(0.038)	(0.019)	(0.007)	(0.639)
ROA (CEO firms)	0.083	0.001	0.005	−0.090	−0.025	0.224
	(0.520)	(0.996)	(0.982)	(0.577)	(0.868)	(0.351)
ROA (appointing firms)	−0.134	−0.042	−0.190	−0.220	0.020	0.287
	(0.266)	(0.664)	(0.260)	(0.130)	(0.850)	(0.368)
ln(CEO age)	0.053	0.088	0.144	−0.044	−0.089	0.396**
	(0.580)	(0.274)	(0.281)	(0.679)	(0.346)	(0.040)
ln(CEO tenure)	0.017	0.014	0.033	0.022	0.020	0.007
	(0.287)	(0.330)	(0.141)	(0.160)	(0.277)	(0.703)
CEO education	0.022*	0.029***	0.020	0.026**	0.032***	−0.003
	(0.068)	(0.009)	(0.208)	(0.034)	(0.009)	(0.824)
Patent count (CEO firms)	0.008	−0.011	0.027	−0.036	−0.050	−0.005
	(0.811)	(0.670)	(0.504)	(0.335)	(0.162)	(0.903)
Major committee membership dummy	0.013	0.005	−0.003	0.004	0.019	0.029
	(0.444)	(0.740)	(0.889)	(0.849)	(0.360)	(0.402)
Same industry dummy	0.013	0.009	−0.026	0.039	0.020	−0.003
	(0.658)	(0.691)	(0.244)	(0.150)	(0.520)	(0.895)
Industry and year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95	95	72	95	95	72
Adjusted R^2	0.483	0.632	0.494	0.464	0.571	0.489

Table 4.9: CSR performance and the stock market returns on the appointing firms upon director appointment

This table reports the effects of the CEO's on-the-job CSR performance on the appointing firms' abnormal returns upon director appointment. The Weighted Least Squares (WLS) regressions are estimated with and without instrumental variables. The weights in the regressions are the inverse of the variance of the residuals from the market model used to compute the abnormal returns upon director appointments. The dependent variable is the appointing firm's cumulative abnormal returns ($CARs$) measured over the event window $(-1, +1)$. In models (4)−(6), the Net Adjusted CSR Score is instrumented by its initial level measured in the first year of data coverage, and the interaction term, the Net Adjusted CSR Score × Strong Governance Dummy, is instrumented by the initial Net Adjusted CSR Score × Strong Governance Dummy. Both the Net Adjusted CSR Score and the Strong Governance Dummy belong to the CEOs' own firms. The variable definitions are in Table 1. We indicate in the parentheses whether the variables belong to the CEO's own firms (CEO firms) or to the appointing firms. The standard errors are robust to heteroskedasticity. The industry classification is based on the Fama-French 12-industry specification. The p-values are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Dependent variable:	Appointing-firm CAR(−1, +1)					
				Instrumented		
	(1)	(2)	(3)	(4)	(5)	(6)
Governance proxy:		independent directors (%)	E-index		independent directors (%)	E-index
Net Adjusted CSR Score	−0.022	−0.035*	−0.041	0.079	−0.039	0.036*
(CEO firms)	(0.338)	(0.070)	(0.160)	(0.270)	(0.663)	(0.088)
Net Adjusted CSR Score (CEO firms) ×		0.173***	0.184**		0.465***	0.058
Strong Governance Dummy (CEO firms)		(0.000)	(0.014)		(0.005)	(0.349)
Strong Governance Dummy (CEO firms)	−0.060**	−0.030	0.049**	−0.075***	−0.023	−0.000
	(0.027)	(0.106)	(0.040)	(0.009)	(0.414)	(0.990)
ln(Total assets) (appointing firms)	−0.001	0.005	−0.016*	0.004	0.010	−0.009
	(0.898)	(0.328)	(0.066)	(0.545)	(0.171)	(0.473)
ln(Total assets) (CEO firms)	0.027**	0.018**	0.032**	0.033**	0.026***	0.006
	(0.014)	(0.025)	(0.038)	(0.019)	(0.007)	(0.639)
ROA (CEO firms)	0.083	0.001	0.005	−0.090	−0.025	0.224
	(0.520)	(0.996)	(0.982)	(0.577)	(0.868)	(0.351)
ROA (appointing firms)	−0.134	−0.042	−0.190	−0.220	0.020	0.287
	(0.266)	(0.664)	(0.260)	(0.130)	(0.850)	(0.368)
ln(CEO age)	0.053	0.088	0.144	−0.044	−0.089	0.396**
	(0.580)	(0.274)	(0.281)	(0.679)	(0.346)	(0.040)
ln(CEO tenure)	0.017	0.014	0.033	0.022	0.020	0.007
	(0.287)	(0.330)	(0.141)	(0.160)	(0.277)	(0.703)
CEO education	0.022*	0.029***	0.020	0.026**	0.032***	−0.003
	(0.068)	(0.009)	(0.208)	(0.034)	(0.009)	(0.824)
Patent count (CEO firms)	0.008	−0.011	0.027	−0.036	−0.050	−0.005
	(0.811)	(0.670)	(0.504)	(0.335)	(0.162)	(0.903)
Major committee membership dummy	0.013	0.005	−0.003	0.004	0.019	0.029
	(0.444)	(0.740)	(0.889)	(0.849)	(0.360)	(0.402)
Same industry dummy	0.013	0.009	−0.026	0.039	0.020	−0.003
	(0.658)	(0.691)	(0.244)	(0.150)	(0.520)	(0.895)
Industry and year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95	95	72	95	95	72
Adjusted R^2	0.483	0.632	0.494	0.464	0.571	0.489

Chapter 5

Summary and suggestions for future research

This thesis presents three essays in corporate finance. In Chapter 2, I study the determinants and effectiveness of reverse takeovers in the U.K. as an alternative going public method to the traditional IPOs. In Chapter 3, I examine whether the outside director labor market values CEOs' innovation leadership and how innovation leadership diffuses across firm boundaries. In Chapter 4, I investigate the impact of a CEO's social performance on her reputation and career.

Chapter 2 examines the factors motivating private firms in the U.K. to go public via RTO instead of IPO. It also provides evidence on the effectiveness of RTO as a listing method. I find that private firms in the U.K. strategically resort to RTO for listing when market valuation is low. During the low valuation periods, it is more difficult to communicate with a large number of public investors with pessimistic views on the economy's prospects. Listing through RTO provides private firms an opportunity to only communicate with the shareholders of a public firm, which is easier to negotiate a share price that reflects the firm's fundamental value. Further, consistent with the fact that the stringent requirements imposed on RTO listing in the U.K. largely reduce the benefits of RTO as a fast and cost-efficient alternative to IPO, I find no clear evidence showing that RTO firms are different from IPO firms in operating performance, business expansion or certification to prospective equity investors in

post-listing years. Overall, we conclude that RTOs do not introduce inferior listings in the U.K. The results also demonstrate that the motives and effectiveness of RTO can be affected by the country-specific regulations and institutional environment. Previous studies also show that RTOs in different countries (e.g., China and Australia) have different characteristics than U.S. counterparts (Brown, Ferguson, and Lam, 2010; Lee, Li, and Zhang, 2014). Therefore, further studies on RTO using international data would be of interest. Other interesting issues remain to be addressed are related to the potential synergy emerged from the takeover process embodied in RTO. Unlike IPO, RTO is an event to obtain public listing as well as takeover another firm. Private firms may initiate RTOs with a variety of strategic reasons beyond the scope of obtaining public listing. The assets and value of the public acquiring firms involved in RTOs may also generate great impact on the success of RTO firms in the post-listing periods. Therefore, further analysis on the post-RTO restructuring and synergy gains would be fruitful.

In Chapter 3, I study whether the director labor market values CEOs' innovation leadership. The labor market discipline theory (see Fama and Jensen (1983); Kaplan and Reishus (1990); Yermack (2004)) posits that the director labor market serves as an important market-based institution to evaluate CEO's managerial skills and also offers them prestige and opportunities. Based on this intuition, a CEO's skills of successfully managing innovative companies should be also valued by external firms in the director labor market. I find that the likelihood of holding outside directorships and the number of outside directorships held by a CEO are both positively related to the innovation performance (measured by a firm's patenting activity) of the firm she manages. Consistent with the matching theory of directors and boards (Adams, Akyol, and Verwijmeren, 2017; Coles, Daniel, and Naveen, 2008; Fahlenbrach, Low, and Stulz, 2010; Hermalin and Weisbach, 1998), my results demonstrate that CEOs of innovative firms are matched to the boards of firms who are also innovative or are technologically similar. Apart from confirming the value of innovation leadership as an important component of a CEO's human capital, I also show that such leadership and skills can transfer across firms. My results demonstrate that firms appointed innovative CEOs as an outside director significantly improves their innovation performance and operating performance in post-appointment years. The findings of this study suggest

two new directions for future research. First, what are the specific channels through which innovative CEO-directors can benefit the appointing firm? For example, are they more likely to seat on the major committees of boards (i.e., the compensation and audit committees) or some specific committees related to innovation? Do they help the appointing firm make better acquisitions? Besides the advisory role of such directors, do they monitor CEOs better than other types of directors, particularly in innovative firms? Second, the analysis in this study mainly focuses on the demand side of innovative CEO-directors, it would be also of interest to further explore the supply side story. CEOs accept outside directorships when they can bring them prestige or enhance their managerial skills that will benefit their primary position in their own firms. The reputation effect has been examined in this essay, further study can investigate the information benefits and skill enhancement benefits.

In Chapter 4, I examine whether CEOs are judged on their social performance. With the ever-increasing attention on corporate responsibilities for environmental, social and governance issues, CSR is becoming an integral part of business operation and is taking corporate decisions beyond the conventional perceived scope of capitalism. Based on the contract theory and the theory of firms, a company is a nexus of implicit or explicit contracts between shareholders and stakeholders. The valuable resources held by the stakeholders are essential for shareholders' value maximization. Therefore, managing CSR activities appropriately to engage stakeholders constitutes an important component of a CEO's human capital. In line with this conjecture, I find that the CEOs of firms having better CSR ratings are more likely to serve on external boards and they hold more outside directorships. As a poorly designed governance structure can result in agency conflicts between CEOs and shareholders, I show that the positive effect of CSR score on CEO outside directorships vanishes when the CEOs' own firms are poorly governed. Overall, the findings demonstrate that the leadership of using CSR to engage stakeholders and maximize shareholders' value is a highly-valued type of human capital in the outside director labor market. My results also suggest that the outside director labor market serves as an effective market-based institution motivating CEOs to be more socially responsible. The main focus of this essay is whether external firms recognize a CEO's social performance. Future research can focus on studying the impact of socially responsible CEOs on external firms in which

they serve as outside directors. Specifically, it is important to explore whether the absence of socially responsible CEOs on a firm's board as outside directors leads to the better delivery of CSR activities. Dahya and Herron (2017) document a co-movement effect between the investments of a fund and the directors of firms a fund invested in. Funds follow directors to make equity investments in new firms appointing these directors. It is interesting to examine whether institutional investors follow socially responsible CEOs to firms in which they serve as outside directors, particularly given the fact that increasingly more institutional investors start to integrate CSR criteria into their investment processes. The other direction of future research is to investigate reputation incentives of socially responsible CEOs in the director labor market. For instance, are socially responsible CEOs more likely to leave the firms they serve as outside directors when these firms are expected to have negative CSR-related events? Do socially responsible CEOs devote more effort than other types of outside directors on fulfilling their responsibilities?

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