ESSAYS IN EMPIRICAL CORPORATE FINANCE

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Declaration

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I confirm that Chapter 2 is co-authored with Dr. Jianhua Shao and Chapter 3 is co-authored with Professor Sudi Sudarsanam and Dr. Valeriya Vitkova.

Abstract

This thesis explores three topics in empirical corporate finance. The first chapter examines the cross-border private equity buyout performance. The second chapter investigates social ties and venture capital investment. The final chapter looks into the internal capital market of the conglomerate and examines the investment efficiency by taking the equity carve-out as the restructuring event.

The first chapter examines the question of a country's institutional quality as a determinant of the cross-border buyout performance. Using a sample of 2,665 cross-border buyout investments from 1998 to 2007 in 40 countries and regions, I find that institution quality of the portfolio company nation, as measured by the ranking in the composite index of political, economic and financial risk, is important to cross-border buyout performance in terms of exit success. In a high institution quality country, the probability of a successful exit via Initial Public Offerings (IPO) or Mergers and Acquisitions (M&A) is higher. Institutional distance between portfolio company country and private equity (PE) firm country lowers the exit success. PE firms' international experience, industrial experience, and reputation based on deal experience help to improve buyout exit success and their industrial experience could mitigate the adverse influence of institutional distance.

The second chapter investigates how social ties between VC partners and start-up founders influence the venture capital investment. We find that if the VC partners have social ties, obtained from previous education, past employment or ethnic minority community, with the start-up founders, the collaboration between the VC firm and the start-up is more likely to happen. Also, this homophily improves the post-investment outcome and we observe higher probability of next round financing, higher hazard rate of next round financing and shorter expected duration, larger amounts of fund-raising in the next round, and higher probability of the VC firm taking the start-up to Initial Public Offerings (IPO) or Mergers and Acquisitions (M&A). Using the estimate of a two-stage Heckman selection model and addressing the selection effect, we find that post-investment monitoring effect still accounts for the performance patterns.

In the third chapter, we examine whether equity carve-outs (ECOs) lead to improvements in the functioning of the internal capital markets (ICM) of diversified firms. Divestments, including spin-offs, sell-offs, and ECOs, can be employed by firms to improve allocative efficiency. Equity carve-outs, unlike spin-offs and sell-offs, leave the parent's ICM intact but provide the opportunity to enhance internal and external corporate governance mechanisms. Using a U.S. sample of 354 ECOs completed between 1980 and 2013, we find that the allocative efficiency of parents is augmented significantly following ECOs. This increase in investment efficiency is related to the improvements in the internal and external governance characteristics of parent companies.

Chapter 1 Cross-border Buyout Performance

1.1 Introduction

A leveraged buyout (LBO), an important part of private equity (PE) investments, is the acquisition of a company financed with a substantial portion of borrowed funds. During a typical buyout investment, PE firms (1) improve the portfolio company's value by conducting financial, governance, and operational engineering (Kaplan and Strömberg, 2008), (2) exit portfolio companies as PE funds have a limited contractual lifetime, and (3) return capital to their investors. Cross-border PE investments have become a phenomenon since the late 1990s (Cao, Cumming, Qian, and Wang, 2015). In the global PE report by Duff & Phelps (2014), 30% of PE executive respondents planned to make cross-border deals in the following year.

The objective of this paper is to examine the country's institutional quality as a determinant of cross-border buyout performance in terms of exit success and the role of PE's experience in mitigating the effects of institutional barriers. The previous literature on cross-border PE investment performance mainly either focuses on early-stage venture capital (VC)'s cross-border performance (Dai, Jo, and Kassicieh, 2012; Wang and Wang, 2012; Betroni and Groh, 2014; Li, Vertinsky, and Li, 2014; Nahata, Hazarika, and Tandon, 2014; Espenlaub, Khurshed, and Mohamed, 2015; Buchner, Espenlaub, Khurshed, and Mohamed, 2017) or compares buyout performance in domestic markets within different countries (Strömberg, 2008; Jenkinson and Sousa, 2015; Hammer, Knauer, Pflücke, and Schwetzler, 2017). To my knowledge, no study has focused on the factors predicting a PE cross-border buyout's eventual successful exit. In this study, I attempt to fill this gap in the PE literature by examining the determinants of cross-border buyout performance.

Uncertainty and information asymmetry could create transaction obstacle for PE investments. Formal institutions are a set of political, economics and contract rules which guide the human behaviour and human interaction (North, 1990). When making their investment in countries of higher institution quality, which offers stronger investor protection and contract enforcement and has less political, economic and financial uncertainty and lower transaction cost, PE firms could facilitate the divestment process and are more likely to exit the portfolio company successfully. Further, when PE firms invest abroad, such transaction problems could be more severe because of the significant intrinsic risks arising from the institutional, cultural and geographic distance of a foreign country which could jeopardise the exit success (Li et al., 2014; Buchner et al., 2017). However, PE firms could accumulate local business, institutional and cultural knowledge and increase international practice in their ongoing activities. Also, PE firms tend to circumscribe investment activities by focusing on specific industries and develop their industry expertise, thereby reducing information asymmetry and uncertainty (Cressy, Munari, and Mallipiero, 2007; Gompers, Kovner, Lerner, and Scharfstein, 2008) and helping them to overcome the institutional barriers. I thus hypothesise that PE firms' deal experience will have a positive impact on cross-border buyout performance and mitigate the negative impact of institutional barriers.

I adopt a sample of 2,665 cross-border buyout investments in 40 countries between 1998 and 2007. To proxy for the country's institution quality, I use the country risk index from the International Country Risk Guide (ICRG) database. ICRG has recorded this country composite risk index for more than 140 countries and regions since 1984 by taking the political, economic, and financial risks into account. A country is a low risk country and of high institution quality if the country risk index is higher than 80 points. I measure the institutional distance between two countries based on the absolute country risk index differences between the portfolio company country and PE firm country. To proxy for cultural distance, I adopt the

Hofstede's cultural dimensions which include power distance, uncertainty avoidance, and individualism vs. collectivism and masculinity vs. femininity. I create four deal experience variables: country-specific, multinational and industry experience, and reputation based on deal experience.

Following Hochberg, Ljungqvist, and Lu (2007), Nahata (2008), and Nahata et al. (2014), I measure performance in terms of exit success. I define the PE's portfolio company exit to be successful if it is later brought to the market through an initial public offering (IPO) or acquired by another company. I first examine the relationship between exit success and institutional and cultural factors at the portfolio company's country level and the portfolio company-PE firm country-pair level. I then examine the probability of a successful exit in a Cox Hazard model. In additional analyses, I study the impact of the above factors on the choice between initial public offerings (IPO) and mergers and acquisitions (M&A) as exit routes. I further relate the PE firms' IRR and exit multiple with these factors.

This paper demonstrates that the exit success increases when the quality of the portfolio company country's institutional environment is higher. The institutional differences between PE firm and portfolio company countries raise an obstacle to cross-border investment and are detrimental to the exit success. However, the cultural distance between PE firms and their portfolio companies has no significant impact on cross-border buyout performance. Further, PE firm's deal experience is positively related to the likelihood of the exit success. My findings on PE's performance are consistent with those in Li et al. (2014) who report insignificant and marginally significant mitigating effects of country-specific and multinational experience on institutional distance for VC's cross-border performance. However, I find that PE firms' industrial experience helps them to reduce the institutional barriers. PE firms with more industrial experience learn more and gain deeper knowledge of companies in that industry.

Cressey et al. (2007) and Gompers et al. (2008) show that VC firms with the most industrial experience are most responsive to public signals of investment opportunities. Consequently, being an industry expert could also alleviate the burden of being a foreigner for PE firms.

In terms of exit strategies, compared with choosing M&A as the exit route, PE firms are more likely to exit via IPO when PE firms are in an investment club and when initial buyout value is larger. In contrast to unsuccessful exits, the probability of going IPO increases when PE firms are more experienced, form an investment club and when deal size is larger; similarly the probability of choosing M&A increases when the quality of the institutional environment is higher and when PE firms are more experienced. In addition, I find that IRR of the PE firm's investment in the portfolio company is larger if institution quality of the portfolio company country is higher.

The results are robust as regards the self-selection issue in which the performance of PE firms may be attributable to the quality of their portfolio companies rather than PE firms' experience (Nahata, 2008). I follow Nahata (2008) and adopt a variation of Heckman's (1979) correction procedure. In the first stage, I estimate the experienced PE firms' likelihood of investing in a portfolio company. In the second stage, I include the inverse Mills ratio received from the first-step probit model as an additional control variable to estimate the buyout performance. The results are also robust when I adopt the multiple imputation method to compensate for the missing records of deal value.

This study contributes to the literature in several ways. Previous PE literature either focuses on the investments of cross-border VC firms or compares buyout performance in domestic markets with different countries. Nahata et al. (2014) examine the influence of institutional differences on global VC success. Both VC and buyout investments are alternative investments and illiquid. However, buyouts, as a new form of company structure (Jensen, 1989)

and important part of M&A activities (financial bidders), acquire mature companies and are different from VC investments which enter into start-ups and adopt stage-financing. How institutional differences affect cross-border buyout investments is not well answered yet. Cao et al. (2015) and Holloway, Lee, and Shen (2016) shed lights on cross-border LBO activities by examining issues at the stage of entry. My paper investigates the buyout performance at the stage of exit which completes the investment process. Consequently, it helps us to deepen the understanding and expands the literature of internationalization of PE.

Also, this paper complements a number of studies examining the role of intuitions in cross-border M&A (Rossi and Volpin, 2004; Bris and Cabolis, 2008; Ferreira, Massa, and Matos, 2010). They do not incorporate LBO in the sample and examine M&A performance with premium or acquisition announcement cumulative abnormal return. The acquirer's performance in LBO could not be easily examined because PE firms usually are in limited partnership and not listed in stock exchange. My findings offer direct evidence of the influence of institutional differences across countries and between portfolio company country and PE firm country on buyout performance.

Moreover, this paper is related to the literature on PE experience and reputation (Cressy et al., 2007; Gompers et al., 2008; Nahata, 2008; Demiroglu and James, 2010; Ivashina and Kovner; 2011) and investigates the importance of experience in the cross-border setting. Lastly, to alleviate common data limitations in previous deal-level studies, I construct a dataset by extracting portfolio companies' details of 1,008 PE firms around the world and shed light on the determinants of buyout success in both developed and developing markets.

The rest of the paper is structured as follows. Section 1.2 provides a review of the literature, the institutional framework and the hypotheses. Section 1.3 presents the data collection procedure and the variables construction. Section 1.4 discusses the empirical

analyses. Section 1.5 concludes.

1.2 Literature Review and Hypothesis Development

1.2.1 Literature Review

The literature on PE performance can be categorised into two groups: fund-level studies and deal-level studies. Metrick and Yasuda (2011) outline both advantages and limitations of these studies. The net of fund fees and carry could be calculated at the fund level, however, there is missing information about timing and exits of individual projects. Also, investment write-offs which incur losses are not observed at the fund level. In contrast, deal-level data could alleviate the selection bias problem as the outcome of unsuccessful investments could be tracked. Nevertheless, deal-level studies suffer from data incompleteness (Kaplan, Sensoy, and Strömberg, 2002) and a novel data set or a model which could overcome the data problem is thus required.

Fund-level studies track the stream of cash flow and can shed light on the risk and return of PE investment (Kaplan and Scholar, 2005; Phalippou and Gottschalg, 2009; Driessen, Lin, and Phalippou, 2012). Several deal-level studies also consider the risk and returns (Groh and Gottschalg, 2008; Lopez-de-Silanes, Phalippou, and Gottschalg, 2015). Other deal level studies examine the real effects such as post-buyout production efficiency (Alperovych, Amess, and Wright, 2013). Deal-level studies also consider the determinants of buyout exit, including market condition (Jenkinson and Sousa, 2015), PE firm characteristics and strategies (Arcot, Fluck, Gaspar, and Hege, 2015; Hammer et al., 2017) and portfolio company characteristics (Jenkinson and Sousa, 2015).

There is emerging literature focusing on the cross-border PE investment performance. Papers in the international VC field have analysed determinants of VC exit performance: legal

system and economic/market activities across countries (Wang and Wang, 2012; Nahata et al., 2014; Espenluab et al., 2015), legal, institutional, and cultural distance between the country of VC firm and that of entrepreneurial firm (Li et al., 2014; Nahata et al., 2014; Buchner et al., 2017), syndication with local VC and joint venture (Dai et al., 2012), and additional exit opportunities brought by foreign VC firms (Betroni and Groh, 2014). Few papers study cross-border buyout investment performance. The contemporaneous study Chemmanur, Hull, and Krishnan (2014) examines the exit performance of U.S. buyout specialists and exploits the exogenous shock to the effective proximity of U.S. PE investors to other countries.

This paper studies cross-border buyouts and differs from previous literature in several perspectives. Firstly, previous cross-border studies use the sample either in the U.S., the European, or the Asian market or observe the cross-border investments from either U.S. investors or U.K investors. This paper includes investments in both developed and developing countries, and considers non-U.S. and non-U.K. investors. Further, under the framework of institution, this paper not only considers institutional/legal/economic difference across countries but also takes the difference between the country of portfolio company and that of the PE firm into account.

1.2.2 Hypothesis Development

Gompers and Lerner (2004) state that there is little theoretical attention being paid to the divestment aspect of PE and therefore established theories are limited in their ability to explain the sale of portfolio companies. In previous cross-border investment studies, the influence of law and institution (see e.g. Rossi and Volpin, 2004) and national distance (see e.g. Nahata et al., 2014) on investments are well documented. The framework of institution could also be adopted to develop the hypotheses in the cross-border buyout setting. North (1990) defines the institution as the “rule of the game in a society” and “humanly devised constraints

that shape human interaction". The institution emphasizes the role of information asymmetry and transaction cost in economic activities and the key function of the institution is to reduce the uncertainty by establishing a stable structure to facilitate interaction among people. Williamsons (2000) establishes four hierarchies of the institution and the first two levels are country-specific and vary across different countries. The first level is the informal institution which comes from socially transmitted information and is part of the culture (North, 1990). The second level is the formal constraints, including constitutions, contract laws and enforcement of property rights. Differences in formal and informal rules result in different levels of information asymmetry and transaction cost.

1.2.2.1 Formal Institutions

Formal rules contain political and legal rules, economics rules, and contracts. The purpose of these rules is to facilitate political or economic exchange (North, 1990). There are two contrasting views on effects of law and institution on financial transactions. Under the "Coasian" view, institutional differences do not matter as sophisticated investors could privately negotiate and optimize the contract to mitigate the impediments (Bergman and Nicolaievsky, 2007). For instance, Allen, Qian, and Qian (2005) state that, in the emerging economy China, neither its legal or financial system is well developed. However, the institutional impediments do not prohibit China's fast growth. Kaplan, Martel, and Strömberg (2007) show that legal regime does not matter, and more experienced VC investors adopt U.S. style sophisticated contracts.

Under the "law matters" view, La Porta, Lopez-De-Silanes, Shleifer, and Vishny (1997, 1998) show that the legal system exerts a positive influence on investor protection and capital market development. Glaeser, Johnson, and Shleifer (2001) state that appropriate laws and regulations and high enforcement of shareholder and creditor rights are instrumental in building

up the market confidence and attracting investments. Cao et al. (2015) report that the level of creditor rights in a certain country is positively related to the prosperity of LBO activities. The law and institution could affect the PE exit in two ways: institutional differences across countries and between the PE firm country and portfolio company country.

Firstly, all else being equal, in a country with a better-developed institutional system, the capital market will be more active and cross-border PE firms have more opportunities to divest their portfolios. Further, the exit decision will be influenced by the information asymmetry between the foreign PE investors and local markets and the transaction cost. In a country with high institution quality, information asymmetry and transaction cost could be reduced as there are stronger investor protection and contract enforcement, and less political, economic and financial uncertainty, facilitating the exit process. Secondly, when PE firms invest abroad, and the local formal rules are significantly different from their home countries, there will be limitations on the effective transfer and enforcement of the governance structure and contract design they adopt in their home countries (Tykvová and Scherlter, 2014). Consequently, institutional differences between two countries could be the obstacle to cross-border investments.

Hypothesis 1a null: In line with the "Coasian" view, institutional quality of the portfolio company country is not associated with the likelihood of a successful exit.

Hypothesis 1a alternative: In line with the "law matters" view, higher institutional quality of the portfolio company country is associated with a higher likelihood of a successful exit.

Hypothesis 1b: Larger institutional differences are associated with a lower likelihood of a successful exit.

1.2.2.2 Informal Institutions

The informal institution is referred to the culture. Culture could exert influences on economic activities as it shapes economic individuals' choices and perceptions (Hofstede and Bond, 1988). The influence of cultural differences on cross-border investments has been examined in recent studies but the results are mixed. Ahern, Daminelli, and Fracassi (2015) report that the cultural distance adversely affects the cross-border mergers volume and combined announced returns. They argue that different cultural values could lead to impediments such as mistrust, misunderstanding or mismatched goals in cooperation. Li et al. (2014) and Buchner et al. (2017) find similar results in studying cross-border VC performance. However, Nahata et al. (2014) find that cultural distance increases the VC success. They argue the cultural disparity between VC firms and their portfolio companies leads to more rigorous due diligence and deal selection, and hence improves the performance.

The influence of cultural distance on the outcome of buyout investments has not been seriously examined. Li et al. (2014) state that cultural distance between VC firms and their portfolio companies could adversely affect the VC performance in three ways: communication problems, value and beliefs conflicts, and liability of outsidership. In the buyout context, similarly, cultural diversity can lead to different approaches to deal negotiation, contract negotiation, corporate policy design, and working relationship development and thus increase information and transaction costs, leading to conflicts and investment failures.

On the other hand, in an LBO, PE firms usually fully acquire the portfolio company and PE firms' targets are mature companies in the late development stage which could generate a stable cash flow to meet the debt repayment requirement (Jensen, 1989). Also, buyout investors are sophisticated. To add firm value, they restructure the portfolio company's capital structure, replace the management team with industrial experts, and guide the operational

change. In comparison, VC firms invest in early-stage and start-up companies. Understanding of business ideas and entrepreneurs is essential to VC investments (Kaplan and Strömberg, 2004). Consequently, buyout investors might not suffer from the adverse influence of cultural differences because they rely more on the hard information while VC investors could be subject to cultural differences as they rely more on the soft information.

Hypothesis 2 null: Cultural differences will not influence the cross-border buyout performance.

Hypothesis 2 alternative: Cultural differences adversely influence the cross-border buyout performance.

1.2.2.3 Learning

North (1990) claims that games are shaped by formal and informal constraints but the contrast comes from organisational learning in the repeated game. Under the "experience matters view", Meuleman and Wright (2011) claim that PE firms can reduce institutional barriers through learning. Learning is the process in which firms accumulate local institutional and cultural knowledge about a certain market or develop insights into a certain industry through their ongoing activities. De Clercq and Dimov (2007) argue that PE firms obtain knowledge about local businesses and institutions through prior investments and acquire skill sets in the process of evaluation, selection, and management. Also, PE firms could establish their local networks through prior investments in the target country (Humphery-Jenner, Sautner, and Suchard, 2016). As cross-border investments can be considered as part of the internationalization process, multinational experience of a rich array of environments with a broad range of institutional and cultural characteristics also plays a vital role in the cross-border investment process (Li et al., 2014). In addition, PE firms with substantial industrial experience could identify better investment opportunities in a certain industry and obtain the know-how to

manage and add value to these investments (Gompers et al., 2008). PE firms' learning could mitigate the information asymmetry created by intuitional barriers, lower the transaction cost, and hence facilitate the exit process. Further, as PE firms approach the buyout market repeatedly, building reputation is necessary because such a reputation can serve as certification and help to mitigate the information asymmetry between PE firms and potential buyers (Gompers, 1996).

Various empirical studies provide insights into PE learning and experience and confirm the positive role of experience in investment activities. Cressy et al. (2007) find that industrial specialised PE firms are more likely to have higher post-buyout profitability. Demiroglu and James (2010) argue that reputable PE firms have persistent performance, and this confirms PE firms' skills in selecting, monitoring, and restructuring. Reputation based on deal experience will help PE firms to deliver the impression of being less risky to investors and banks, resulting in better lending terms.

Hypothesis 3a: More experienced PE firms are more likely to perform better in the cross-border buyout.

Hypothesis 3b: PE firms' deal experience helps to mitigate the adverse influence of distance.

1.3. Data and Variables Construction

1.3.1 Data and Sample

My sample of global LBOs comes from Mergermarket, a data provider for M&A transactions. Mergermarket tracks investment records for 1,008 worldwide PE firms (as of 31st December 2015). Unlike other databases such as Capital IQ M&A and SDC Platinum M&A, which track investments at the transaction level, Mergermarket categorises investments into

exit portfolios and holding portfolios at the PE firm level. It provides information on holding periods, buyout/exit types, transaction value, deal description, and financial characteristics.

I obtain the sample as follows. Firstly, I select the investment of which the deal type "buyout" is specified. I only keep the investment with the leading PE[1] in club deals where more than one PE firm participates in the transaction. Since my aim is to study cross-border buyout performance, I select deals if the dominant country of the portfolio company is different from the country in which the PE firm is headquartered. In addition, I keep deals for which transaction dates and holding periods are non-missing. Although Mergermarket tracks the deal history back to 1997, it has provided more reliable information since 1998. Consequently, following Nahata et al. (2014), I include buyout transactions from 1st January 1998 and exclude all countries with less than ten observations to avoid the adverse effects of outliers. I stop the sample at the end of 2007 to be able to track the outcome of all buyout transactions during an eight-year window until the end of 2015[2]. The final sample has 2,665 deals from 40 countries from 1998 to 2007.

To supplement other deal characteristics such as deal value and management participation, I match the sample with two other buyout databases: SDC Platinum M&A and Zephyr. Zephyr has better coverage for European deals and smaller deals. I match these databases using the PE name, the portfolio company's name, and the transaction date[3]. Since some PE firms have changed their name (for example, HSBC PE is renamed as Montagu PE),

[1] The leading PE is defined as the one which invests the largest stake or the oldest firm in the club deals if stake information is missing (Nahata et al. 2014). To confirm the correctness of leading PE firms, I also go through the deal description and check if the PE firm is leading the consortium/group. As Mergermarket keeps records at the PE firm level, same transaction will be recorded several times for club deals. I check the deal ID and target name and delete duplicates. Only transactions with leading PE firms are kept.

[2] Strömberg (2008) investigates a sample of 21,000 LBO transactions 1970-2007 and documents that the median duration is 9 years. In line with his findings, this paper leaves a window which is at least 8 years for PE firms to exit their portfolios.

[3] Deal is labelled as "Leveraged Buyout" in SDC and "Institutional Buyout" in Zephyr; deal status is "completed deals"; the time span is from 1st January 1998 to 31st December 2007. The geographical area is worldwide, and the dominant country is defined as the place where the portfolio company is located in. In Zephyr, the PE name is not always specified so that I go through each deal description to figure out the PE firms behind each deal.

I therefore extensively check the company website, confirm the change, and carefully match different databases. In addition, following Cao et al. (2015), I carefully check the industry based on the sub-industry description in Mergermarket and reclassify it into one of the 11 SIC industries, as defined by the U.S. Securities and Exchange Commission (SEC) SIC Code List.

Finally, I obtain institutional data from the ICRG database and cultural distance data from Taras, Steel, and Kirkman (2011). The market development data come from SDC Platinum M&A database. Other country-pair controls are from the Central Intelligence Agency (CIA) World Factbook, the Foreign Law Guide database, and CEPII website.

1.3.2 Variable Construction

1.3.2.1 Dependent Variables

Mergermarket identifies the following four exit types: IPO, secondary buyout, trade sale, and other exits. Other exits are exit routes excluding IPO, secondary buyout and trade sale as well as routes for which Mergermarket could not track details. I follow the previous PE literature (Hochberg et al., 2007; Nahata, 2008; Nahata et al., 2014) and code exits as being successful if PE firms were able to exit portfolio companies either via IPO or M&A (trade sales and secondary buyout).

In the aggregate country-level analysis, I calculate the successful exit ratio as the number of successful exits to the number of investment for each portfolio company country in each investment year and for each portfolio company-PE firm country pair in each investment year. For the deal-level analysis, to take the time-to-successful exit and right-censored data characteristic into account, I adopt the survival analysis. The hazard rate is the conditional probability that the PE firm divests the portfolio company successfully. The time-to-successful exit is the number of months between the buyout date and the successful exit date. For portfolio

companies with unsuccessful exits, the holding time is the number of months between the buyout date and 31st December 2015 or the last available tracking date.

1.3.2.2 Explanatory Variables

The explanatory variables can be categorized into four sets of variables. The first set pertains to the institution. The second set consists of learning factors from different perspectives. I also control for deal characteristics including management participation, club size (the number of PE firms) and deal value and country-pair variables including common religion, common language, common law origin, and geographic distance. The Appendix 1.2 provides detailed description of all deal characteristics and country-pair control variables.

1.3.2.2.1 Factors Related to Institutions

Firstly, I obtain the country risk index from International Country Risk Guide database. This database has been intensively used in the law and intuition studies (La Porta et al., 1998; Rossi and Volpin, 2004; Bekaert et al., 2005; Lerner and Schoar, 2005; Cumming, Fleming, and Schwienbacher, 2006; Cumming, 2008; Bris and Cabolis, 2008; Ferreira et al., 2010; Nahata et al., 2014). The country risk index is a composite index: political risk components account for 50% and the rest consists of economic and financial risk components. Political risk components include: government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and bureaucracy quality. Economic risk rating aims to provide a measure of a country's current economic strengths and weakness. It includes following components: GDP per head, real GDP growth, annual inflation rate, budget balance as a percentage of GDP, and current account as a percentage of GDP. Financial risk rating measures a country's ability to finance its official, commercial, and trade debt obligations. It includes following components: foreign debt as a percentage of GDP, foreign

debt services as a percentage of exports of goods and services, current age account as a percentage of exports of goods and services, net international liquidity as months of import cover, and exchange rate stability. The composite index calculation method is developed and used in several law and institution studies such as Cumming et al. (2006) and Nahata et al. (2014). As argued by Nahata et al. (2014), the positive aspect of using a single composite index is to alleviate the influence of multicollinearity when all individual variables are included.

Bhagwat, Brogaard, and Julio (2017) classify countries into three groups based the political risk components: medium risk country (political risk score is between 60 and 80), high risk country (political risk score is below 60), and the rest group (political risk score is higher than 80). In line with their measurement, to proxy institution quality of the portfolio company country, I create a dummy variable *Low_Risk_Country* which is defined as the one with composite rating score higher than 80 points in the ICRG database. Low risk countries have lower political, economic and financial risk and thus have higher institution quality. The variable *Institutional_Distance* is defined as the logarithm of the absolute difference between the country risk indices of PE firm country and portfolio company country. As a further test, I follow Berkowitz, Pistor, and Richard (2003) and Cumming et al. (2006) and construct a legality index. The legality index captures the impact of the quality of legal system on the buyout performance. Additionally, Meuleman and Wright (2011) state that the development of local LBO market is one of the key factors in the institutional context. A mature LBO market could facilitate the exit process because there are more buyout-related investment banks, law firms, and financial advisors and the transaction complexity could, therefore, be reduced. Also, PE firms could find more financial buyers and sell their portfolios via a secondary buyout. In line with Nahata et al. (2014), I construct the *LBO_Market_Development* variable as the aggregate number of LBOs in the country of the portfolio company from 1990 to the year prior to the initial buyout and normalize it by the world total number of LBOs in the same period.

To proxy for the cultural distance, I adopt the Hofstede's cultural distance. There are four dimensions in his cultural evaluation: power distance, individualism, masculinity, and uncertainty avoidance. I compute the multidimensional cultural distance between the country of the PE firms and the country of the portfolio company as follows:

$$\text{Cultural Distance} = \frac{(\sum_{i=1}^{4}(C_{TC,i} - C_{PE,i})^2)^{1/2}}{4}$$

where $C_{TC,i}$ is the portfolio company's national culture measured on element i and $C_{PE,i}$ is the leading PE firm's national culture measured on element i. To capture changes in the cultural distance, I use culture scores from Teras et al. (2011). These data are country-specific and time-varying over three periods: 1980s, 1990s, and 2000s. If the buyout year is between 1998 and 1999, the 1990s data will be used; if the buyout year is between 2000 and 2007, the 2000s data will be used. Following Nahata et al. (2014), if the data are missing for the 1990s, I will use 2000s score as the proxy. If the data are missing for both 1990s and 2000s, the 1980s score will be used as the proxy[4].

1.3.2.2.2 Factors Related to Learning

I construct four variables to measure different aspects of experience. Strömberg (2008) shows that the experience of PE firms consistently explains the global exit behaviour and the variation in holding periods. The first learning variable is the *Country_Experience*. Following Kogut and Singh (1998) and Humphery-Jenner et al. (2016), I construct this variable as the number of buyouts which the PE firm completed in the country of the portfolio company from 1990 to the year prior to the initial buyout. The second variable *Multinational_Experience* is

[4] There are three countries and regions where I could not obtain available culture information from Teras et al. (2011): the Channel Island, Iceland, and Luxemburg. Luxemburg is the portfolio company country or PE firm country in 29 investments, the Channel Island is the PE firm country in 6 investments, and Iceland is PE firm country in 1 investment, amounting to a total of 35 investments. I adopt the average of culture score in the group with a legal system of the same origin as the proxy, namely, the average of the French civil law group for Luxemburg, the average of English common law origin group for the Channel Island, and the average of Scandinavian civil law origin group for Iceland. In addition, I remove these 35 investments and re-run main regressions and find statistically and qualitatively similar results.

constructed as the number of foreign countries in which the PE firm invested from1990 to the year prior to the initial buyout (Barkema and Vermeulen, 1998). The next variable *Industrial_Experience* aims to capture the industrial specialization as each PE firm has its own industrial focus. For example, in Mergermarket records, the U.K. PE group 3i focuses more on Service industries. Industry experience is calculated as the number of buyouts which the PE firm completed in the industry of the portfolio company from 1990 to the year prior to the initial buyout. Further, as argued by Demiroglu and James (2010), experience will accumulate over time but this will not be able to distinguish between funds. Following Demiroglu and James (2010), I construct another variable *Reputation* based on recent experience, i.e. the total number of buyout transactions completed by the PE firm in the three years prior to the initial buyout. As there is a time gap between the initial buyout date and the final exit date, all measures link PE firms' experience to their future performance and thus avoid the reverse causality.

1.3.3 Summary Statistics

Table 1.1 provides descriptive statistics for the sample of cross-border buyouts. Panel A reports the incidence of buyout based on the buyout year. I classify the exit outcome types based on the Mergermarket records as of 31st December 2015: successful exits and unsuccessful exits. Successful exits represent 64% of the sample and portfolio companies are divested via IPO (4%) or M&A (60%)[5]. The sample suggests that PE firms prefer M&A as the way to divest their portfolios. Unsuccessful exits include other exits (7%) and non-exit ones (30%). Other exits are portfolio companies for which Mergermarket loses tracking information and non-exit portfolios are still privately held by PE firms. The sample is comparable to that used by Strömberg (2008) who reports one-third of portfolio companies are still private until

[5] For IPO: 110/2,665 = 4%; for M&A: 1,603/2,665 = 60%; for other exits: 180/2,665 = 7%; for non-exit ones: 772/2,665 = 30%.

2008 and M&A earns its popularity as the divestment alternative to IPO. In terms of the distribution of the sample, most buyout portfolios taking place in early years are exited successfully. For the buyout portfolios that took place in 2007, 47% of them are still private until 2015. The holding time is thus right censored.

[Insert Table 1.1 about here]

In panel B of Table 1.1, I show the incidence of buyout portfolios based on industry. Most portfolio companies operate in the Manufacturing industry, amounting to 45% of the deals. Service industry and Retail industry account for 24% and 7% of the buyouts, respectively. The distribution in terms of industry is comparable to that in Cao et al. (2015). The successful exit ratios within each industry are highest in Manufacturing (69%) and Service (66%) industries. I also find that in the Finance industry, the successful exit ratio (45%) is lower than other groups. To control the industry heterogeneity, I include the industry fixed effects in the empirical tests.

Panel C of Table 1.1 shows the clustering of buyouts across countries of portfolio companies. Cross-border buyouts in Germany constitute 12% of the deals and U.K. accounts for 10%. Cao et al. (2015) use a sample in which 60% of buyout transactions are in the U.S. and U.K. markets. My sample is more comprehensive as I include deals in both developed and developing markets. Further, emerging Asian countries have attracted foreign investors' attention in recent years, especially China and India, as there are rapid macroeconomic growth, demographic change, and legal and financial reforms (Dai et al., 2012). India and China account for 5% and 4% of the deals, respectively. I find that in these countries, the successful exit ratio is lower and less than 50%. This result is consistent with Lerner, Sørensen, and Strömberg (2009) who find a low exit ratio in emerging Asian countries. I list the countries of PE firms in panel D of Table 1.1 U.S. and U.K. markets are generally believed to be the most

developed LBO markets, and PE specialists from these two countries contribute to 67% of the buyouts.

Table 1.2 reports the descriptive statistics for main explanatory variables. The average deal value is around 523 million USD (logarithm value of 4.901) which is close to 526 million USD reported in Cao et al. (2015).

[Insert Table 1.2 about here]

1.4 Empirical Results and Discussions

1.4.1 Aggregate Cross-border Buyout Successful Exit Ratio

In this section, I test the relationship between cross-border buyout exit success and institutional and cultural factors at the country level as well as country-pair level. For the country-level test, I follow Ferreira et al. (2010) and adopt a specification that allows for heteroscedaisticity, cross-correlation, and autocorrelation in the error term, cluster the standard errors at portfolio company country level, and include year fixed effects. Alternatively, I follow Bekaert et al. (2005) and Ferreira et al. (2010) and use seemingly unrelated regression (SUR) standard errors to adjust for heteroscedasticity, cross-sectional correlation, and autocorrelation. Because of the heteroscedasticity adjustment, generally, the SUR standard errors are smaller than the OLS standard errors. For the country-pair-level test, I cluster the standard errors in the country-pair level.

[Insert Table 1.3 about here]

As can be seen in Table 1.3, the successful exit ratio is positively related to the institution quality of the portfolio company country across all specifications. In columns 4 and 5, the ratio is negatively related to the institutional distance between portfolio company country

and PE firm country. However, cultural distance has no significant influence on the exit success. Overall, the results in Table 1.3 support hypotheses 1a the "law matters" view and 1b (La Porta et al., 1998; Nahata et al., 2014; Cao et al., 2015). I could not reject the null hypothesis regarding the cultural distance. In the country of well-developed institution system, information asymmetry and transaction cost could be lower and PE firms are more likely to bring their portfolio company to IPO or M&A. However, if PE firms are unfamiliar with the local institutional rules, information asymmetry and transaction cost are higher, and it is more difficult for them to successfully exit the portfolio companies.

1.4.2 Likelihood of a Successful Exit – Hazard Rate of a Successful Exit

I apply the survival analysis to analyse the impact of the chosen explanatory variables on the time-to-successful exit. After the initial buyout, a portfolio company can be privately held, unidentified as tracking details are missing, or divested via IPO or M&A. The right-censored observations in the dataset are those portfolio companies that are either privately held as of the cut-off date 31st December 2015 or lost. I follow Nahata (2008) and Nahata et al. (2014) and use a dichotomous variable describing the status of a portfolio company as either successful exits (IPO and M&A) or unsuccessful exits (other exits and non-exit ones). In survival models, I interpret the probability of a failure event for a buyout portfolio as the probability of its exit success. I adopt both non-parametric and semi-parametric approaches of survival analysis to assess the influence of chosen explanatory variables on the failure and hazard functions. The non-parametric analysis provides insights into the difference between groups. The semi-parametric approach could be used for the multivariate analysis.

1.4.2.1 Non-parametric Analysis

In the non-parametric analysis, I categorise the sample based on institution quality, institutional distance, cultural distance, and reputation. I create three new dummy variables. The first one is *Familiar_Institution* which equals one, if the institutional distance belongs to the lowest quartile, and zero otherwise. The second dummy variable is *Familiar_Culture* which equals one if the cultural distance belongs to the lowest quartile and zero otherwise. Further, the variable *Reputable_PE* is an indicator variable denoting whether the PE firm belongs to the top quartile of reputable PE firm groups based on the reputation measurement in the year prior to the initial buyout. In Kaplan-Meier estimations, the failure function is the cumulative probability of a successful exit at any given time *t*.

[Insert Figure 1-4 about here]

In Figures 1-4, I plot the Kaplan-Meier failure functions based on the institutional quality, institutional distance, cultural distance, and reputation, respectively. As plotted in Figure 1, the probability of a successful exit at any given time is always higher for the low risk country group. In the unreported log-rank test, the difference between these two failure functions is significant at 1% level ($\chi^2 = 77.94$). The result suggests that in the low risk country (i.e. higher institutional environment quality), PE firms have higher likelihoods of bringing portfolio companies to successful exits. Figure 2 shows the plot of Kaplan-Meier functions based on institutional difference. The failure function of Familiar Institutions group is always higher than the rest of the sample, suggesting a negative relationship between institutional distance and probability of a successful exit. The difference is significant at 1% level ($\chi^2 = 9.99$). In Figure 3, the curves of failure functions are parallel to each other to a large degree, and one could therefore expect that there is no significant difference between familiar culture group and the rest. The difference in their failure functions is not statistically

significant ($\chi^2 = 1.45$). The PE firms are not influenced by cultural distance. Finally, as shown in Figure 4, the Kaplan-Meier failure function plot of the reputable PE firm is consistently above that of the non-reputable PE firm. The difference of these failure functions is significant at the 1% level ($\chi^2 = 27.90$). This result suggests that reputable PE firms have better performance in cross-border buyout investments.

Overall, the results of the non-parametric analyses suggest the institutional environment quality and reputation are positively associated with the buyout performance and institutional distance is negatively related to the buyout performance, supporting hypotheses 1a the "law matters" view, 1b and 3a. In addition, I find insignificant influences of cultural differences on the buyout performance.

1.4.2.2 Semi-parametric Analysis

In this section, I perform the Cox Proportional Hazard estimation. In the survival model, the hazard rate can be referred to as the probability of a successful exit during one unit of time, conditional on unsuccessful exit up to time *t* (Axelson and Martinovic, 2013). The Cox Hazard model regresses the logarithm of the hazard function on the explanatory variables. A positive and significant coefficient would imply a higher hazard rate and a shorter expected holding duration. A negative and significant coefficient would imply a lower hazard rate and a longer expected holding duration.

[Insert Table 1.4 about here]

Across models 1-4 in Table 1.4, I relate the all institutional and cultural factors, deal characteristics and country-pair control variables to the likelihood of a successful exit. To avoid multicollinearity, I include measurements of experience variables separately. As reported in models 1-4 of Table 1.4, the hazard rate of a successful exit increases when (1) PE firms invest

in low risk countries, (2) PE firms are more experienced, (3) management participates in the deal and (4) deal value is larger. The hazard rate of a successful exit decreases when the institutional distance is larger, when the club size is larger, and when the PE firm is geographically far away from the portfolio company.

Firstly, coefficients of the variable *Low_Risk_Country* are positive and statistically significant. In low risk countries, the likelihood of a successful exit is higher, and the expected holding time is shorter. In model 1, the coefficient of 0.275 on *Low_Risk_Country* indicates that the estimated hazard ratio of the group based on the dummy *Low_Risk_Country* is 1.317[6]. Therefore, the hazard of successful exit when PE firms invest in low risk countries is 1.317 times higher than that when PE firms invest in other countries. This evidence is consistent with survival studies on PE performance (Cumming et al., 2006; Nahata et al., 2014) and provides support to the "law matters" view.

Secondly, the coefficients on *Institutional_Distance* is negative and statistically significant at least at the 5% level. If PE firms are unfamiliar with the institutional environment and institutional distance is larger, the probability of successful exit is lower, and it takes longer time for them to exit. The results suggest that institutional barriers are the investment obstacles which is consistent with the previous cross-border PE studies (Li et al., 2014; Buchner et al., 2017). This finding supports the hypothesis 1b.

Coefficients of the variable *Culture_Distance* are insignificant across all models and this paper fail to reject the null hypothesis that cultural differences will not influence the performance. This result implies that PE firms which are sophisticated investors (Cao et al., 2015) suffer from minimal adverse influences of cultural differences. This is different from the findings on VC by Nahata et al. (2014) who show a positive influence of cultural differences

[6] The hazard ratio = $e^{0.275} = 1.317$

on VC exit performance and Li et al. (2014) and Buchner et al., (2017) who document a negative relationship. Compared to VC firms, buyout firms conduct the LBO to acquire the late-stage and mature firms which could generate enough operating cash flow to repay the debt (Jensen, 1989). Consequently, the sophisticated buyout specialist relies on hard information and thus overcomes the barrier of cultural differences.

In line with Cressey et al. (2007), Gompers et al. (2008), Nahata (2008), Demiroglu and James (2010) and Meuleman and Wright (2011), PE firms' experience and reputation have positive impacts on investment performance. Specifically, country experience which offers local insights, multinational experience which brings in the knowledge of different institutions, industrial experience which offers deep industrial insights, and reputation based on deal experience which serves as the certification to resolve asymmetric information problems, all of which help PE firms achieve higher likelihoods of a successful exit in the cross-border buyout. The findings support the hypothesis 3a.

I also show that management participation which reduces the information asymmetry between insiders and PE managers helps to improve the buyout performance. In terms of club size, I find the diseconomies of scale of the PE club as the larger PE club takes a longer time to successfully divest the portfolio company. In the later section 1.4.3, club size is positively associated with the likelihood of going IPO and negatively associated with the choice of M&A. PE firms frequently adopt M&A as the route to divest portfolio companies, but IPO is considered as the most successful way (Gompers, 1996). Combining these results, one could argue that although it takes more time for the larger PE club to divest the portfolio company, the large PE club improves the cross-border buyout performance in a modest way as it increases the probability of bringing the portfolio company to the market through an IPO. When the geographic distance is taken into consideration, I provide consistent evidence to support the

geographic proximity studies (Chen, Gompers, Kovner, and Lerner, 2010). PE firms are less likely to exit successfully if they are far away from their portfolio companies.

In model 5, instead of using the country risk classification to proxy institution quality, I follow Berkowitz et al. (2003) and Cumming et al. (2006) and adopt the legality index. I find that the legality index is positively related to the investment performance and statistically significant at 10% level. The result indicates that well-developed legal systems which generally reduce the information asymmetry and transaction complexity are beneficial to improve the buyout performance. In model 6, I include the deal value to control for the size effect and I find that the larger the size, the higher the probability of successful divestment.

To examine the mitigation effects of a PE firms' deal experience on institutional distance, I construct interaction terms of institutional distance and four deal experience variables and include them in the models separately. The results are reported in Table 1.5.

[Insert Table 1.5 about here]

The coefficients of interaction terms institutional distance and country-specific experience, multinational experience, and reputation based on recent deal experience are statistically insignificant. The results suggest that only having the knowledge about the local institution, business and international practice might not be enough for PE firms to overcome the intuitional barriers. The findings are consistent with Li et al. (2014). However, the coefficient of the interaction term of institutional distance and industrial experience are positive and significant at the 5% level. In cross-border activities, PE firms could effectively transfer the governance structure and enforce the contract design if they have substantial experience in the portfolio company's industry. As PE firms tend to specialize in particular industries, compared to other experience, the industrial experience is more important in their investment activities. The findings are consistent with Cressy et al. (2007) and Gompers et al. (2008).

Overall, the results of the Cox Proportional Hazard analysis suggest that the hazard rate of a successful exit has a positive relationship with the quality of the institutional environment, PE firms' experience and management participation, and has a negative relationship with institutional distance and geographic distance, providing supporting evidence to hypotheses 1a "law matters" view, 1b and 3a. Moreover, this paper documents that PE firms' industrial experience could help to overcome the adverse influence of institutional distance, which supports the hypothesis 3b.

1.4.3 Exit Strategies: IPO versus M&A

1.4.3.1 Multinomial Analysis on the Status

To test whether the chosen factors have different impacts on the choice between IPO and M&A as exit strategies, I firstly relate the choice of IPO relative to M&A as the exit strategies, and then perform the multinomial logit analysis. The base category for the multinomial analysis is the group of portfolio companies with unsuccessful exits (other exits and non-exit ones).

[Insert Table 1.6 about here]

As shown in model 1 of Table 1.6, the choice of IPO as the exit strategy over M&A mainly depends on deal characteristics. With management participation, the PE firm prefers the M&A over IPO as the exit strategy. The larger the PE club size, the higher the likelihood of PE firms bringing the portfolio company to the market through an IPO. The deal value matters for the exit strategy as there are certain threshold limits on the IPO requirement (Brau, Francis, and Kohers, 2003). The larger the deal value, the higher the probability of going IPO.

In models 2-5, I relate the learning variables separately as well as other explanatory variables to the choice of the exit strategy. As shown in Table 1.6, compared to the group with

unsuccessful exits, the likelihood of choosing IPO increases when private equity firms are more experienced, when the club size is larger, and when the initial buyout value is higher. M&A is the most frequently adopted exit route by buyout specialists. Compared to the unsuccessful exits group, the quality of institutional environment is positively associated with the likelihood of choosing a takeover. In addition, the PE firm's experience and reputation help to increase the likelihood of conducting M&A. These findings support the conjecture based on the "law matters" and "experience matters" views. Also, compared to the unsuccessful exits group, the PE firm is more likely to divest the portfolio company via M&A if management participates in the buyout. In terms of club size, a larger PE club aims for the most successful divestment way IPO (Gompers, 1996).

Overall, the results of the multinomial logit analysis show that the probability of bringing the portfolio company to the market through an IPO increases when PE firms are more experienced, the PE club size is larger and deal value is higher. The probability of divesting the portfolio company via M&A rises when the quality of the institutional environment is higher, when the PE firms are more experienced, and when the management participates in the buyout.

1.4.3.2 Holding Time for IPO and M&A

I also perform the survival analysis on the choice between IPO and M&A as exit strategies and report the results in Table 1.7. The specifications used for this test are the same as those in Table 1.5.

[Insert Table 1.7 about here]

As shown in Table 1.7, the hazard rate of choosing IPO as the exit strategy is related to the deal characteristics: it increases when PE firms are more experienced, when the PE club

size is larger, and when the initial buyout value is larger. Like the findings in Table 1.6, coefficients of all institutional variables are insignificant for the choice of going IPO, and the coefficient of the variable Legality Index remains positive. In terms of the hazard rate of choosing M&A as the exit strategy, I find that it is positively related to the institutional environment quality and PE firms' experience. Also, management participation increases the hazard rate of choosing M&A. Finally, PE club size is positively related to the choice of IPO as the exit route and negatively related to the choice of M&A.

1.4.4 IRR and Exit Multiple

Constrained by the data availability, just a few studies consider PE returns and most studies measure performance in terms of exit success (Buchner et al., 2017). Mergermarket database does not provide detailed cash flow data, but it records the initial investment value and exit sale value for certain transactions. I acknowledge that the sample of IRR and exit multiple is relatively small as 161 out of 2,665 investments have available information for buyout value, buyout date, exit value, and exit date. I calculate the IRR as the discount rate which equates the exit value to the buyout value and exit multiple as the value of exit value to the buyout value.

[Insert Table 1.8 about here]

Table 1.8 reports the results on IRR and exit multiple. The coefficient of *Low_Risk_Country* is significant at the 10% level and suggests that in a country of high institution quality, PE firms are more likely to receive higher returns. This study documents no evidence on the influence of institutional distance on returns. The coefficient sign of *Institutional_Distance* is negative, albeit insignificant, which is consistent with Buchner et al. (2017), and suggests that institutional distance might be detrimental to the returns. I also find that the management participation is negatively related to the IRR and exit multiple. Previous

results suggest that management participation leads to a shorter holding time. The combined findings indicate that management might be eager to exit the portfolio company even though the IRR and exit multiple are lower.

1.4.5 Robustness Tests

1.4.5.1 Selection Bias

The results of the analyses of the successful exit can be biased if I ignore the fact that the performance is not due to the experience of PE firms, but to the selection of high quality portfolio companies. Sørensen (2007) argues that the endogeneity originates from two effects: selection effect and monitoring effect. Selection effect means that more experienced PE firms select companies of higher quality while monitoring effects mean that PE activities after the acquisition add value to the target company. To address concerns of endogeneity, I follow Nahata (2008) and use the Heckman's (1979) correction procedure. The dependent variable *Experienced_PE* in the selection stage is an indicator variable denoting whether the PE firm belongs to the top quartile of experienced PE firm group based on the industrial experience measurement in the year prior to the initial buyout. Nahata (2008) adopts the total VC funding as the proxy for the company quality. Buyout specialists invest in the late stage and usually do not enter further stage financing. This study adopts the deal value which captures the company quality to a certain degree. Sørensen (2007) and Bottazzi, Da Rin, and Hellmann (2008) argue that aggregate market characteristics are good candidates for exogenous variables because the distribution of companies and investors in various markets is exogenous. As shown in Panel D of Table 1.1, U.S. and U.K. PE firms are the most active cross-border buyout investors. These two markets are the most two developed markets for PE investment and buyout specialists from these two markets tend to accumulate more experience. I use two PE firms' country origins U.S. and U.K. to create two dummy variables as exogenous variables. Intuitively, for example,

a portfolio company in Australia is more likely to encounter foreign investors from U.S. and U.K.. These investors are more likely to be experienced buyout specialists. However, conditioned on encountering an experienced investor, there is no more screening advantage and the quality of investment of an experienced U.S. or U.K. investor is not necessarily better than that of an experienced France investor. Further, some PE firms are public companies and they establish the reputation as a listed company. I include these explanatory variables in the selection step plus other deal characteristics variables. The first stage model estimates the likelihood of the experienced PE firm investing in the portfolio company. I then add the inverse Mills ratio from the first step into the second step regression to estimate the performance. The specifications thus are:

First step (selection):

$$Experienced\_PE_i = \text{Probit}(K_j), \text{where } K_i = \alpha_j + \beta_1 Deal\_Value_i + \beta_2 Management_i + \beta_3 Club\_Size_i + \beta_4 U.S.\_PE_i + \beta_5 U.K.\_PE_i + \beta_6 Listed\_PE_i$$

Second step:

(Cox Hazard): $Hazard\_Rate = \lambda(t|X) = \lambda_0(t) * e^{x_i'\beta_i + \beta\, Inverse\_Mills\_Ratio}$

(Logit): IPO vs M&A = $\text{Logit}(y_i), \text{where } y_i = \alpha_i + x_i'\beta_i + \beta Inverse\_Mills\_Ratio$

[Insert Table 1.9 about here]

As shown in Table 1.9, in the selection stage, the likelihood of the experienced PE firm investing in the portfolio company is higher when the initial buyout value is larger, when the PE firm is from the U.S. or the U.K., and when the PE firm is a public company. In the second step, I find that after controlling for the selection bias, the probability and the hazard rate of successful exits increase when the institutional environment quality is higher, when PE firms

have a better reputation and when the management team participates in the deal. I also find consistent evidence of the mitigation effect of industrial experience on institutional distance. In terms of the choice between IPO and M&A as exit strategies, deal characteristics are important in the decision-making process.

1.4.5.2 Imputed Deal Value

The sample includes 2,665 cross-border buyout deals but the size decreases to 1,997 if the deal value is considered. The sample reduction through the missing values might result in biased estimation. To alleviate the concern of missing value, I follow Strömberg (2008) and adopt the multiple imputation to create the complete case dataset.

[Insert Table 1.10 about here]

In Table 1.10, I present re-estimations of the main models with deal value imputed based on the multiple imputation. The main results remain consistent with previous tests. Institution quality and private equity firms' experience insert positive influence on buyout performance while institutional distance has the opposite effect. Moreover, industrial experience could mitigate the adverse effects of institutional distance.

1.5 Conclusion

This study examines the determinants of the cross-border buyout performance, focusing on institutional and learning factors. I use the Mergermarket database and obtain a sample of 2,665 cross-border buyout transactions in 40 countries from 1998 to 2007. Firstly, I test the relationship between sucessful exit ratio and the factors mentioned above. To study the likelihood of a successful exit, I follow Hochberg et al. (2007), Nahata (2008), and Nahata et al. (2014) and use the survival analysis to examine the determinants of exit success. I conduct additional analyses to examine the impact of chosen explanatory variables on the choice of exit

strategies and IRR/exit multiple.

I find that the institutional environment quality is positively related to the likelihood of successful exits while the likelihood decreases when the institutional differences between PE country and portfolio company country are larger. The result is in line with Nahata et al. (2014) and consistent with the "law matters" view (La porta et al., 1997, 1998). Further, cultural differences do not play a role in determing cross-border buyout performance. I measure PE firms' learning from four aspects: country-specific experience, multinational experience, industry experience and reputation. Consistent with previous studies (Cressey et al. 2007; Gompers et al., 2008; Nahata, 2008), I find that more experienced PE firms perform better and their industrial experience has a mitigation effect. In the additional analyses examining the choice of exit routes, PE experience, PE club size, and initial buyout value are positively associated with the likelihood of going IPO. As the most frequently used exit strategy, M&A is more likely to be adopted when the institutional environment quality is higher and when PE firms learn more from their past activities. Finally, the institution quality of portfolio company country is positively related to the IRR. This study is the first using a novel dataset of portfolio companies' details of PE firms around the world to offer important insights into the determinants of buyout success in both developed and developing countries.

Appendix 1.1: Variable definition

Variables	Definition and Source
Dependent variables	
Hazard_Rate	Conditional probability that the PE firm could exit the portfolio company successfully.
Exit_Types	Exit types include three categories: IPO, M&A (Secondary buyout and trade sales), and unsuccessful exits (other exits and non-exit ones). (Source: Mergermarket)
Institutions	
Low_Risk_Country	Dummy variable which equals one if the country risk index of the portfolio company's country is higher than 80. The country risk index consists of political risk components with 50% weight, economic risk components with 25% weight and financial risk components with 25% weight. (Source: International Country Risk Guide)
Institutional_Distance	Logarithm of one plus the absolute value of the country risk index difference between the country of portfolio company and the country of the PE firm. (Source: International Country Risk Guide)
Legality_Index	Legality Index = 0.381*(Efficiency of Judiciary) + 0.5578*(Rule of Law) + 0.5031*(Corruption) + 0.3468*(Risk of Expropriation) + 0.3842 * (Risk of Contract Repudiation). (Source: La Porta et al., 1998).
Cultural_Distance	The cultural distance between the country of the leading PE firm and country of the portfolio company. It is measured as the distance between Hofstede's four-dimensional cultural factors on time-varying meta-analytic scores: power distance, individualism, uncertainty avoidance and masculinity. (Source: Taras et al., 2011)
Buyout_Market_ Development	The number of buyouts in the country of the portfolio company from 1990 to the year prior to the initial buyout. The number is then normalized by the world total number of buyouts in the same period. (Source: SDC Platinum M&A)
Learning	
Country_Experience	Logarithm of one plus the number of buyouts which the PE firm completed in the country of the portfolio company from 1990 to the year prior to the initial buyout. (Source: Mergermarket and SDC Platinum M&A)
Multinational_Experience	Logarithm of one plus the number of foreign countries in which the PE firm invested from1990 to the year prior to the initial buyout. (Source: Mergermarket and SDC Platinum M&A)
Industrial_Experience	Logarithm of one plus as the number of buyouts which the PE firm completed in the industry of the portfolio company from 1990 to the year prior to the initial buyout. (Source: Mergermarket and SDC Platinum M&A)
Reputation	Logarithm of one plus the number of buyouts completed by the PE firm three years prior to the initial buyout. (Source: Mergermarket and SDC Platinum M&A)
Deal Characteristics	
Management	Dummy variable which equals one if the management participates in the initial buyout transaction and zero otherwise. (Source: Mergermarket, SDC Platinum M&A, and Zephyr)
Club_Size	The number of PE firms in the club deal. (Source: Mergermarket, SDC Platinum M&A, and Zephyr)
Deal_Value	Logarithm of buyout deal value (Source: Mergermarket, SDC Platinum M&A, and Zephyr)
PE Characteristics	
U.S._PE	Dummy variable which equals one if the PE firm headquarters in the U.S. and zero otherwise. (Source: Mergermarket)
U.K._PE	Dummy variable which equals one if the PE firm headquarters in the U.K. and zero otherwise. (Source: Mergermarket)
Listed_PE	Dummy variable which equals one if the PE firm is listed in stock exchange and zero otherwise. (Source: Orbis)
Country-pair Controls	
Common_Religion	Dummy variable which equals one if the country of the PE firm and the country of the portfolio company have the same primary religion and zero otherwise. (Source: CIA World Factbook)
Common_Language	Dummy variable which equals one if the country of the PE firm and the country of the portfolio company have the same first official language and zero otherwise. (Source: CIA World Factbook)
Common_Law-Origin	Dummy variable which equals one if the country of the PE firm and the country of the portfolio company have the same legal origin and zero otherwise. (Source: Foreign Law Guide database)
Geographic_Distance	Logarithm of geographic distance between the most populated city of the country of the PE firm and the country of the portfolio company. (Source: CEPII)

Appendix 1.2: Description of Variables

Factors related to deal characteristics

With the management team participating in the buyout transaction, the information asymmetry between PE firms and the portfolio company could be reduced and hence a better performance is anticipated. To account for the corporate governance characteristics, I adopt the dummy variable *Management* which equals one if the deal is defined as "management buyout" in Mergermarket, "acquirer including management" in SDC Platinum M&A database, or "management buyout" in Zephyr.

Further, to account for the syndication among PE firms, the variable *Club_Size* is included. Officer, Ozbas, and Sensoy (2010) demonstrate that the PE club pays less for the buyout transaction and such lower pricing might be an inadvertent by-product of an unobserved motivation for club deals. Meuleman and Wright (2011) find that institutional differences induce U.K. PE firms to cooperate with a local PE firm when they invest in continental Europe. The variable Club Size[7] is calculated as the number of PE firms in the deal. Moreover, Nahata (2008) includes the total funding amount across all rounds to capture the quality of the portfolio company. The higher the total funding across all rounds, the better the company quality. He admits that because of the data limitation, the proxy is imperfect and involves the look-ahead bias. Mergermarket, SDC and Zephyr provide little information on portfolio companies other than transaction details. In a similar manner of Nahata (2008), I include the deal value to measure the size effect and the quality of the portfolio company. The larger the deal value, the larger the investment the PE firm makes. The deal value thus could capture the quality of the portfolio company to a certain degree. The deal value information is from the "buy value" in Mergermarket, "transaction value" in SDC Platinum M&A or "deal value" in Zephyr.

Factors related to country-pair controls

I also consider other types variables measuring the link between the country of the PE firm and the country of the portfolio company. Guiso, Sapienza, and Zingales (2003) and Aizenman and Kendall (2008) show that religion and language have an impact on the economic development. The religion and language information is extracted from Central Intelligent Agency (CIA) World Factbook. Variable *Common_Religion* is a dummy variable that equals one if the country of the PE firm and the country of the portfolio company have the same primary religion. Variable *Common_Language* is the dummy variable that equals one if they have the same first official language. Also, I track the law origin and commercial code of both portfolio companies' nations and PE firms' nations in Foreign Law Guide database. Following previous law and finance studies such as La Porta et al. (1998) and Lerner and Schoar (2005), the world legal systems are divided into six groups: English common law, French civil law, German civil law, Scandinavian civil law, Islamic law and Socialism background law. Variable *Common_Law_Origin* is a dummy variable that equals one if country of the PE firm and the country of the portfolio company have the same legal origin. Finally, geographic proximity could favour the participation of PE firms in portfolio companies and improve the performance (Chen et al., 2010). I measure the geographic proximity by using the geographic distance between the most populated city of the country of the portfolio company and the country of the PE firm. The data is from CEPII database.

[7] To find the club size in Mergermarket, I read through the details in buyer description, seller description, equity provider and deal description, and figure out the number of PE firms.

Table 1.1: Distribution of buyouts and exit types

Panel A: Temporal distribution

Panel A illustrates the distribution of buyouts and exit types by the buyout year. The buyout sample includes 2,665 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket.

Year	Successful exits			Unsuccessful exits			Total
	IPO	M&A	Sub total	Other exits	Non-exit	Sub total	
1998	2	75	77	8	11	19	96
1999	10	107	117	7	15	22	139
2000	6	117	123	11	13	24	147
2001	5	86	91	7	21	28	119
2002	7	117	124	12	20	32	156
2003	11	137	148	12	25	37	185
2004	14	205	219	19	66	85	304
2005	17	253	270	24	123	147	417
2006	23	272	295	39	221	260	555
2007	15	234	249	41	257	298	547
Total	110	1,603	1713	180	772	952	2,665

Panel B: Industrial distribution

Panel B illustrates the distribution of buyouts and exit types by industry. The sample includes 2,665 worldwide buyouts over 11 SIC two-digit industries. The sample is extracted from Mergermarket.

Industry	Successful exits			Unsuccessful exits			Total
	IPO	M&A	Sub total	Other exits	Non-exit	Sub total	
Agriculture	0	4	4	1	2	3	7
Mining	5	14	19	3	11	14	33
Construction	2	29	31	5	20	25	56
Manufacturing	45	778	823	86	277	363	1,186
Transportation	1	55	56	6	31	37	93
Communication	9	89	98	10	49	59	157
Energy	1	36	37	3	24	27	64
Whole Sales	4	42	46	4	18	22	68
Retails	10	112	122	13	61	74	196
Finance	6	68	74	12	80	92	166
Services	27	376	403	37	199	236	639
Total	110	1,603	1713	180	772	952	2,665

Panel C: Countries of portfolio companies

Panel C illustrates the distribution of buyouts and exit types by countries of portfolio companies. The sample includes 2,665 worldwide buyouts across 40 countries and regions. The sample is extracted from Mergermarket. Panel C includes the top ten countries in terms of the number of buyouts and presents them in descending order.

Target Country	Successful exits			Unsuccessful exits			Total
	IPO	M&A	Sub total	Other exits	Non-exit	Sub total	
Germany	10	251	261	19	48	67	328
U.K.	12	160	172	16	89	105	277
France	4	183	187	17	56	73	260
U.S.	7	104	111	19	54	73	184
India	4	47	51	15	73	88	139
Netherlands	7	81	88	11	36	47	135
Italy	3	88	91	7	32	39	130
Sweden	9	73	82	4	30	34	116
China	16	21	37	9	56	65	102
Canada	5	44	49	7	40	47	96

Panel D: Countries of PE firms

Panel D illustrates the distribution of buyouts and exit types by countries of PE firms. The PE firms are from 42 countries and regions. The sample is extracted from Mergermarket. Panel D includes top ten countries in terms of the number of buyouts and presents them in descending order.

PE Country	Successful exits			Unsuccessful exits			Total
	IPO	M&A	Sub total	Other exits	Non-exit	Sub total	
U.S.	48	513	561	58	332	390	951
U.K.	40	590	630	51	149	200	830
France	5	68	73	12	21	33	106
Australia	1	43	44	9	43	52	96
Netherlands	1	59	60	4	16	20	80
Sweden	3	49	52	4	18	22	74
Hong Kong	2	29	31	5	29	34	65
Bahrain	1	44	45	7	9	16	61
Germany	0	30	30	6	9	15	45
Singapore	1	10	11	4	27	31	42

Table 1.2: Summary statistics

The table shows the summary statistics for key explanatory variables. The sample includes 2,665 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Variable	N	Mean	Std.	Min	Max
Institutions					
Low_Risk_Country	2,665	0.628	0.483	0	1
Institutional_Distance	2.665	1.559	0.677	0.000	3.370
Cultural_Distance	2,665	0.290	0.136	0.000	0.976
LBO_Market_Development	2,665	0.075	0.123	0.000	0.457
Legality_Index	2,665	18.778	1.167	11.733	21.714
Learning					
Country_Experience	2,665	0.785	0.871	0.000	3.780
Multinationa_Experience	2,665	1.309	0.931	0.000	3.220
Industrial_Experience	2,665	1.627	1.255	0.000	5.160
Reputation	2,665	2.213	1.118	0.000	4.440
Deal Characteristics					
Management	2,665	0.370	0.483	0.000	1.000
Club_Size	2,665	1.416	0.905	1.000	11.000
Deal_Value	1,997	4.901	1.561	2.303	7.623
Country-pair Controls					
Common_Religion	2,665	0.214	0.410	0.000	1.000
Common_Language	2,665	0.219	0.413	0.000	1.000
Common_Law-origin	2,665	0.383	0.486	0.000	1.000
Geographic_Distance	2,665	4.229	4.212	1.730	19.147

Table 1.3: Success ratio analysis

The sample includes 2,665 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. The dependent variable in specifications 1-3 is successful exit ratio at the country *i* and investment year *t*. The dependent variable is specifications 3-5 is the successful exit ratio at the country pair level *j* and in investment year *t*. Robust standard errors are clustered at the portfolio company country level in models (1) and (3) and are in parentheses. SUR standard errors are used in model (2) and are in parentheses. Robust standard errors are clustered at the country-pair level in models (4) and (5) and are in parentheses *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Model	Country (1)	Country (2)	Country (3)	Country-Pair (4)	Country-Pair (5)
Institutions					
Low_Risk_Country	0.086*	0.125***		0.103***	0.100***
	(0.046)	(0.034)		(0.036)	(0.033)
Institutional_Distance				-0.055***	-0.056***
				(0.019)	(0.020)
Cultural_Distance				0.068	-0.005
				(0.098)	(0.100)
Legality_Index			0.204*		
			(0.114)		
Country-pair Controls					
Common_Religion					-0.028
					(0.038)
Common_Language					-0.109**
					(0.053)
Common_Law-Origin					0.015
					(0.035)
Geographic_Distance					-0.019*
					(0.011)
Observations	318	318	318	919	919
Year FE	Yes	No	Yes	Yes	Yes
R^2	0.232	0.041	0.227	0.140	0.151

Table 1.4: Cox proportional hazard estimation

The sample includes 2,665 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. The hazard rate is the conditional probability that the PE firm exits the portfolio company successfully. The holding time of the successful portfolio company is the total months from the buyout date to the successful exit date. For portfolio companies with unsuccessful exits, the holding time is the number of months between the buyout date and 31st December 2015 or the last available tracking date. In Cox hazard model, the failure event is the case that the PE firm divests the portfolio company via IPO or M&A before the end of 2015. Robust standard errors clustered at the portfolio company country level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Model	(1)	(2)	(3)	(4)	(5)	(6)
Institutions						
Low_Risk_Country	0.275***	0.231***	0.225***	0.218***		0.183***
	(0.081)	(0.075)	(0.073)	(0.076)		(0.070)
Institutional_Distance	-0.076**	-0.097***	-0.086**	-0.089***	-0.085**	-0.107***
	(0.035)	(0.033)	(0.034)	(0.034)	(0.035)	(0.039)
Cultural_Distance	-0.234	-0.313	-0.268	-0.275	-0.320	-0.230
	(0.231)	(0.224)	(0.221)	(0.226)	(0.239)	(0.255)
LBO_Market_Development	-0.392**	0.035	0.070	0.063	-0.219	-0.006
	(0.173)	(0.167)	(0.169)	(0.173)	(0.213)	(0.195)
Legality_Index					0.682**	
					(0.298)	
Learning						
Country_Experience	0.180***					
	(0.033)					
Multinational_Experience		0.229***				
		(0.029)				
Industrial_Experience			0.162***			
			(0.031)			
Reputation				0.183***	0.183***	0.182***
				(0.023)	(0.023)	(0.025)
Deal Characteristics						
Management	0.222***	0.215***	0.202***	0.199***	0.191***	0.260***
	(0.056)	(0.063)	(0.061)	(0.060)	(0.060)	(0.066)
Club_Size	-0.090***	-0.096***	-0.090***	-0.087***	-0.093***	-0.111***
	(0.032)	(0.033)	(0.034)	(0.033)	(0.033)	(0.035)
Deal_Value						0.073***
						(0.021)
Country-pair Controls						
Common_Religion	-0.048	0.027	0.007	-0.010	-0.035	0.021
	(0.053)	(0.054)	(0.051)	(0.048)	(0.047)	(0.058)
Common_Language	-0.089	-0.105	-0.156	-0.124	-0.145	-0.170
	(0.110)	(0.110)	(0.111)	(0.111)	(0.108)	(0.133)
Common_Law-Origin	-0.088	-0.036	-0.032	-0.051	-0.026	-0.028
	(0.098)	(0.103)	(0.103)	(0.102)	(0.099)	(0.105)
Geographic_Distance	-0.030*	-0.068***	-0.053***	-0.060***	-0.054***	-0.061***
	(0.017)	(0.014)	(0.013)	(0.014)	(0.015)	(0.018)
Observations	2,665	2,665	2,665	2,665	2,665	1,997
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Log-Pseudolikelihood	-12403	-12389	-12393	-12388	-12389	-8722

Table 1.5: The role of PE firm's experience

The sample includes 2,665 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. The hazard rate is the conditional probability that the PE firm exits the portfolio company successfully. The holding time of the successful portfolio company is the total months from the buyout date to the successful exit date. For portfolio companies with unsuccessful exits, the holding time is the number of months between the buyout date and 31st December 2015 or the last available tracking date. In Cox hazard model, the failure event is the case that the PE firm divests the portfolio company via IPO or M&A before the end of 2015. Robust standard errors clustered at the portfolio company country level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Model	(1)	(2)	(3)	(4)
Institutions				
Low_Risk_Country	0.276***	0.227***	0.218***	0.214***
	(0.081)	(0.075)	(0.073)	(0.077)
Institutional_Distance	-0.097*	-0.168***	-0.186***	-0.158*
	(0.051)	(0.064)	(0.054)	(0.083)
Cultural_Distance	-0.229	-0.315	-0.248	-0.270
	(0.229)	(0.225)	(0.225)	(0.228)
LBO_Market_Development	-0.401**	0.039	0.083	0.063
	(0.175)	(0.163)	(0.169)	(0.172)
Learning				
Country_Experience	0.135*			
	(0.071)			
*Institutional_Distance*Country_Experience*	0.030			
	(0.042)			
Multinational_Experience		0.143**		
		(0.073)		
*Institutional_Distance*Multinational_Experience*		0.056		
		(0.046)		
Industrial_Experience			0.069*	
			(0.039)	
*Institutional_Distance*Industrial_Experience*			0.063**	
			(0.024)	
Reputation				0.135**
				(0.054)
*Institutional_Distance*Reputation*				0.032
				(0.035)
Deal Characteristics				
Management	0.221***	0.211***	0.193***	0.197***
	(0.056)	(0.063)	(0.061)	(0.061)
Club_Size	-0.091***	-0.096***	-0.091***	-0.087**
	(0.032)	(0.034)	(0.034)	(0.034)
Country-pair Controls				
Common_Religion	-0.045	0.019	0.006	-0.013
	(0.052)	(0.055)	(0.049)	(0.049)
Common_Language	-0.088	-0.098	-0.157	-0.119
	(0.110)	(0.107)	(0.108)	(0.109)
Common_Law-Origin	-0.086	-0.043	-0.033	-0.055
	(0.098)	(0.101)	(0.100)	(0.100)
Geographic_Distance	-0.031*	-0.073***	-0.058***	-0.062***
	(0.017)	(0.014)	(0.013)	(0.014)
Observations	2,665	2,665	2,665	2,665
Year FE & Industry FE	Yes	Yes	Yes	Yes
Log-Pseudolikelihood	-12403	-12388	-12391	-12388

Table 1.6: Multinomial logit analysis for choice of exit routes

The sample includes 1,997 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. The dependent variable in specification 1 is the dummy variable which equals one if the portfolio firm has gone public and zero if it is acquired. In specifications 2-5, the multinomial logit estimation is used. The base group in the multinomial logit model is group of portfolio companies with unsuccessful exits (other exits and non-exit ones). Robust standard errors clustered at the portfolio company country level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Model	IPO vs. M&A	IPO vs. Unsuccessful	M&A vs. Unsuccessful	IPO vs. Unsuccessful	M&A vs. Unsuccessful	IPO vs. Unsuccessful	M&A vs. Unsuccessful	IPO vs. Unsuccessful	M&A vs. Unsuccessful
	(1)	(2)		(3)		(4)		(5)	
Institutions									
Low_Risk_Country	-0.426	0.026	0.314**	-0.019	0.271**	-0.033	0.267**	-0.041	0.258*
	(0.389)	(0.379)	(0.134)	(0.361)	(0.136)	(0.366)	(0.134)	(0.362)	(0.136)
Institutional_Distance	0.211	-0.028	-0.226***	-0.071	-0.261***	-0.052	-0.239***	-0.037	-0.232***
	(0.159)	(0.150)	(0.067)	(0.148)	(0.064)	(0.147)	(0.066)	(0.148)	(0.069)
Cultural_Distance	1.892*	1.249	-0.390	1.071	-0.529	1.166	-0.446	1.176	-0.454
	(1.063)	(0.884)	(0.498)	(0.972)	(0.500)	(0.938)	(0.491)	(0.954)	(0.488)
LBO_Market_Development	-1.821	-2.299**	-0.206	-1.335	0.552	-1.490	0.476	-1.505	0.480
	(1.473)	(1.108)	(0.519)	(1.168)	(0.467)	(1.150)	(0.482)	(1.163)	(0.485)
Learning									
Country_Experience		0.323**	0.269***						
		(0.160)	(0.062)						
Multinational_Experience				0.427***	0.340***				
				(0.141)	(0.066)				
Industrial_Experience						0.300**	0.282***		
						(0.122)	(0.051)		
Reputation	0.048							0.303**	0.279***
	(0.123)							(0.118)	(0.046)
Deal Characteristics									
Management	-0.897***	-0.335*	0.523***	-0.354*	0.512***	-0.357*	0.495***	-0.360*	0.501***
	(0.246)	(0.177)	(0.112)	(0.185)	(0.112)	(0.185)	(0.115)	(0.186)	(0.111)
Club_Size	0.409***	0.117*	-0.263***	0.110*	-0.266***	0.113*	-0.258***	0.120*	-0.254***
	(0.098)	(0.065)	(0.062)	(0.065)	(0.062)	(0.066)	(0.063)	(0.066)	(0.063)
Deal_Value	0.327**	0.429***	0.127***	0.367***	0.075**	0.393***	0.090**	0.385***	0.087**
	(0.142)	(0.109)	(0.041)	(0.112)	(0.038)	(0.113)	(0.037)	(0.112)	(0.039)
Country-pair Controls									
Common_Religion	0.009	-0.295	-0.179	-0.192	-0.069	-0.214	-0.106	-0.235	-0.120
	(0.320)	(0.300)	(0.122)	(0.323)	(0.118)	(0.321)	(0.113)	(0.318)	(0.115)
Common_Language	0.889*	0.450	-0.406*	0.403	-0.419*	0.327	-0.502**	0.378	-0.458**
	(0.511)	(0.546)	(0.231)	(0.534)	(0.216)	(0.540)	(0.219)	(0.539)	(0.221)
Common_Law-Origin	-0.015	-0.028	0.001	0.017	0.031	0.038	0.066	-0.008	0.022
	(0.613)	(0.575)	(0.181)	(0.568)	(0.177)	(0.569)	(0.175)	(0.565)	(0.179)
Geographic_Distance	0.117	0.046	-0.113***	-0.025	-0.172***	0.010	-0.147***	-0.009	-0.162***
	(0.163)	(0.124)	(0.034)	(0.117)	(0.041)	(0.120)	(0.038)	(0.118)	(0.041)
Observations	1,259	1,997		1,997		1,997		1,997	
Year FE & Industry FE	Yes	Yes		Yes		Yes		Yes	
Pseudo R2	0.130	0.132		0.136		0.136		0.136	
Log-Pseudolikelihood	-297.3	-1439		-1431		-1432		-1432	

Table 1.7: Hazard analysis for IPO and M&A

The sample includes 1,997 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. The holding time of the successful portfolio company is the total months from the buyout date to the successful exit date. For portfolio companies with unsuccessful exits, the holding time is the number of months between the buyout date and 31st December 2015 or the last available tracking date. In specifications 1-5, the failure event is the case that the PE firm divests the portfolio company via IPO before the end of 2015. In specifications 6-10, the failure event is case that the PE firm divests the portfolio company via M&A before the end of 2015. Robust standard errors clustered at the portfolio company country level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	IPO				M&A			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Institutions								
Low_Risk_Country	-0.021	-0.038	-0.064	-0.072	0.239***	0.209***	0.211***	0.201**
	(0.399)	(0.386)	(0.386)	(0.382)	(0.079)	(0.081)	(0.077)	(0.081)
Institutional_Distance	0.069	0.042	0.054	0.066	-0.120***	-0.134***	-0.117***	-0.121***
	(0.130)	(0.129)	(0.130)	(0.128)	(0.040)	(0.037)	(0.039)	(0.039)
Cultural_Distance	1.238	1.141	1.186	1.208	-0.374	-0.435	-0.394	-0.393
	(0.894)	(0.924)	(0.901)	(0.913)	(0.273)	(0.282)	(0.268)	(0.269)
LBO_Market_Development	-2.487**	-1.856	-1.928	-1.976*	-0.318	0.194	0.191	0.175
	(1.125)	(1.189)	(1.189)	(1.191)	(0.228)	(0.209)	(0.216)	(0.219)
Learning								
Country_Experience	0.223				0.178***			
	(0.157)				(0.035)			
Multinational_Experience		0.325***				0.226***		
		(0.112)				(0.035)		
Industrial_Experience			0.198**				0.169***	
			(0.095)				(0.029)	
Reputation				0.218**				0.180***
				(0.093)				(0.026)
Deal Characteristics								
Management	-0.483***	-0.515***	-0.503***	-0.522***	0.336***	0.324***	0.313***	0.312***
	(0.180)	(0.186)	(0.186)	(0.193)	(0.068)	(0.073)	(0.075)	(0.071)
Club_Size	0.165***	0.168***	0.168***	0.173***	-0.175***	-0.173***	-0.169***	-0.166***
	(0.055)	(0.052)	(0.055)	(0.054)	(0.039)	(0.039)	(0.040)	(0.039)
Deal_Value	0.356***	0.313***	0.337***	0.328***	0.074***	0.041*	0.054**	0.053**
	(0.108)	(0.110)	(0.110)	(0.110)	(0.026)	(0.025)	(0.026)	(0.026)
Country-pair Controls								
Common_Religion	-0.176	-0.113	-0.120	-0.135	-0.006	0.069	0.051	0.032
	(0.324)	(0.338)	(0.336)	(0.335)	(0.050)	(0.064)	(0.061)	(0.056)
Common_Language	0.652	0.615	0.559	0.613	-0.220*	-0.231*	-0.285**	-0.248**
	(0.510)	(0.505)	(0.503)	(0.502)	(0.132)	(0.124)	(0.126)	(0.126)
Common_Law-Origin	-0.043	0.004	0.010	-0.022	-0.035	-0.011	0.010	-0.019
	(0.574)	(0.570)	(0.566)	(0.558)	(0.110)	(0.109)	(0.108)	(0.109)
Geographic_Distance	0.136	0.099	0.121	0.105	-0.046**	-0.077***	-0.064***	-0.073***
	(0.130)	(0.126)	(0.129)	(0.126)	(0.020)	(0.022)	(0.021)	(0.023)
Observations	1,997	1,997	1,997	1,997	1,997	1,997	1,997	1,997
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log-Pseudolikelihood	-655.9	-654	-655.3	-655	-8031	-8024	-8024	-8024

Table 1.8: IRR and exit multiple

The sample includes 161 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. In specifications 1-2, the dependent variable is IRR which is measured as the discount rate which equates the exit value to the buyout value. In specifications 3-4, the dependent variable is exit multiple which is measured as the value of exit value to the buyout value. Robust standard errors clustered at portfolio company level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Model	IRR (1)	IRR (2)	Exit Multiple (3)	Exit Multiple (4)
Institutions				
Low_Risk_Country	0.106*	0.105*	0.415	0.418
	(0.056)	(0.053)	(0.761)	(0.721)
Institutional_Distance	-0.069	-0.076	-0.269	-0.339
	(0.065)	(0.055)	(0.264)	(0.263)
Cultural_Distance	0.297	0.318	3.002	3.420
	(0.333)	(0.276)	(2.302)	(2.291)
LBO_Market_Development	0.420	0.528	1.266	2.321
	(0.437)	(0.514)	(2.861)	(3.080)
Learning				
Reputation		-0.033		0.074
		(0.081)		(0.147)
Deal Characteristics				
Management		-0.233**		-1.665***
		(0.098)		(0.523)
Club_Size		0.037		-0.175
		(0.087)		(0.632)
Country-pair Controls				
Common_Religion	0.120	0.135	2.124	2.203*
	(0.082)	(0.090)	(1.255)	(1.160)
Common_Language	-0.170	-0.194	-0.623	-0.767
	(0.115)	(0.130)	(0.860)	(0.802)
Common_Law-Origin	0.119*	0.096	1.671	1.650
	(0.063)	(0.064)	(1.025)	(1.015)
Geographic_Distance	-0.023	-0.047	-0.153	-0.367
	(0.032)	(0.046)	(0.240)	(0.258)
Observations	161	161	161	161
R^2	0.041	0.058	0.093	0.142

Table 1.9: Robustness test for selection bias

The sample includes 2,665 worldwide buyouts between 1998 and 2007. The sample is extracted from Mergermarket. In the selection stage, the dependent variable Reputable PE is a dummy variable which equals to one if the PE firm belongs to first quartile of reputable PE firm group based on the reputation measurement. The model settings for the second stage analysis are similar to the settings in Tables 4, 5, and 7, respectively. Robust standard errors clustered at the portfolio company country level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

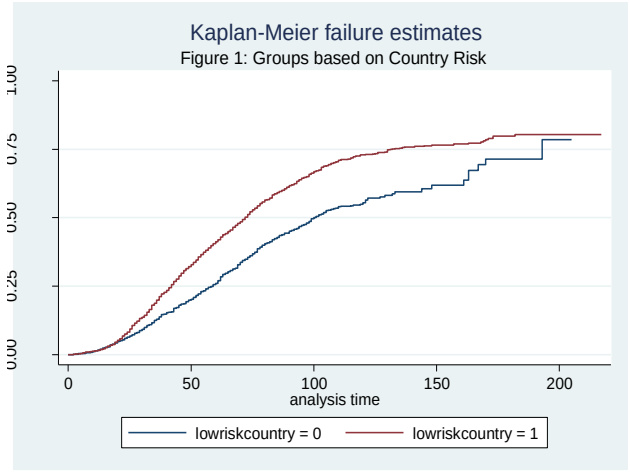
Model	Selection	Cox Hazard	Selection	Cox Hazard	Selection	IPO vs. M&A
	(1)		(2)		(3)	
Institutions						
Low_Risk_Country		0.201***		0.193***		-0.341
		(0.066)		(0.064)		(0.398)
Institutional_Distance		-0.105***		-0.219***		0.198
		(0.040)		(0.057)		(0.169)
Cultural_Distance		-0.193		-0.194		2.084**
		(0.245)		(0.245)		(1.058)
LBO_Market_Development		0.159		0.186		-1.439
		(0.213)		(0.214)		(1.486)
Learning						
Industrial_Experience		0.143***		0.034		-0.059
		(0.030)		(0.044)		(0.134)
*Institutional_Distance*Industrial_ Experience*				0.072**		
				(0.030)		
Deal Characteristics						
Management	0.190**	0.223***	0.190**	0.219***	0.223***	-1.015***
	(0.078)	(0.078)	(0.078)	(0.077)	(0.078)	(0.212)
Club_Size	-0.086	-0.104***	-0.086	-0.106***	-0.065	0.434***
	(0.056)	(0.035)	(0.056)	(0.035)	(0.066)	(0.098)
Deal_Value	0.088***	0.064***	0.088***	0.064***	0.061	0.311**
	(0.031)	(0.022)	(0.031)	(0.022)	(0.047)	(0.143)
Country-pair Controls						
Common_Religion		0.046		0.028		0.050
		(0.055)		(0.052)		(0.329)
Common_Language		-0.269*		-0.229		0.676
		(0.145)		(0.146)		(0.553)
Common_Law-Origin		0.047		0.014		0.153
		(0.117)		(0.117)		(0.684)
Geographic_Distance		-0.048***		-0.059***		0.135
		(0.016)		(0.017)		(0.166)
Private Equity Firms Characteristics						
U.S._PE	0.682***		0.682***		0.752***	
	(0.157)		(0.157)		(0.180)	
U.K._PE	0.937***		0.937***		0.973***	
	(0.132)		(0.132)		(0.177)	
Listed_PE	0.953***		0.953***		1.141***	
	(0.148)		(0.148)		(0.175)	
Inverse_Mills_Ratio		-0.184*		-0.188**		-0.665*
		(0.095)		(0.095)		(0.356)
Observations	1,997	1,997	1,997	1,997	1,259	1,259
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.123	-	0.123	-	0.136	0.135
Log-Pseudolikelihood	-967.2	-8721	-967.2	-8721	-650.1	-295.8

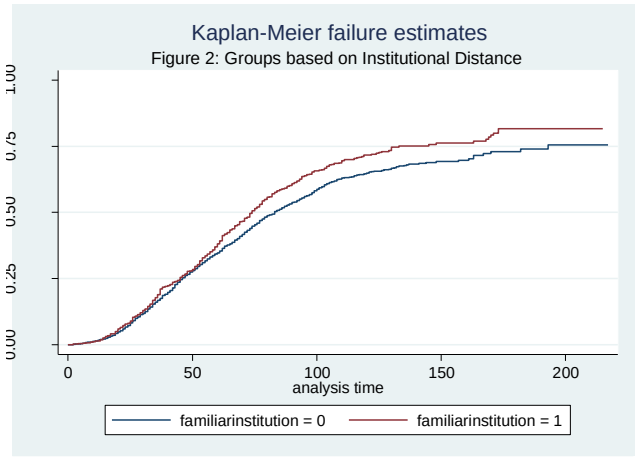
Table 1.10: Robustness test for imputed deal value

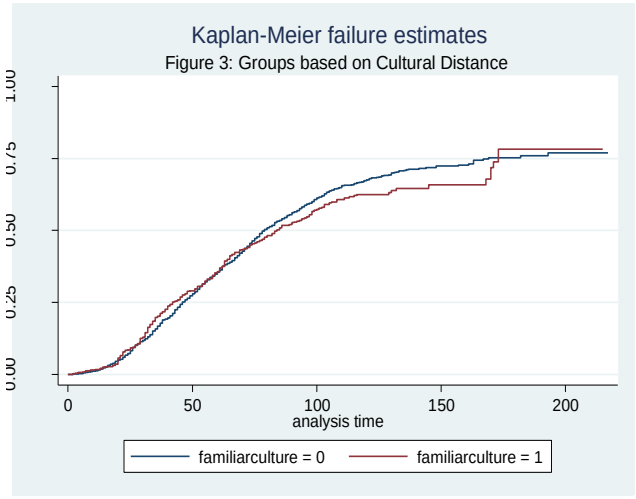
The sample is extracted from Mergermarket. In Table 8, following Strömberg (2008), I impute the deal value with Multiple Imputation. Robust standard errors clustered at the portfolio company country level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Model	Cox Hazard	Cox Hazard	IPO vs. M&A
	(1)	(2)	(3)
Institutions			
Low_Risk_Country	0.195***	0.188***	-0.4536
	(0.070)	(0.070)	(0.343)
Institutional_Distance	-0.085**	-0.185***	0.2017
	(0.035)	(0.053)	(0.183)
Cultural_Distance	-0.271	-0.252	1.440
	(0.216)	(0.220)	(0.953)
LBO_Market_Development	-0.014	-0.0008	-2.0499
	(0.175)	(0.175)	(1.252)
Learning			
Industrial_Experience	0.152***	0.060	0.0654
	(0.031)	(0.038)	(0.094)
*Institutional_Distance*Industrial_Experience*		0.063***	
		(0.024)	
Deal Characteristics			
Management	0.202***	0.192***	-0.536**
	(0.062)	(0.061)	(0.211)
Club_Size	-0.101***	-0.103***	0.435***
	(0.033)	(0.034)	(0.104)
Deal_Value	0.059***	0.059***	0.275**
	(0.020)	(0.020)	(0.127)
Country-pair Controls			
Common_Religion	-0.0026	-0.00382	-0.1239
	(0.052)	(0.050)	(0.249)
Common_Language	-0.178*	-0.179*	0.994**
	(0.107)	(0.105)	(0.430)
Common_Law-Origin	-0.00113	-0.00307	-0.1631
	(0.098)	(0.094)	(0.538)
Geographic_Distance	-0.054***	-0.059***	0.1555
	(0.013)	(0.013)	(0.143)
Observations	2,665	2,665	1,713
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes

Figure 1-4: Plots of Kaplan-Meier failure functions







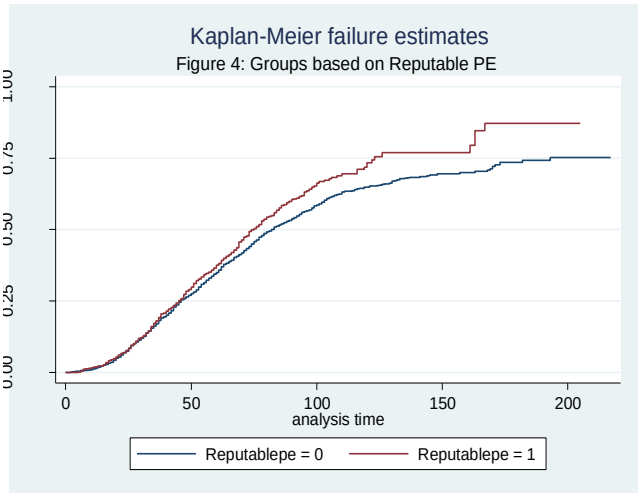


Figure 4: Groups based on Reputable PE

Chapter 2 Benefits of Friendship: Social Ties and Venture Capital Investment

2.1 Introduction

Information asymmetry is a typical friction in financial markets (Spence, 2002). In sociology literature, people sharing similar characteristics such as ethnicity and school tend to interact with each other and this shapes connection formation in schools and work places. Social ties thus lead to a sense of trust between individuals and can serve as the channel of information transfer and help to reduce the information asymmetry among financial market participants. There is a growing literature investigating social connections and financial activities including mutual fund performance (Cohen, Frazzini, and Malloy, 2008), boards (Cai and Sevilir, 2012; Cohen, Frazzini, and Malloy, 2012; Engelberg, Gao, and Parsons, 2013; Ishii and Xuan, 2014), hedge fund activism (He and Li, 2018), sell-side analyst recommendation (Cohen, Frazzini, and Malloy, 2010), loan markets (Engelberg, Gao, and Parsons, 2012; Lin, Prabhala, and Viswanathan, 2013), and angel investment (Venugopal, 2017). In venture capital markets, social ties are critical. Firstly, start-up founder team characteristics, one kind of soft information, is the most important determinant in VC's investment decision and investment success (Gompers, Gornall, Kaplan, and Strebulaev, 2016 (hereafter 2016a)). The soft information, unlike hard information such as revenue and cash flow, is difficult to obtain and verify. Secondly, the VC investment process is a two-sided matching one. The information gap between VC partners and start-up founders could put great strain on the investment. Social ties between VC partners and start-up founders can increase the information flow and reduce information asymmetry. Consequently, socially connected pairs are more likely to collaborate with each other. Upon collaboration, social ties can be either beneficial or detrimental to the investment performance. Social ties could be associated with either superior performance

because of easier communication (Hedge and Tumlinson, 2014) or poor performance because of group-thinking and social conformity (Ishii and Xuan, 2014; Gompers, Mukharlyamov, and Xuan, 2016 (hereafter 2016b)).

This paper investigates two questions: How do social ties influence the collaboration of the VC firm and the start-up and how do social ties influence the post-investment outcome. The first comprehensive paper on VC's social network is Hochberg, Ljungqvist, and Lu (2007) which focuses on the VC firm level and examines the VC firms' investment network and investment performance. Investment in VC markets is typically individually-led and individual level studies are demanded. However, because of data limitation on the biographic information of individuals, social ties studies in the VC market are rather limited. There are a few exceptions. Gompers et al. (2016b) examine the influence of social ties between the leading VC partner and subsequent VC partners on the syndication decision and investment outcome. Hedge and Tumlinson (2014) examine the ethnic tie between VC partners and start-up founders and conclude that there is a positive influence of social ties on investment match and investment success. Bengtsson and Hsu (2015) also examine the ethnic tie but take into account the composition of the board. They document positive influence of social ties on investment match, but negative influence on investment success.

This paper focuses on the ties between VC partners and start-up founders and extends previous papers as follows. Firstly, we consider not only the ethnic tie but also two other important ties: education and employment. The education tie is an important unit in social connection analysis (Cohen et al., 2008). Secondly, previous papers apply SDC Venture Expert database which include all founders in the start-up and all active partners in the VC firm. In a VC firm, a partner could be in a network with a start-up, but he/she may not be the decision maker for funding the deal and taking responsibility for the follow-on monitoring activities.

Bengtsson and Hsu (2015) assume that all partners are actively involved in all investments. They also include all VC-start-up pairs in a deal. However, in an investment, it is the leading VC firm which initiates the investment and invites other VC firms to participate in the deal (Gompers et al., 2016b). By using a new database, we have been able to identify the participating partners in the leading VC firm and provide a clear measure of social ties. Finally, Bengtsson and Hsu (2015) admit that they do not address the endogeneity and control for the selection effect. The omitted selection effect could be the key reason why they find negative influence of social ties on investment success. We adopt the two-stage Heckman selection model and attempt to control for the selection effect.

We hand collect data from Crunchbase (www.crunchbase.com), which archives early stage investments (Hellmann and Thiele, 2015) and is the largest crowd-sourced database on entrepreneurial activities (Venugopal, 2017). It contains the detailed information on the funding round, VC firms, start-ups, founders, and VC firm partners. The data includes 2,246 leading VC firm-start-up pairs during the period from 2006 to 2016.

To investigate the probability of collaboration of the VC firm and the start-up, we need both actual pairs and counterfactual pairs (what if the VC did not invest in the start-up). We create counterfactual pairs as if the VC firm invests in other start-ups in the same year-state-industry of the actual start-up. We find that social ties are positively related to the probability of collaboration of the VC firm and the start-up. To examine the post-investment outcome, we conduct both round level analysis and exit outcome analysis. In the round level analysis, we remove the final financing round if the next round is IPO/M&A. We find that social ties are related to higher probability and hazard rate of next round financing. Upon surviving to next round, connected start-ups can raise larger amounts of funds. In the exit outcome analysis, we restrict our sample to the period before 2015 and leave an at least three years window for the

VC firm to exit the start-up. We find that social ties are related to higher likelihood of exit outcome either via IPO or M&A. Our results support the "Benefits of Friendship" hypothesis.

Improved post-investment outcome could be due the selection of higher quality start-ups instead of better post-investment monitoring. The selection effect could be omitted and captured by the error term in the post-investment regression. Following Bottazzi, Da Rin, and Hellmann (2008) and Hedge and Tumlinson (2014), we adopt the Heckman selection model and create an exogenous variable in the first stage. The exogenous variable is the local percentage of connected pairs in the market which is defined as the same year-state-industry of the start-up. This variable captures the characteristics of the local market and helps to identify the selection effect (Sørensen, 2007). After addressing the selection effect, we still document positive and statistically significant influence of social ties on post-investment outcome.

This paper contributes to a growing community of finance research investigating the impact of social ties on financial transactions. Instead of studying aggregate firm level of social connection such as board level connection (see e.g. Ishii and Xuan, 2014), fund level connection (see e.g. Cohen et al., 2008), and VC firm level connection (see e.g. Hedge and Tumlinson, 2014), this paper looks into the key investment principal, avoids the noisy measure of social connection, and documents the relationship between individual level social ties and financial activities.

Further, this paper contributes to the broad venture capital studies. Start-ups have short operation and financial records. Little information is systematically observed for early start-ups and VC firms emphasize the intangible qualities such as the founding team characteristics in the investment selection and post-investment management (Kaplan and Strömberg, 2004; Sørensen, 2007; Gompers et al., 2016). By investigating the social ties in the VC context and empirically testing the role of know-how of soft information in VC investments, we provide

new evidence and broaden the horizon in understanding the match between VC partners and start-up founders and VC's investment success.

The rest of the paper is structured as follows. Section 2.2 develops the testing hypotheses. Section 2.3 describes the data and present the variable construction. Section 2.4 examines the across-firm evidence on the role of social ties. Section 2.5 concludes the paper.

2.2 Hypothesis Development

In VC markets, the investment process is a two-sided matching one (Sørensen, 2007). VC firm partners conduct the deal sourcing and select the start-ups to include in their portfolios while entrepreneurs are also looking for the right investors who will finance them and help them to grow. Collaboration could help to increase the likelihood that the start-up will become successful and this could be a win-win situation for both partners and founders. Upon investment success, partners will receive the carry and build-up of their reputation while founders will receive monetary payoffs and enjoy the benefits of being successful.

However, little hard information such as revenue and product development are available in the VC investment. Gompers et al. (2016a) report that, the characteristic of start-up team is the most important factor in a VC firms' investment decision making process and determinant in the VC firms' investment success. Soft information, unlike hard information, is difficult to obtain and verify, leading to high information asymmetry in the VC markets. Social ties, which could serve as an information channel, could help to alleviate the information asymmetry in the economic decision (Granovetter, 2005). In the VC context, if social ties could help to reduce the information asymmetry between VC firm partners and start-up founders, they might lead to the collaboration of the VC firm and the start-up and help to improve investment performance.

2.2.1 Collaboration of the VC Firm and the Start-up

In the sociology literature, homophily describes the situation where individuals tend to form relationships with people who share similar characteristics and background (McPherson, Smith-Lovin, and Cook, 2001). It shapes the partnership formation in various settings such as school, work, marriage and friendship. Similarity between group members could then be found across a broad range of characteristics including age, gender, education, social status and ethnicity. Currarini et al. (2009) report the biases toward same-types in both individual preferences and the matching processes affect the pairing result and the homophilic behaviour has been shown to be critical in financial markets (Bottazzi, Da Rin, and Hellmann, 2016). In VC markets, particularly, the flow of information, especially the soft one, is larger between the VC partners and start-up founders who are of the same type.

Following Gompers et al. (2016b), I formally incorporate three social ties elements: education, employment, and ethnicity. I hypothesize that those ties may affect information exchange, VC firms' investment decision, and founder's decision to accept funding from the VC. Cohen et al. (2008) argue that educational institutions can form an effective basis for social ties since life long relationship could be formed via alumni associations, college sports, and donation programs. In addition to the education tie, individuals could also build up relationship in past employment and are more likely to speak the same "company language". Finally, as our focus is the U.S. VC industry and the U.S. is an immigrant country, we also include the ethnicity tie. As claimed by Bengttson and Hsu (2015), individuals might prefer to conduct business with co-ethnics with a typical example being that patients may prefer to meet doctors of same ethnicity. Also, as information about the participants and their actions spreads rapidly within a tight ethnic social network, any misconduct behaviour is monitored. As a result, individuals are more likely to build up trust with each other.

Hypothesis 1: Social ties between VC firm partners and Start-up founders are associated with higher probability of collaboration of the VC firm and the Start-up.

2.2.2 Post-investment Outcome

Social ties can impact not only the matching between the VC firm and the start-up but also the post-investment outcome. However, previous empirical results about the influence of social ties on financial market activities are mixed and the success implications of social ties remain unclear.

2.2.2.1 Cost of Friendship

On one hand, social connections could lead to flawed decision making and poor performance because of a lack of diverse viewpoints, a tendency for social conformity or group-thinking mentality (Ishii and Xuan, 2014; Gompers et al., 2016b). Firstly, because individuals in homophilic relationship could gain personal utility by working together, they are more likely to lower the expected return hurdle and perform a less strict due diligence. Further, they tend to ignore the disadvantages of the favoured decision as well as the external advice. Cohen et al. (2012) find that companies which appoint overly optimistic analysts as the independent directors are also relatively poor performers and appear to be poorly governed. Ishii and Xuan (2014) report that acquirer-target social ties are related to statistically significant abnormal negative returns to the acquirer and to the combined entity upon the merger announcement. Gompers et al. (2016b) find that social ties between the founding VC firm partners and subsequent VC firm partners contribute to ultimately worse VC investment results.

2.2.2.2 Benefits of Friendship

On the other hand, the more characteristics a pair of individuals have in common, the better the performance that can be expected. The benefits of friendship may come from more

efficient communication and the ability to effectively convey tacit information and make joint decisions. Cohen et al. (2008) claim that information is exchanged via educational networks between mutual fund managers and corporate boards. They find that portfolio managers place higher weight on connected firms and earn higher returns than with the non-connected holdings. Engelberg et al. (2012) report that firms could borrow money at a lower interest rate from the connected banks and have better future credit ratings and stock returns. Cai and Sevilir (2012) report that board connections benefit acquirers as they pay lower premiums and have greater value creation. Engelberg et al. (2013) find that CEOs with large networks are better compensated than those with small networks. Lin et al. (2013) study the Peer-to-Peer market and claim that friendships leads to a higher probability of successful funding, lower interest rates and lower ex post probability of default. Further, Venugopal (2017) and He and Li (2018) find connected intuitions perform better in the angel investment and hedge fund investment, respectively.

In the VC context, social ties could lead to easier communication between founders and partners and lower the coordination cost (Hedge and Tumlinson, 2014). After the investment, VC partners will interact with their portfolio companies and try to add value to the start-up. The value adding activities including board structuring (Lerner, 1995), professionalization of start-up (Hellmann and Puri, 2002), outside director hiring (Amornsiripanitch, Gompers, and Xuan, 2016), and strategy guidance (Gompers et al., 2016a). Founders are more receptive to the value adding suggestions if they are socially connected with their VC partners. Consequently, social ties could improve the post-investment outcome via better communication and increasing value adding activities. Based on the discussion above, the null and alternative hypotheses with respect to post-investment outcome are:

Hypothesis 2 null: In line with "Cost of Friendship", social ties between VC partners and Start-up founders are associated with worse post-investment outcome.

Hypothesis 2 alternative: In line with "Benefits of Friendship", Social ties between VC partners and Start-up founders are associated with better post-investment outcome.

2.3 Sample and Variables

2.3.1 Sample

To construct the sample, firstly, we need to identify partners in the leading VC firm who make the investment decision and lead the investment. Secondly, we need the biographies of the founders and the partners involved in each investment. Few commercial databases could provide the information about participating partners and the relevant biographic information. One exception is Crunchbase (www.crunchbase.com) which is the largest crowd-sourced database on global entrepreneurial activity. It was founded in 2007 and provides detailed profiles on investors and founders back to 1980s. It identifies partners who lead the deal in the leading VC in each financing round. Also, it contains information about start-ups, VC firms, deal, founders, and partners.

We collect the data as follows. Firstly, we download all financing rounds by the U.S. VC firms and obtain the relevant hyperlinks to each financing round web page. Secondly, we search the financing found on each web page and acquire the hyperlinks for start-ups, VC firms, participating partners and founders and other information including: leading VC status, fund-raising round, fund-raising date, number of VCs and news article coverage. In addition, we search the webpages via those links and obtain the following information: Start-ups (founding date, location, industry category, and exit status), VC firms (founding date, location, and investment history), participating partners (identity, LinkedIn, education history and

employment history) and start-up founders (identity, LinkedIn, education history and employment history). To obtain a more complete data coverage, we also search LinkedIn, S&P Capital IQ, Bloomberg Investor Profiles, company websites, and relevant news websites.

The ethnic information of partners and founders is obtained by using the database constructed by Kerr (2008). Kerr (2008) classifies the ethnic minority groups by using surnames of investors. We have the 100 most common surnames for Chinese, Indian, Japanese, Korean, Russian, Hispanic, and Vietnamese. Following Bengtsson and Hsu (2015), we use a list of the most common Jewish surnames from Wikipedia. In total, we have eight ethnic minority groups and these eight groups represent the most important subgroups which are active in the U.S. VC industry.

We apply the following sample selection criteria. We restrict our sample to the U.S. start-ups. Also, we require that the information about the leading VC firm in each round is available. If the leading VC information is missing, we identify a VC firm as leading VC firm if it makes the largest investment. Also, we require that the participating partners' information in the leading VC firm is available. Further, as VC firms could enter stage-financing and participate in several financing rounds, we restrict the sample to the first match between VC firm and start-up. Consistent with Hedge and Tumlinson (2014) and Gompers et al. (2016b), the unit of analysis in this paper is VC firm-start-up pair. In addition, we require that profiles of founders and partners should be available. Finally, even though Crunchbase provides funding history back to 1980s, the size and the quality of the data has been increasing since 2006. We restrict our sample to the time span from 2006 to 2016 and track the investment outcome as of 31 Dec 2017. We have a final sample of 2,246 leading VC firm-start-up pairs.

2.3.2 Variables

2.3.2.1 Dependent Variables

2.3.2.1.1 Collaboration of the VC firm and the Start-up

VC investment is a two-sided matching process in which both the founder and investor must achieve agreement on each other's requirement (Sørensen, 2007). The information gap between founders and partners leads to mutual doubt. To test the influence of social ties on collaboration of VC and start-ups, we have a sample of actual pairs of lead VC-start-ups and we need to construct counterfactual pairs, for which lead VC firm could potentially invest in start-ups but do not. Following Bengtsson and Hsu (2015), we construct the counterfactual pair of a single investment as those potential investments made by the same VC firm in other start-ups in the same year, state and industry of the actual start-up. As a result, the dependent variable *Collaboration* is a dummy variable which is equal to one if the VC firm invested in the start-up (the actual pair) and zero if the VC firm invested in a potential start-up in the same year-state-industry of the actual start-up (the counterfactual pair).

2.3.2.1.2 Post-investment Outcome

Round Level Analysis

To examine post-investment outcome, we follow Hochberg et al. (2007) and firstly conduct the analysis at the round level. In this sector, we remove the observations if the first match between leading VC firm and start-up is in the final financing stage of which the next round is IPO/M&A. We then create three dependent variables, firstly testing the probability of next round financing if the start-up could survive to next round. We then apply survival analysis with the Hazard rate of surviving to next round as the dependent variable. Finally, we try to analyse the amount of funds that could be raised if the start-up survives to the next round.

Exit Performance

We treat the final investment outcome as the successful one if the VC firm is able to bring the start-up to the IPO market or M&A market (Hochberg et al., 2007). We restrict the sample to the time span from 2006 to 2014 and track the investment outcome as of 31 Dec 2017, leaving an at least a three years window for the VC firm to exit their portfolio companies.

2.3.2.2 Independent Variables

2.3.2.2.1 Social Connection Variables

To measure the social ties between the leading VC firm and start-up, we create five different variables. *Connected_Pair* is a dummy variable which equals one if any participating partner in the leading VC firm shares any tie (education, employment and ethnicity) with any founder in the start-up and zero otherwise. We then break the connection variable into individual ties. *Same_School* is a dummy variable which is equal to one if any participating partner in the leading VC firm went to the same university with anyone of founders and zero otherwise. We apply the same logic to construct the *Same_Employer* and *Same_Ethnic_ Minority* variables.

We then follow Ishii and Xuan (2014) and construct another variable to measure the degree of connections between the leading VC firm and start-up. For each leading VC firm-start-up pair, we define a matrix consisting of all the participating partners and founders. Each element of the matrix is a pair of individuals composed of one participating partner from the leading VC firm and one founder from the start-up. The total number of elements in the matrix is thus equal to the total number of participating partners of the leading VC firm and the total number of founders of the start-up. We then count the total number of connected pairs and divide this number by the total number of pairs to form the variable *Connection_Degree*.

Connection_Degree captures the extent to which the participating partners of the leading VC firm and the founders are socially connected. For example, a *Connection_Degree* of 50% between a leading VC firm with two participating partners and a start-up with three founders indicate that, out of 6 pairs of individuals from the two firms, three people are connected based on education, employment and ethnic minority ties.

2.3.2.2.2 Control Variables

We also control for VC characteristics, start-up characteristics, and deal characteristics. VC experience is the logarithm of the total number of investment activities of the lead VC in the three preceding years. We do not use age to proxy experience as age is an accumulating variable and does not reflect the recent investment capability of VC firms. In addition, the leading VC firm could syndicate with other VC firms and we count the number of VC firms in the first match of the leading VC firm and the start-up. We also include a dummy variable *Fewer_than_50_Employees* to control for the relative size of the start-up. Also, to account for the start-up quality, we follow Gompers et al. (2016b) and construct *Media_Coverage* which is the number of news articles published in the initial stage of the match of the leading VC firm and the start-up. Further, as the first match of the leading VC firm and the start-up might take place at a different stage in the development of the start-up company, we include the round fixed effects to account for the maturity of the start-up. We also include year effects as VC investment is affected by the vintage year economic conditions. Finally, we include the industry and state fixed effects.

2.3.3 Summary Statistics

We present the descriptive statistics of the sample in Table 2.1. Panel A demonstrate the number of pairs by year. Crunchbase database was first established in 2007 and tracks records back to 1980s. As can be seen in panel A, data coverage has gradually been increasing in recent

years. Similar pattern can be also found in the mean value and aggregate value in our sample. The aggregate value trend is consistent with the one of overall U.S. VC industry investment (www.statista.com), with the sharp increase in 2014 and the peak in 2015. Panel B reports the number of observations in our sample by the state of start-ups. The VC industry is highly concentrated in three states including California, New York, and Massachusetts. The geographic distribution is consistent with the findings of Chen, Gompers, Kovner, and Lerner (2010). They document geographic concentration of VC activities in three metropolitan areas: San Francisco, Boston, and New York. Panel C documents the number of pairs by the industry of start-ups and the industry category is classified by the Crunchbase database. The three most representative industries in our sample are Data and Analytics, Biotechnology, and Commerce and Shopping. Crunchbase database archives more high technology investments and this reflects the recent trend in the U.S. VC industry as VC investments are flowing into the high technology sector. Panel D reports the investment round when the leading VC firm first matches with the start-up. The majority of VCs begin to invest in the seed stage or round A. Compared to later rounds, the mean value of seed round or round A is smaller than that of following financing rounds. As decreasing numbers of start-ups are able to survive to the next financing round (Hochberg et al., 2007), we see fewer pair matches in the later rounds. VC begins to invest in round R+1, with the condition that the start-up survives to round R. As mentioned earlier, we include the round fixed effects to control the maturity of the start-ups and the vintage year effects.

[Insert Table 2.1 about here]

In Table 2.2, we present a univariate comparison of connected and unconnected start-ups. Firstly, the percentage of connected groups is around 4.3% in the test of collaboration and is around 8.3% in test of post-investment outcome, suggesting that the VC firm is more likely

to invest the connected start-up. We calculate the mean difference between the two groups in the last column. From this table, we could observe that, compared to unconnected start-ups, connected start-ups have a higher percentage of collaboration with VCs (0.152 vs 0.074), higher probability of going to next round financing (0.745 vs 0.587), shorter duration before going to next round financing (19.975 months vs 23.293 months), higher next round fund-raising value (38 million vs 25 million) and a higher percentage of IPO/M&A exit outcomes (0.375 vs 0.276). In brief, the univariate test suggests that socially connected pairs of VC firm and start-up are more likely to collaborate with each other and have better post-investment outcomes.

[Insert Table 2.2 about here]

2.4 Empirical Results

2.4.1 Collaboration of the VC firm and the start-up

Table 2.3 reports the regression results on probability of collaboration of the VC firm and the start-up. The coefficients of all social connection variables are positive and statistically significant at 1% level, suggesting that social ties might help to build up trust between VC partners and start-up founders and facilitate the VC firm's decision of making investment and the start-up's decision of receiving funding. The findings are in line with Hedge and Tumlison (2014) and Bengtsson and Hsu (2015). In terms of economic significance, ceteris paribus, the likelihood of collaboration increases by 6% when the leading VC firm's participating partners and start-up founders are socially connected. When we break the *Connected_Pair* into individual ties, the strongest effect comes from the employment tie. Ceteris paribus, the likelihood of collaboration increases 12% if the leading VC firm's participating partners and start-up founders worked for the same employer before. In the last column, we consider the

degree to which the VC firm is connected to the start-up and include the variable *Connection_Degree*. The result suggests that the stronger the connection between the VC firm and start-up, the higher the probability of collaboration between the VC firm and start-up. In brief, our results conclude the positive influence of social ties on collaboration of the VC firm and start-up, providing supporting evidence to the first hypothesis.

[Insert Table 2.3 about here]

2.4.2 Post-Investment Outcome

2.4.2.1 Round Level Analysis

After testing the relationship between social ties and investment collaboration, we next examine the impact of social ties on post-investment outcome. We conduct two parts of analysis: round level analysis and exit performance.

Table 2.4 demonstrates the probability of the start-up obtaining next round financing. To begin, all coefficients of social connection variables are statistically significant and positive, implying that socially connected start-ups are more likely to survive to next round financing. As for economic significance, ceteris paribus, the likelihood of a start-up surviving to next round financing is increased by 16% if the start-up is socially connected to the leading VC firm. When we look into individual ties, the magnitudes of individual ties are qualitatively similar, and the strongest effect is from the ethnicity tie. When we consider the degree of connection, we find that the stronger the connection between the leading VC firm and the start-up, the higher the probability of the start-up going into next round financing. In brief, social ties between the leading VC firm's participating partners and start-up founders might help to facilitate the communication and improve the cooperation, leading to better post-investment outcome. In brief, we reject the null hypothesis "Cost of Friendship" and the results in Table

2.4 support the “Benefits of Friendship” hypothesis.

[Insert Table 2.4 about here]

We next apply the survival analysis and examine the hazard rate of next round equity financing by taking the duration into consideration. In the Cox Hazard model, the positive coefficient suggests a higher likelihood of a start-up going to the next round financing and shorter expected duration.

As can be seen from Table 2.5, coefficients of all social connection variables are statistically significant at least at 10% level and positive. The results suggest that, if a start-up is socially connected with the leading VC firm, the probability of going to the next round financing is higher and the expected duration of going to the next round financing is lower. The findings, again, provide supporting evidence to the “Benefits of Friendship” hypothesis.

[Insert Table 2.5 about here]

As an additional step, since social ties are associated with higher probability of next round financing, we test how social ties are associated with the amount of fund-raising in the next round. Table 2.6 reports that, the majority coefficients of social connection variables are positive in a significant way. The results imply that, upon surviving to the next round financing, socially connected start-ups will raise larger amounts of funding. In terms of economic significance, ceteris paribus, compared to the unconnected group, the socially connected start-ups raise 35% more funding. This is especially the case if the start-up and the VC firm share the school tie, where the start-up could raise 58% more funding. Further, when we consider the degree of connection, we find that the stronger the connection, the higher the amount of fund-raising. In summary, social ties are not only associated with higher probability of a start-up going into next round financing, but also related to larger amounts of fund-raising upon

surviving to the next round. The findings in the round level analysis consistently support the "Benefits of Friendship" hypothesis.

[Insert Table 2.6 about here]

2.4.2.2 Exit Performance

After performing the round level analysis, we then test the relationship between social ties and final exit outcome. By exiting via the route of an IPO, both start-ups and VC firms could earn the highest amount of returns and build up their reputations. However, VC firms also tend to approach the acquisition market either as the second-best option to going public or when they want to exit a portfolio company via "fire sales". M&A still accounts for the critical exit option in the VC market (Phillips and Zhdanov, 2017) and M&A also generates positive returns for VCs and start-ups (Gompers and Lerner, 2004). In this regard, we follow Hochberg et al. (2007) and treat the investment success as a dummy variable which is equal to one if the VC firm is able to bring the start-up to the IPO market or the M&A market and zero otherwise.

[Insert Table 2.7 about here]

Table 2.7 reports the result on the exit performance analysis. The majority coefficients of social connection variables are statistically significant and positive except for the coefficient of *Same_Ethnic_Minority.* Regarding the ethnic minority tie, Hedge and Tumlinson (2014) find positive influence of the ethnicity tie on exit outcome while Bengtsson and Hsu (2015) take the composition of the board into consideration and report negative influence of ethnicity ties on exit outcome. In our paper, we consider ties between the participating partners in the leading VC firm and start-ups rather than all partners in all VC firms and start-ups. Our findings might suggest that at least for the leading VC firm the ethnicity tie is not the primary determinant in the exit process. In terms of economic significance, compared to the unconnected group, the

likelihood of going IPO/M&A is 9% higher if the start-up is socially connected to the VCs, ceteris paribus. When we consider the degree of connection, we find that the stronger the connection, the higher the probability of the VC firm taking a start-up to IPO/M&A. Overall, our results on exit performance suggest social ties are associated with better post-investment outcome and provide further evidence to support the "Benefits of Friendship" hypothesis.

2.4.3 Selection or Monitoring

The better performance of socially connected start-ups could be due to pre-investment selection of higher quality companies by the leading VC firm or the post-investment monitoring. The assortative matching behaviour in VC markets is documented by (Sørensen, 2007). In this case, high quality VC firms invest in high quality start-ups. To address the selection effect in the post-investment outcome analysis, we adopt the Heckman two-stage model. In the first stage, the inverse Mills ratio (IMR) is estimated and proxies for unobservable factors that affect matching between the VC firm and the start-up. In the second stage, we run the linear probability model and include the IMR in the regression. By doing so, we address the selection bias on the social connection variable and document the post-investment monitoring of VC partners on start-up performance. Woodridge (2002) explains that the null hypothesis of no selection effect can be tested by using standard t-test for the coefficient of IMR.

In the first stage, we need an exogenous variable which affects the matching between the VC firm and the Start-up, but not the post-investment success. To construct such a variable, we follow Bottazzi et al. (2008) and Hedge and Tumlinson (2014) and use the market characteristic variable as the exogenous variable because they exogenously determine the availability of connected partners and consequently the likelihood of connected match. More specifically, in a highly connected market, a VC firm is more likely to encounter and invest in a socially connected start-up. However, conditioned on encountering a connected founder, the

VC firm is no more likely to enjoy screening advantages in highly connected market than low connected market. In this sense, the quality of investment is not necessarily better in highly connected market than in low connected market. After controlling for the selection effects, we could then examine how the social ties shape the performance of connected pair. Here, the market is defined as the year-state-industry of the start-up. We create an exogenous variable *Local_Percentage_of_Connected_Pairs* as the number of connected pairs (both actual and counterfactual) divided by the total number of pairs in the market. This variable helps to capture the market characteristics as it reflects the degree of connection of the market.

[Insert Table 2.8 about here]

In Table 2.8, we note that in the first stage, the coefficients of *Local_Percentage_of_Connected_Pairs* variables are statistically significant and positive, suggesting that in the highly connected market, the probability of collaboration between VC firms and start-ups is higher. In the second stage, we note that the coefficients of social connection variables are positive and statistically significant. This suggests that the inclusion of selection effects does not appear to interfere with the basic relationship between social connection variables and post-investment outcome. We also note that IMR are always insignificant. Consequently, we cannot reject the null hypothesis of no selection effects.

Overall, as argued by Gompers et al. (2016b), it is impossible to completely rule the selection story. In this paper, the story is that connected VC firms are more likely to select high quality start-ups. By adopting the two-stage Heckman selection model, we attempt to address this endogeneity and we report that the post-investment monitoring activity of VC firms is most likely to be the key mechanism through which the connectedness between the VC firm and start-up affects the post-investment outcome.

2.4.4 Robustness Check: An International Sample

As the robustness check, we expand our sample to a global sample. In this part, we modify the variable *Connection_Degree* by excluding the ethnicity tie. This is because the ethnicity tie might not be influential in other single ethnicity countries such as China. Also, instead of including state fixed effects, we include region fixed effects: US, UK, Europe and Rest of the World (Espenlaub, Khurshed and Mohamed, 2015). As can be seen from Table 2.9, the main results still hold in the international sample and socially ties are associated with better post-investment outcome.

[Insert Table 2.9 about here]

2.5 Conclusion

Information asymmetry is a typical friction in the financial markets and social ties which are able to serve as the channel of information transfer help to mitigate the information problem and facilitate the financial transaction. In the VC markets, the information gap between investors and entrepreneurs is large as little hard information such as revenue and cash flow is available for implementation of the valuation model. This paper investigates how social ties between VC partners and start-up founders, obtained via school, employment and ethnic minority group, affect the collaboration between VC firms and start-ups and post-investment outcome.

To build up social tie variables, we need a comprehensive dataset of the biographies of investors and entrepreneurs. We hand collect 2,246 leading VC firm-start-up pairs in the U.S. during the period from 2006 to 2017, using the Crunchbase dataset (www.crunchbase.com). We obtain detailed information about start-ups, VC firms, participating partners (who lead each investment) and founders. To study the collaboration of the VC firm and the start-up, we

construct the counter-factual pair which is the potential investments of the VC firm in the same year-state-industry of the start-up. In the post-investment outcome analysis, we firstly conduct the round-level analysis and then perform the exit outcome analysis.

We find that, compared to unconnected pairs, socially connected pairs have a higher likelihood of collaborating with each other. Upon investment, a start-up which is socially connected with the VC firm has a higher probability of going into next round financing, a higher hazard rate of going into next round financing and a shorter expected duration, a larger amount of fund-raising in the next round and higher probability of going IPO/M&A. After addressing the selection effect, we still document the positive relationship between social ties and post-investment outcome.

Appendix 2.1: Variable definition

Variables	Definition and Source
Dependent variables	
Collaboration	Dummy variable which equals one for the actual pair and zero for the counterfactual pair (potential investment of the leading VC firm in the same year-state-industry of the actual start-up). (Source: Crunchbase)
Next_Round_Financing	Dummy variable which equals one if the start-up survives to next round financing and zero otherwise. (Source: Crunchbase)
Hazard_Rate	Conditional probability that the start-up survives to next round financing. (Source: Crunchbase). Duration is
Next_Round_Value	The amount of funding raised by the start-up upon surviving to next financing round. (Source: Crunchbase)
IPO/M&A	Dummy variable which equals one if the VC firm brings the start-up to the IPO market or the M&A market before the end of 2017 and zero otherwise. (Source: Crunchbase/SDC)
Social ties variables	
Connected_Pair	Dummy variable which equals one if any participating partner in the leading VC firm shares any tie (education, employment and ethnicity) with any founder in the start-up and zero otherwise. (Source: Crunchbase, LinkedIn, S&P Capital IQ, Bloomberg, and company websites)
Same_School	Dummy variable which is equal one if any participating partner in the leading VC firm went to the same university with anyone of founders and zero otherwise. (Source: Crunchbase, LinkedIn, S&P Capital IQ, Bloomberg, and company websites)
Same_Previous_Employer	Dummy variable which is equal one if any participating partner in the leading VC firm worked in the same company with anyone of founders and zero otherwise. (Source: Crunchbase, LinkedIn, S&P Capital IQ, Bloomberg, and company websites)
Same_Ethnic_Minority	Dummy variable which is equal one if any participating partner in the leading VC firm share the same ethnicity with anyone of founders and zero otherwise. (Source: Crunchbase, LinkedIn, S&P Capital IQ, Bloomberg, and company websites)
Connection_Degree	Total number of connected pairs between the leading VC firm and the star-up over total number of pairs between two parties. (Source: Crunchbase, LinkedIn, S&P Capital IQ, Bloomberg, and company websites)
Control variables	
VC_Experience	Logarithm of the total number of investment activities of the lead VC in the three preceding years. (Source: Crunchbase)
Number_of_VCs	The number of VC firms in the first match of the leading VC firm and the start-up. (Source: Crunchbase)
Fewer_than_50_Employees	Dummy variable which equals one if the number of employees of the start-up is fewer than 50. (Source: Crunchbase)
Media_Coverage	The number of news articles published in the initial stage of the match of the leading VC firm and the start-up. (Source: Crunchbase)

Table 2.1: Descriptive statistics

Panel A: Temporal distribution

Panel A illustrates the distribution of VC investments by the vintage year. The sample includes 2,246 investments between 2006 and 2016. The sample is extracted from Crunchbase.

Year	N	Percent	Mean Value ($Mil)	Aggregate Value ($Mil)
2006	29	0.013	8.179	237.191
2007	48	0.021	15.134	726.432
2008	42	0.019	14.509	609.378
2009	44	0.020	10.120	445.280
2010	65	0.029	13.187	857.155
2011	77	0.034	11.899	916.223
2012	124	0.055	13.835	1,715.540
2013	145	0.065	12.206	1,769.870
2014	749	0.333	18.226	13,651.270
2015	577	0.257	27.183	15,684.590
2016	346	0.154	16.460	5,695.160
Total	2,246	1	18.837	42,307.900

Panel B: State distribution

Panel B illustrates the distribution of VC investments by the state of the start-up. The sample includes 2,246 investments between 2006 and 2016. The sample is extracted from Crunchbase. Panel C includes the top ten states in terms of the number of investments and presents them in descending order.

State	N	Percent	Mean Value ($Mil)
California	1,187	0.528	21.630
New York	332	0.148	14.319
Massachusetts	197	0.088	18.174
Texas	71	0.032	12.316
Washington	60	0.027	17.156
Colorado	36	0.016	8.040
Georgia	32	0.014	23.403
Illinois	31	0.014	23.756
Utah	30	0.013	22.116
North Carolina	26	0.012	22.238
Others	244	0.108	13.883
Total	2,246	1	18.837

Panel C: Industry distribution

Panel C illustrates the distribution of VC investments by the state of the industry category. The sample includes 2,246 investments between 2006 and 2016. The sample is extracted from Crunchbase. Panel C includes the top ten industry categories in terms of the number of investments and presents them in descending order.

Industry Category	N	Percent%	Mean Value ($Mil)
Data and Analytics	243	0.108	16.964
Biotechnology	203	0.090	23.684
Commerce and Shopping	192	0.085	25.424
Financial Services	154	0.069	23.003
Information Technology	154	0.069	18.146
Advertising	149	0.066	13.321
Apps	143	0.064	13.871
Hardware	122	0.054	20.307
Consumer Electronics	119	0.053	26.047
Health Care	117	0.052	17.946
Others	650	0.289	16.176
Total	2,246	1	18.837

Panel D: Round distribution

Panel D illustrates the distribution of VC investments by the financing when the VC firm firstly invests in the start-up. The sample includes 2,246 investments between 2006 and 2016. The sample is extracted from Crunchbase.

Financing Rounds	N	Percent	Mean Value ($Mil)
Seed/Round A	793	0.353	9.245
Round B	549	0.244	19.765
Round C	308	0.137	27.861
Later Rounds	596	0.265	26.081
Total	2,246	1	18.837

Table 2.2: Univariate test

The table 2.2 shows the univariate test for key dependent and independent variables. The sample includes 2,246 investments between 2006 and 2016. The sample is extracted from Crunchbase. The last column shows the univariate test statistics for mean difference between the connected group and unconnected group. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Variables	Connected			Unconnected			Mean Difference
	Mean	SD	N	Mean	SD	N	
Collaboration	0.152	0.360	964	0.074	0.263	21,524	0.077***
Next_Round_Financing	0.745	0.436	181	0.587	0.492	1,975	0.158***
Duration (Months)	19.975	16.399	164	23.293	16.703	1,854	-3.317**
Next_Round_Value ($mil)	37.963	70.736	105	25.300	43.958	946	12.663**
IPO/M&A	0.375	0.486	120	0.276	0.447	1,180	0.098**
VC_Experience	3.663	0.111	187	3.438	0.031	2,059	0.225**
Number_of_VCs	3.695	0.195	187	4.115	0.056	2,059	-0.420**
Fewer_than_50_Employees	0.492	0.501	187	0.455	0.498	2,059	0.037
Media_Coverage	1.257	0.710	187	1.321	0.843	2,059	-0.065

Table 2.3: Collaboration between VC and Start-up

The sample includes 2,246 investments between 2006 and 2016. The sample is extracted from Crunchbase. For each actual investment (pair of the VC firm and the start-up), we create the counterfactual investment based on the year-state-industry of the start-up. The dependent variable *Collaboration* is equal to one for the actual pair and zero for the counterfactual pair. Robust standard errors clustered at the industry level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
Connected_Pair	0.064***				
	(0.012)				
Same_School		0.053***			
		(0.017)			
Same_Previous_Employer			0.127***		
			(0.020)		
Same_Ethnic_Minority				0.028**	
				(0.013)	
Connection_Degree					0.089***
					(0.010)
VC_Experience	0.001***	0.002***	0.001***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fewer_than_50_Employees	0.003**	0.004***	0.003**	0.004**	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Observations	22,447	22,447	22,447	22,447	22,447
R^2	0.126	0.123	0.127	0.122	0.127

Table 2.4: Probability of next round financing

The sample includes 2,156 investments between 2006 and 2016. The sample is extracted from Crunchbase. The dependent variable *Next_Round_Financing* is equal to one if the start-up survives to next round financing and zero otherwise. Robust standard errors clustered at the industry level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
Connected_Pair	0.156***				
	(0.023)				
Same_School		0.162***			
		(0.056)			
Same_Previous_Employer			0.130***		
			(0.038)		
Same_Ethnic_Minority				0.180***	
				(0.056)	
Connection_Degree					0.208***
					(0.051)
VC_Experience	0.016***	0.018***	0.018***	0.018***	0.017***
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
Number_of_VCs	0.010**	0.009**	0.010**	0.009**	0.010**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Fewer_than_50_Employees	-0.095***	-0.094***	-0.096***	-0.094***	-0.095***
	(0.022)	(0.022)	(0.022)	(0.023)	(0.023)
Media_Coverage	0.017	0.017	0.017	0.015	0.016
	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)
Round FE	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Observations	2,156	2,156	2,156	2,156	2,156
R^2	0.272	0.270	0.270	0.269	0.271

Table 2.5: Hazard Rate of next round equity financing

The sample includes 2,018 investments between 2006 and 2016. The sample is extracted from Crunchbase. The hazard rate is the conditional probability that the start-up survives to the next round financing. The duration is the total months from the investment date to the next round financing date. For start-up without next round financing, the duration is the number of months between the investment date and 31st December 2017. In Cox hazard model, the failure event is the case that the start-up survives to next round financing before the end of 2017. Robust standard errors clustered at the industry level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
Connected_Pair	0.432***				
	(0.082)				
Same_School		0.467***			
		(0.141)			
Same_Previous_Employer			0.374***		
			(0.102)		
Same_Ethnic_Minority				0.263*	
				(0.145)	
Connection_Degree					0.589***
					(0.112)
VC_Experience	-0.002	0.002	0.001	0.001	-0.002
	(0.022)	(0.021)	(0.021)	(0.021)	(0.022)
Number_of_VCs	0.005	0.003	0.005	0.002	0.005
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Fewer_than_50_Employees	-0.466***	-0.463***	-0.461***	-0.458***	-0.463***
	(0.058)	(0.057)	(0.061)	(0.061)	(0.061)
Media_Coverage	-0.104*	-0.099*	-0.101*	-0.104*	-0.105*
	(0.053)	(0.053)	(0.053)	(0.054)	(0.054)
Round FE	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Observations	2,018	2,018	2,018	2,018	2,018

Table 2.6: Next round value

The sample includes 1,051 investments between 2006 and 2016. The sample is extracted from Crunchbase. The dependent variable *Next_Round_Value* is the amount of funding raised by the start-up upon surviving to next financing round. We take the logarithm of the value. Robust standard errors clustered at the industry level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
Connected_Pair	0.391**				
	(0.145)				
Same_School		0.614***			
		(0.182)			
Same_Previous_Employer			0.517**		
			(0.235)		
Same_Ethnic_Minority				0.224	
				(0.222)	
Connection_Degree					0.418**
					(0.198)
VC_Experience	0.066***	0.070***	0.065***	0.066***	0.067***
	(0.023)	(0.023)	(0.022)	(0.022)	(0.022)
Number_of_VCs	0.052***	0.049***	0.052***	0.050***	0.052***
	(0.014)	(0.014)	(0.013)	(0.013)	(0.014)
Fewer_than_50_Employees	-1.009***	-1.021***	-1.009***	-1.014***	-1.010***
	(0.080)	(0.082)	(0.080)	(0.082)	(0.081)
Media_Coverage	0.131**	0.129**	0.134**	0.121**	0.128**
	(0.055)	(0.055)	(0.056)	(0.055)	(0.056)
Round FE	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Observations	1,051	1,051	1,051	1,051	1,051
R^2	0.385	0.388	0.385	0.378	0.382

Table 2.7: Probability of IPO/M&A

The sample includes 1,300 investments between 2006 and 2014. The sample is extracted from Crunchbase. The dependent variable *IPO/M&A* is equal to one if the VC firm brings the start-up to the IPO market or the M&A market before the end of 2017 and zero otherwise. Robust standard errors clustered at the industry level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
Connected_Pair	0.091**				
	(0.042)				
Same_School		0.149**			
		(0.062)			
Same_Previous_Employer			0.128*		
			(0.068)		
Same_Ethnic_Minority				-0.058	
				(0.100)	
Connection_Degree					0.124***
					(0.040)
VC_Experience	0.002	0.003	0.002	0.003	0.002
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Number_of_VCs	0.010**	0.009**	0.010**	0.009*	0.010**
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
Fewer_than_50_Employees	0.050*	0.050*	0.050*	0.050*	0.052*
	(0.028)	(0.029)	(0.028)	(0.028)	(0.028)
Media_Coverage	0.004	0.005	0.005	0.006	0.003
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Round FE	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Observations	1,300	1,300	1,300	1,300	1,300
R^2	0.123	0.124	0.124	0.121	0.124

Table 2.8: Selection effects vs monitoring effects: Heckman selection model

In Table 2.8, we perform the hackman selection model. In the first stage, the dependent variable *Collaboration* is equal to one for the actual pair and zero for the counterfactual pair (as in Table 2.3). In the second stage, we include the Inverse_Mills_Ratio in the second stage regressions. In the next round financing analysis, the dependent variable *Next_Round_Financing* is equal to one if the start-up survives to next round financing before the end of 2017 and zero otherwise. In the IPO/M&A analysis, the dependent variable IPO/M&A is equal to one if the VC firm brings the start-up to the IPO market or the M&A market before then end of 2017 and zero otherwise. Robust standard errors clustered at the industry level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	Next Round Financing		IPO/M&A	
	1st Stage	2nd Stage	1st Stage	2nd Stage
Connection_Degree	0.016***	0.156***	0.013*	0.177***
	(0.006)	(0.045)	(0.008)	(0.051)
Local_Percentage_of_Connected_Pair	0.764***		0.683***	
	(0.100)		(0.104)	
VC_Experience	0.002***	0.013**	0.002***	-0.011
	(0.001)	(0.006)	(0.001)	(0.007)
Number_of_VCs		0.007**		0.012**
		(0.003)		(0.005)
Fewer_than_50_Employees	0.005*	-0.058**	0.004	0.074**
	(0.002)	(0.023)	(0.003)	(0.034)
Media_Coverage		0.019		-0.013
		(0.012)		(0.014)
Inverse_Mills_Ratio		-0.034		-0.020
		(0.026)		(0.042)
Round FE	N	Y	N	Y
State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Observations	21,518	1,831	11,774	956
R^2	0.190	0.325	0.212	0.156

Table 2.9: External validity: an international sample

The sample includes 2,753 investments between 2006 and 2016. The sample is extracted from Crunchbase. In Table 2.9, we re-run previous regressions by using an international sample. We construct the *Connection _Degree* by excluding the ethnic minority tie. Robust standard errors clustered at the industry level are in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	Next Round Equity Financing	Cox Hazard	Next Round Equity Value	IPO/M&A
Connection_Degree (Excl. Ethnic Tie)	0.172***	0.520***	0.439***	0.101**
	(0.044)	(0.119)	(0.153)	(0.046)
VC_Experience	0.023***	0.017	0.109***	0.007
	(0.005)	(0.019)	(0.022)	(0.006)
Number_of_VCs	0.013***	0.013	0.060***	0.010***
	(0.004)	(0.010)	(0.011)	(0.004)
Fewer_than_50_Employees	-0.115***	-0.508***	-0.972***	0.054**
	(0.025)	(0.070)	(0.073)	(0.026)
Media_Coverage	0.006	-0.126***	0.151***	-0.000
	(0.013)	(0.047)	(0.046)	(0.012)
Round FE	Y	Y	Y	Y
Region FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Observations	2,753	2,583	1,292	1,620
R^2	0.248	-	0.341	0.104

Chapter 3 Do Diversified Firms Allocate Capital Inefficiently? Evidence from Equity Carve-outs

3.1 Introduction

Whether a conglomerate is an efficient model for a business has been a question for the markets for many years. Prior studies have demonstrated that the market valuation of conglomerates is at discount to the aggregated individual values of their component businesses (Lang and Stulz, 1994; Lamont, 1997; Shin and Stulz, 1998). This undervaluation is generally attributed to the failure of the capital allocation function of the conglomerate, i.e. the failure of the Internal Capital Market (ICM). Several authors argue that the dysfunctionality of the ICM is due to factors such as the complexity and opacity of the parent's portfolio, and asymmetry of information between divisional managers and top management as well as between divisional managers and shareholders (Scharfstein and Stein, 2000; Rajan, Servaes, and Zingales, 2000). Academics have also suggested other reasons for the ICM dysfunctionality, particularly corporate socialism, which provides blood life to the weak divisions and starves the strong ones of investment funds as well as the managerial preference to allocate capital according to organisational politics, rather than objective value-generating criteria (Rajan et al., 2000; Stein, 2003).

To address the putative causes of inefficiency in the parent's ICM, diversified firms have the option to undertake divestments of segments of their business in the form of sell-offs, spin-offs and equity carve-outs (ECO). A sell-off is a sale of a business segment to another company, a spin-off is the floatation of the divested part in a stock exchange, with the distribution of the shares in that newly listed company to the shareholders of the parent, and an ECO is the floatation of the divested part on a stock exchange, with the parent selling a minority

of share ownership to outside investors. A few studies have examined the direct impact of spin-offs and sell-offs on the allocative efficiency of the parent's ICM (Gertner, Powers, and Scharfstein, 2002; Dittmar and Shivdasani, 2003; Burch and Nanda, 2003; Ahn and Denis, 2004; McNeil and Moore, 2005). Çolak and Whited (2007) (hereafter ÇW) conclude that there is no significant improvement in the allocative efficiency of the parent's ICM following these restructuring events. The impact of an ECO on the ICM efficiency of the parent has surprisingly received scant attention in the literature; and if such an impact exists, it is not clear what drives such changes in the functioning of the parent's ICM following ECOs.

In this paper we examine the efficiency of the ICM in a new and arguably more appropriate context, i.e. the ECO. Prior studies report the impact of ECOs only on the parent's shareholder value and the improvement in the parent's operating performance, drawing indirect inferences about the functioning of the parent's ICM. However, we believe that this approach is consistent with, and not necessarily corroborative of, an improvement in the parent's ICM (Vijh, 2002). Our investigation is, therefore, the first study to focus on the direct impact of ECOs on the allocative efficiency of the parent's ICM, a major financial rationale for diversification. In contrast to spin-offs and sell-offs, the advantage of using the ECO event for assessing the ICM efficiency of the diversified parent is that ECOs directly address some of the putative causes of ICM inefficiency. Independent monitoring of the carved-out segment by analysts and investors can mitigate the agency conflict between different managerial levels and between the top management and the parent's shareholders.

An ECO allows the parent to augment its corporate focus and provide the offspring with greater autonomy, while the two business entities continue to maintain a strategic relationship (Schipper and Smith, 1986). The external capital market also provides valuable information to the parent regarding the prospects of the two businesses as separate units (Nanda,

1991; Slovin, Sushka, and Ferraro, 1995). As a result, and unlike in spin-offs and sell-offs, monitoring of the offspring by the ECM also has a healthy feedback effect on the governance and efficiency of the parent's ICM. The ECO generally provides a mechanism to align the interests of top management in the newly formed company and the shareholders by facilitating managerial incentives based on stock market performance (Holmstrom and Tirole, 1993). For these reasons, we hypothesise that ECOs can lead to a significant increase in the parent's ICM efficiency and improvements in the internal and external governance of the parent are associated with such increase.

To test these predictions, we use a U.S. sample of ECOs completed between 1980 and 2013. We compare the allocative efficiency of the parent firms before and after the ECO and assess the statistical significance of any improvement. We employ three different metrics of ICM efficiency following the methodology in Rajan et al. (2000) and ÇW. Two are direct measures of capital allocation (relative investment ratio, *RINV*, and relative value added, *RVA*) and one is an indirect measure reflecting the change in the parent company valuation (excess value, *EXVAL*). We also consider the endogeneity that can be associated with restructuring events. Any observed improvement in allocative efficiency following restructuring can potentially be linked to the idiosyncratic characteristics of the conglomerate rather than the restructuring *per se*. This calls into question studies that point to inefficient ICMs prior to restructuring based on the evidence of post-restructuring increases in allocative efficiency. To address the issue of endogeneity, our primary methodology employs the Abadie and Imbens (AI) (2006) estimator which corrects for the asymptotic bias that can be present in simple matching estimators, such as the propensity score matching (PSM) estimator (Dehejia and Wahba, 2002). As an additional test of the robustness of our results, we analyse the change in allocative efficiency by using the PSM estimator and the Heckman (1979) model. Our results based on the AI estimator demonstrate that ECOs lead to an improvement in the allocative

efficiency of parent firms, consistent with the hypothesis of ICM inefficiency in these firms prior to ECO. We observe similar results using the PSM and the Heckman methodologies.

To test whether increased qualities of corporate governance in the parent firms are associated with the improvements in the functioning of the parent's ICM, we examine the changes in the internal and external corporate governance characteristics of these firms. Specifically, we analyse internal corporate governance characteristics such as board duality i.e. non-separation of the board chairman and CEO roles, board size, board composition, CEO compensation structure, and CEO tenure. The external governance characteristics that we investigate include the degree of analyst coverage, the number of institutional investors on the share register of the parent firm, and the concentration of their ownership. We show that the analyst coverage of both parent and offspring firms increases significantly following the ECOs which suggests that both the parent and carved-out unit are exposed to greater stock market scrutiny and greater transparency in the functioning of the ICM. We also find improvements in many internal governance characteristics of the parent firms, such as greater board independence, smaller board size and CEO compensation and CEO compensation which is based more on stock-based incentives than cash.

More importantly, we demonstrate that the improvement in the parent's investment efficiency is significantly higher in the firms which experience such positive changes in their internal and external governance characteristics. We find that higher analyst coverage and board independence are related to larger improvements in the parent's *RINV*. Additionally, higher levels of non-cash CEO compensation are positively related to changes in all three measures of the parent's investment efficiency. Finally, the valuation of the parent firms is significantly enhanced by higher numbers of analysts following the parent, by higher non-cash

CEO compensation but reduced by larger board size and overlap between the roles of the CEO and chairperson.

This paper contributes to the conglomerate literature in several ways. Previous studies adopt corporate restructuring events such as spin-off and sell-off which lead to changes of conglomerate components to assess the efficiency of the internal capital market and they do not include a benchmark group or control group (see e.g. Dittmar and Shivadasani, 2003; Ahn and Denis, 2004). This paper proposes a more appropriate restructuring event equity carve-out to assess the efficiency of the internal capital market and address the endogeneity. Further, this paper provides new evidence to the literature on the "dark side" of the internal capital market (Scharfestein and Stein, 2000; Rajan et al., 2000) by showing that measures of investment efficiency increase after a conglomerate equity carve-out. This analysis carries important implications for the corporate managers who seek to improve the investment efficiency of their companies by demonstrating that ECOs could be a more effective mechanism to restructure company operations than spin-offs and sell-offs.

This paper is organised as follows: Section 3.2 provides a review of the literature on refocusing and investment efficiency as well as the different implications for the ICM following carve-outs and other types of refocusing; Section 3.3 discusses the data sources, provides a description of the methodology, and a full list of variables; Section 3.4 presents empirical tests of the hypotheses; and the conclusion is presented in Section 3.5.

3.2 Literature Review and Hypotheses

One of the important rationales for the conglomerate or diversified business portfolio held by companies is that it allows them to allocate their scarce capital more efficiently among the businesses in their portfolio than do less diversified firms that rely on the external capital

market for debt or equity. The conglomerate head office is expected to function as a capital market playing an allocative role and, as a result, this market is referred to as the ICM. Such a market is said to have an information advantage over investors in the conventional external capital market, which allows the conglomerate head office to select potential winners and allocate capital to the highest valued investment opportunities (Stein, 1997; Khanna and Tice, 2001; Guedj and Scharfstein, 2004; Anjos and Fracassi, 2011).

This benign view of the ICM efficiency has been challenged by several scholars. Some studies have provided evidence that conglomerates in the stock market trade at discount to the value of a portfolio composed of the individual segments assuming such segments were traded as stand-alone (or pure play) entities (Berger and Ofek, 1995). The difference in value between the conglomerate and the portfolio of businesses as stand-alone entities is referred to as the conglomerate or diversification discount (DD). Several explanations have been offered for the existence of the DD. Among them is a dysfunctionality of the ICM arising from both the complexity and diversity of internal politics and the agency conflicts between the top managers and divisional managers (Milgrom and Roberts, 1990; Scharfstein, 1998; Rajan et al., 2000; Scharfstein and Stein, 2000). A corollary to this argument is that any restructuring of the conglomerate's portfolio that results in greater focus or reduced complexity should improve the efficiency of the ICM. One should therefore observe a significant improvement in the allocative efficiency of the parent following such restructuring. Similarly, where the ICM inefficiency is caused by the failure of internal governance to prevent capital misallocation due to rent seeking, misaligned incentives, corporate socialism etc., one should observe a significant improvement in allocative efficiency when governance is improved following a divestment.

Diversified firms undertake divestments of segments of their business to cure one or more of the putative causes of the dysfunctionality of the parent ICM and the DD. The parent firm's shareholders experience significant positive returns when divestments in the form of sell-off, spin-off and ECO are announced, indicating that they are perceived by investors as value creating decisions (Comment and Jarrell, 1995; Seward and Walsh, 1996, Mulherin and Boone, 2000; Lee and Madhavan, 2010; Desai, Klock, and Mansi, 2011). Other studies have reported improved operating performance of the parents following divestments (John and Ofek, 1995; Maksimovic and Phillips, 2001; Denis and Shome, 2005; Klein and Rosenfeld, 2010). These results are consistent with an improvement in the underlying parent's ICM efficiency and a reduction in the DD. They also imply a pre-divestment allocative inefficiency of the parent.

Other studies on divestments have empirically tested the inefficiency of the conglomerate's ICM prior to restructuring by examining the post-restructuring data of the parent and offspring (Ahn and Denis, 2004)[8]. This approach is however affected by an endogeneity problem. Any observed improvement in allocative efficiency following restructuring can potentially be linked to the idiosyncratic characteristics of the conglomerate rather than the restructuring *per se*. This calls into question studies that point to inefficient ICMs prior to restructuring based on the evidence of post-restructuring allocative efficiency. In this paper we choose to account for the endogenous nature of the ECO decision in the spirit of Çolak and Whited (2007). In particular, ÇW assess whether the allocative efficiency of diversified firms improves significantly following a spin-off or a sell-off. In the former event, a business segment becomes a listed entity subject to independent scrutiny but there are no

[8] This approach has been held to be methodologically superior to the prior approach of using a stand-alone single segment investment opportunity as a proxy for the unobservable investment opportunity of the segments of the diversified firm (Lang and Stulz, 1994). Critics of this proxy-based approach to measuring the segment's investment opportunity set have argued that it suffers from endogeneity bias since the conglomerate's acquisition of a segment is self-selected and based on its strategic considerations (Campa and Kedia, 2002).

direct implications for the efficiency of the parent's residual portfolio. In the latter event, the business segment becomes part of the buyer's portfolio and is shielded from any independent monitoring. To assess post-restructuring allocative efficiency, ÇW advocate using a new methodology that addresses the issue of endogeneity. ÇW find no evidence of significant change in allocative efficiency and conclude that any improvement reported by prior studies is likely to be the artefact of a flawed methodology that ignored the endogeneity.

In this sense, the issue of whether diversified parents have dysfunctional ICMs and whether divestments contribute to improvements in the allocative efficiency of the parent remains unresolved. This is particularly the case in the context of ECOs as a form of divestment. The ECO setting has superior conceptual and methodological properties over sell-offs and spin-offs for such investigation. An ECO enables the parent to establish the offspring's value in a more transparent manner. In particular, the ECO reduces the information gap that exists between company insiders and the capital market participants (i.e. the company outsiders) thanks to the release of information about the offspring in the form of regulatory filings and annual financial statements (Desai et al., 2011)[9].

Cline, Garner, and Yore (2014) argue that diversified firms operating inefficient ICMs tend to avoid issuing new equity or debt since the external capital market generally discounts such issues. Such external capital market monitoring improves the ICM by means of a feedback loop from investors. Habib, Johnson, and Naik (1997) support the feedback argument in the context of spin-offs which, like ECOs, are subject to external capital market monitoring. In the

[9] Nanda (1991), drawing upon Myers and Majluf (1984), however, models the ECO decision as opportunistic, designed and timed by the parent to exploit its information advantage as the insider over the investors in the ECM and sell stock in the overvalued offspring. Slovin et al. (1995), Slovin and Shushka (1998), and Powers (2003) report empirical evidence supportive of the Nanda model. Other studies challenging this information asymmetry model provide evidence that the observed shareholder value gains are supported by improvement in the operating performance of both the parent and the offspring (Vijh, 2002). Hulbert, Miles, and Woolridge (2002) argue that such operational improvement is inconsistent with the Nanda model of the parent exploiting overvaluation by external capital markets. In our study we focus on the operating performance of the parent as manifested in the improvement of the parent ICM functioning.

ECO setting, however, the feedback is about both the offspring and the residual parent. Further, the need for a more transparent capital allocation between the two and the greater bargaining power of the offspring against the parent can improve allocative efficiency (Klein, Rosenfeld, and Beranek, 1991; Slovin and Shushka, 1998; Hulbert et al., 2002; Boone, 2003; Triantis, 2002). The greater bargaining power of the offspring emanates from its new access to the external capital market and the constraint on any rent-seeking behaviour by the offspring's managers. To finance the capital investment needs of the offspring, the parent can choose from the options of either raising equity directly or through the offspring. This increased financing flexibility can also augment the efficiency of the ICM (Nanda, 1991; Slovin and Shushka, 1998).

At the same time, the carved-out entity can still enjoy most of the synergistic benefits arising from joint operations with the parent company. The extent of these synergistic benefits depends on the degree of control that the parent continues to maintain over the offspring. Given that the offspring is now a separately listed entity, it is not free to enter contracts or other arrangements that are structured in favour of the parent to the detriment of the shareholders in the offspring. However, the parent firm can employ a range of control levers such as majority ownership, control of the executive composition and control of the board of directors to receive favourable treatment. Thus, the parent can still reap the potential benefits of preserving the ICM, thereby enhancing its own value (Desai et al., 2011).

An additional benefit associated with ECOs is that they allow the different residual business segments of the parent as well as the offspring to be independently valued by analysts who have developed expertise in their respective industries. This is consistent with the literature which shows that the number of covering analyst increases and their specialisation improves following ECOs (Schipper and Smith, 1986; Slovin et al., 1995; Gilson, Healy, Noe,

and Palepu, 2001). Moreover, the management of the offspring can be rewarded with its own stock following ECO, thereby enhancing the alignment of the interest of managers and shareholders (Holmstrom and Tirole, 1993; Schipper and Smith, 1986). There is also evidence that the adoption of segment-based incentive plans could exert a positive influence on the quality of employees that either the offspring or the parent can hire (Kumar and Sopariwala, 1992). Such incentive alignment enhances both the offspring's and parent's valuations. This channel of efficiency enhancement of the parent is not available in spin-offs and sell-offs since the spun-off or sold-off segment has no bearing on the performance of the parent. Hulbert et al. (2002) argue that the incentive alignment of the managers of carved-out units through stock-based compensation will incentivise both the carved-out and parent firms to improve their operating performance. Stock-based compensation is also likely to reward the parent's managers if their ECO decision is value enhancing and results in higher market valuation of the parent, which should be the rationale behind such a decision.

In the ECO setting, the financing and investment cash flows between the two entities are more transparent and more rigorously monitored by analysts and investors. As a result, investment decision processes are improved (Vijh, 2002; Hulbert et al., 2002). While this enhances the transparency and monitoring of the ICM, the parent's business scope is essentially unaffected, and this differentiates an ECO from a spin-off or a sell-off. The internal and external governance structures of both the parent and the offspring (such as board size and independence, institutional ownership, and level of analyst following), are expected to change because of the ECO. The potential decrease in information asymmetry and improvement in management incentive plans can enhance the quality of corporate governance of both the parent and offspring, thereby driving the observed improvement in the efficiency of the parent's ICM. Such improvement in corporate governance mechanisms is the evidence that the expected divestment gains are likely to be the true motive for the ECO.

The discussion presented in this section motivates the following hypotheses that we test in this study:

Hypothesis 1: The allocative efficiency of the parent's ICM improves following an ECO.

Hypothesis 2: The internal and external corporate governance improvements of the parent following the ECO are associated with the improvement in allocative efficiency of the parent's ICM.

3.3 Sample, Methodology, and Variables

3.3.1 Sample

To investigate the impact of ECOs on allocative efficiency and firm valuation we construct two different samples of companies based on U.S. data: a sample of companies that carve out divisions and a sample of companies that do not perform any divestment activity over the entire sample period from 1980 to 2013. We obtain the sample of ECOs from the SDC Global New Issues Database and our initial sample consists of 1,328 parent firms that complete ECOs during the sample period. Following the sample construction methodology in ÇW, we exclude companies that operate in financial services industries with Standard Industry Classification (SIC) codes between 6000 and 6999, which reduces the sample of ECOs to 889. We exclude parent companies for which company- and segment-level data are not available. Specifically, since we track each ECO over a 7-year period (i.e. from three years before to three years after the transaction year), we exclude companies that do not have relevant financial information over this period surrounding each ECO. Our final sample consists of 354 ECOs.

We obtain our sample of control companies from the most recent Compustat business information file. We exclude the firm-year observations that lack any of the financial information necessary to perform the matching procedures. We also remove from the control

group companies with a changing number of segments during the sample period as this suggests some restructuring. Finally, we require that each control firm has more than one business segment, i.e. it is a diversified firm. These criteria result in a final sample of 3,695 control firms. From this control sample we identify a matching firm that did not perform an ECO but has characteristics similar to its ECO performing counterpart. To this end we use the Abadie and Imbens (2006) procedure and a probit model of the likelihood of performing an ECO. Appendix 3.1 provides detailed definitions of the variables used in this study.

3.3.2 Measuring Allocative Efficiency of ICM Before and After ECO

We adopt two direct measures of allocative efficiency, namely, the relative investment ratio (*RINV*) and relative value added (*RVA*) (Rajan et al., 2000; and Çolak and Whited, 2007). We also employ an indirect measure of allocative efficiency, namely, *EXVAL* (Ahn and Denis, 2004; Çolak and Whited, 2007). These correlation-based measures aim to capture the association between the level of investment and the investment opportunities across segments. The parent's investment programme is considered the more efficient, the greater the investment in the segments with the highest growth potential and investment opportunities. *RINV* measures the relative investment intensity in high growth versus low growth segments. *RVA* captures the sensitivity of industry-adjusted investment of a parent segment to the industry median *q* ratio that is measured using the pure-play companies which operate in the given segment's industry. The numerator of *q* is calculated as the book value of assets minus book value of equity plus market capitalisation minus deferred taxes. The denominator of *q* equals the book value of assets. *EXVAL* captures the value of a conglomerate relative to a collection of single-segment companies in the industries corresponding to the conglomerate's segments. Appendix 3.2 describes the formulae used for calculating *RINV*, *RVA*, and *EXVAL*.

3.3.3 Treatment Effects Estimator

Our methodology accounts for the possible endogeneity that can arise when analysing the change in allocative efficiency of firms that decide to perform an ECO. In an observational sample such as ours, the assignment of firms to the ECO group (the *treatment* group) and to the non-ECO group (the *non-treatment* group) is not random and could be self-selected. This means that the treatment effect, i.e. the improvement in allocative efficiency of the parent's ICM, could be due to the characteristics of the self-selecting firms rather than to the treatment *per se.* If the decision to carve out business operations is thus endogenous, companies that opt for it would have systematically different characteristics from those that decide not to. If the allocative efficiency of companies does improve following ECOs, and this improvement is attributable to the ECO event, then this treatment effect must be observable after controlling for such systematic differences. The average treatment effect is statistically estimated by building a control sample of companies displaying the same characteristics and thus the same propensity as the treated sample and then averaging the difference in allocative efficiency metrics between the treatment and matched control samples.

We use the matching estimator developed by Abadie and Imbens (AI) (2006). This sample matching technique provides an adjustment for the asymptotic bias present in simple matching estimators such as the PSM estimator. Appendix 3.3 provides a discussion of the methodology for obtaining treatment effect estimates based on the AI procedure. A detailed description of the implementation of the AI estimation procedure with the Stata software is provided by Abadie, Drukker, Herr, and Imbens (2004). All matching results are based on one nearest neighbour, i.e. one with propensity closest to a treated observation, selected from the control group. In unreported results we also perform matching based on more than one nearest neighbour control firms and our conclusions remain unchanged.

Next, we estimate the treatment effects on each of our performance variables, i.e. the control sample-adjusted results. We firstly estimate level treatment effects as the average post-ECO level of each of the three variables relative to the level in the control sample. We calculate the average values of *RINV*, *RVA* and *EXVAL* before and after each ECO. Specifically, we define the variable *Before* as the average for each conglomerate company over a period starting two (or three) years before and ending one year before the completion of the ECO. For *Before*, we do not report level treatment effect[10]. The variable *After* is the average for each conglomerate company over a period starting one year after and ending two (or three) years after the completion of the ECO, relative to the average of a matched sample of diversified firms using the AI method. Following ÇW, we define the variable *Change* as the difference between the variables *After* and *Before*.

The *Difference in Difference (DinD)* treatment effects captures the average change in the performance variables relative to the average change in the control sample. Using *RINV* as an example, the variable *DinD* is defined as:

$$\Delta\ \mathrm{RINV}_{\mathrm{ECO\ Parent}} - \Delta\ \mathrm{RINV}_{\mathrm{Control\ Company}} \qquad (1)$$

It should be noted that the *DinD* variable accounts for unobservable time-invariant control factors, whereas the level treatment-effect estimator does not. When the variables *Change* or *DinD* are significantly greater than zero, we interpret this result as an indication that the given improvement in investment efficiency and valuation is driven by the ECO per se and not by the inherent characteristics of the ECO parents.

[10] In the level treatment effects, it is invalid to adopt the level of *RINV*, *RVA* and *EXVAL* as controls. This is because these variables would be self-explained (Çolak and Whited, 2007).

The AI matching procedure requires the development of a probability model that estimates the likelihood of embarking on an ECO. The probit regression that we estimate is of the form:

$$\text{Probit (ECO)} = \alpha + \beta_n \text{Controls} + \varepsilon_n \quad (2)$$

To estimate the regression, we use two sub-samples of firms: a *treatment* sample of companies that perform ECOs and a control sample of companies that did not engage in any divestment activity. The dependent variable assumes a value of one if the firm has carried out an ECO and zero otherwise. We follow previous literature to construct the vector of control variables.

Following Desai and Jain (1999) and Krishnaswami and Subramaniam (1999), we include *Relative_Entropy*, a measure of the diversity of the industries in which the sample firms operate. Shleifer and Vishny (1992) demonstrate that companies that embark on refocusing activities tend to be highly leveraged. According to Haynes, Thomson, and Wright (2003), larger companies and companies with considerable market shares could gain more by increasing their focus on core-operation through restructuring. To account for these effects, we include, *Log_Sales*, *Debt/Assets*, *MTBV* (Market to book), and *Market_share* (ratio of company sales to industry sales), in our probit regressions. Following Lang, Poulsen, and Stulz (1995), we also incorporate measures of liquidity (*EBITDA/Sales*) and financing needs (*Financing_gap)* in our analysis. We also control for the presence of demand shocks in the firm's main industry (proxied by *Largest_segment_profit,* company's largest segment profits divided by that segment's sales) following Maksimovic and Phillips (2002). Following ÇW, we incorporate variables that control for the timing of carve-out by capturing the broader product and stock market environment. These variables capture the effects of industry sales growth, the demand for corporate assets in the conglomerate's main industry (variable *Control_Activity*), and the

market value of IPO activity and M&A activity. We also incorporate a measure of unanticipated shifts in industry prospects, captured by the industry sales growth in the year prior to refocusing (variable *Industry_Sales_Growth*). Finally, in line with ÇW, we include the levels of *RINV, RVA, Excess_Value* in our probit regression since we expect that low levels of investment efficiency or value should increase the propensity to refocus.

As alternative tests, we employ two other familiar estimators, namely, the PSM estimator developed in Dehejia and Wahba (1999, 2002) and the Heckman (1979) procedure to correct for self-selection[11]. According to ÇW, the AI technique is arguably superior to other matching methods such as the Dehejia and Wahba (2002) PSM and the Heckman bias adjustment methods since it does not involve any parametric assumptions regarding the distributions of the variables. Relaxing such assumptions is particularly important when using data from Compustat, as these distributional assumptions are likely to be untenable and could result in biased standard errors. In addition, the distribution of many income and balance-sheet statement items may not be accurately captured by the logistic or normal distributions and these are the two distributions used by the PSM and the Heckman bias adjustment methods.

The PSM and Heckman methods employ the same first stage probit model as the AI procedure above. For the PSM, as with the AI approach, all matching results are based on one nearest neighbour selected from the control group. In unreported results we also perform matching based on more than one nearest neighbour control firms and our conclusions remain unchanged. In the Heckman (1979) model, we estimate the average investment efficiency before and after an ECO by running the following (Heckman) regression:

$$\Delta S_n(T_n) = \alpha + \beta_1 T_n + \beta_2 \text{InvMills} + \varepsilon_n \quad (3)$$

[11] Villalonga (2004) applies PSM methodology to the study of conglomerate discount.

where α represents the average change in investment efficiency in the sample of non-refocusing companies and the sum of ($\alpha+\beta_1$) captures the average change in investment efficiency in the ECO sample. ΔS is defined as the change in investment efficiency and conglomerate valuation and T_n is a dummy variable that is equal to one if the company performs a carve-out and zero otherwise. In addition, β_2 is defined as the coefficient on the variable used to adjust for self-selection bias in the Heckman regression. If the firm has self-selected to perform the restructuring and the decision thus is endogenous, ε_i is correlated with ΔS and the estimate of β_1 will be biased. According to Heckman (1979), the issue of having a biased estimate is analogous to an omitted variable problem where the omitted variable is the inverse Mills ratio (*InvMills*) that corresponds to the decision to perform an ECO. To obtain a consistent estimate of β_1, we first need to estimate the *InvMills* with a probit model and then include the estimated *InvMills* in Eq. (3). To present the results from the analysis based on the Heckman bias correction procedure, we define the variable *Heckman_Treated* as the sum of ($\alpha+\beta_1$) in Eq. (3). We also define the variable *Heckman_Controls* as the coefficient corresponding to α in Eq. (3). Finally, we note that all tests in this study are performed with winsorised variables at the 1st and 99th percentile of the sample.

3.3.4 Modelling the Impact of Governance Changes on Investment Efficiency

To examine whether enhanced corporate governance of the parent and offspring post-ECO is associated with greater allocative efficiency, we match the offspring and its parent firm with the BoardEx and Execucomp databases. We replace any missing information from BoardEx and Execucomp by searching the Proxy Statements, 10K and Prospectuses filed by the parent and offspring firms. Internal corporate governance characteristics are measured by board duality i.e. non-separation of the board chairman and CEO roles, board size, board composition, CEO compensation structure and CEO tenure. External governance

characteristics are measured by analyst coverage, the number of institutional investors on the share register of the given company and the concentration of their ownership. Detailed definitions of the corporate governance characteristics examined in this study are provided in Table 1. We follow the methodologies in Brickley, Coles, and Terry (1994) and Coles, McWilliams, and Sen (2001) when constructing the internal and external governance characteristics. Data on analyst coverage are obtained from the Institutional Brokers' Estimate System (IBES) database. We regress the changes in our investment efficiency measures on the changes in corporate governance characteristics to assess the impact of governance changes on investment efficiency.

3.4 Empirical Results

3.4.1 Sample Descriptive Statistics

Table 3.1 Panel A presents the distribution of our ECO sample over time. The smallest proportion of ECOs in our sample was announced in the 1980s. The proportions of ECOs announced in the 1990s and 2000s are very similar, with 42% of our ECO sample announced in the former and 39% announced in the latter period.

[Insert Table 3.1 about Here]

Table 3.1 Panel B shows some of the key financial characteristics of companies that embark on ECOs and the control sample of multi-segment companies that do not perform any restructuring activity (non-ECO). The table demonstrates several interesting differences between the two sub-samples. First, ECO parents appear to have significantly better investment opportunities than the control firms (median *MTBV* of 1.65 vs 1.38 respectively). Second, ECO parents have significantly higher *EBITDA/Sales* margins (median values of 0.14 vs 0.10 for the control sample). Third, ECO parents are considerably and significantly more leveraged (with

a median *Debt/Assets* of 0.27 vs 0.18 for control firms), and therefore, under greater financial constraints. In addition, the ECO firms comprise significantly more segments (degree of diversification) than the control sample (median *Number_of_segments* of 4.00 vs 2.00 for the non-ECO firms). The significant difference in *Relative_entropy* further confirms that ECO parents are more diversified. ECO parents face significantly greater *Financing_gap* than non-ECO firms. The other significant differences are in *IPO_activity, Market_share and Largest_segment_profit*.

Based on this initial univariate analysis, it is apparent that the ECO parents are more diverse and complex and, as a result, more vulnerable to dysfunctional ICMs. Additionally, these findings show that ECO parents differ systematically from the control sample. This suggests that any estimate of improvement in allocative efficiency of the ECO parents' ICMs could be subject to a potential endogeneity, i.e. these systematic differences between ECO and non-ECO firms could be the true cause of increase in allocative efficiency and not the ECO event *per se*[12].

Table 3.1 Panel C provides more transactional data on the ECO parents and their offspring units. The median offspring is about one twentieth of the median parent and the ECO raises nearly $97m (median *Total_proceeds*). The parent retains a median 72% of equity in the newly listed segment. The median of *Total_proceeds* is around 30% (97 over 311) of the median ECO market value, which is consistent with the *Equity_retained* statistics. Of the 354 ECOs, 155 are in the same SIC3 industry as the parent, while 84 are in the same SIC2 industry but in different SIC3 industries. Thus, 68% of the offspring retain very strong/strong product market, technology, input or marketing links with their parents.

[12] Such improvement is reported in previous studies that examine the effect of refocusing through spin-offs (Gertner et al., 2002; Burch and Nanda, 2003; Ahn and Denis, 2004) but they ignore the endogeneity.

3.4.2 Probit Model of the ECO Decision

To perform the AI matching procedure, we first estimate a probit regression of the likelihood of performing an ECO by including covariates that have been identified as relevant by previous studies. The results of this analysis are presented in Table 3.2 and described in detail. Our analysis demonstrates, consistent with the univariate results in Table 3.1 Panel B, that companies that perform ECOs have systematically different characteristics from companies that do not embark on refocusing. These differences, potentially accounting for some of the observed treatment effects, highlight the need to address the problem of endogeneity when assessing the change in investment efficiency.

[Insert Table 3.2 about Here]

We find that the size of ECO parents is significantly larger and they are more diversified. Specifically, for one-unit increase in the *Relative_entropy* of the parent firm, the likelihood of performing an ECO increases by 0.1%. They also have larger sales volume and higher valuation, carry more debt, and perform ECOs in favourable market conditions with high IPO activity. We note that the *IPO_activity* and *M&A_activity* are exogenous to the change in parent investment efficiency and valuation following ECO. While being associated with the ECO decision, they are unlikely to be significantly related to any subsequent change in the parent's allocative efficiency.

Based on the above probit model, we employ the AI matching procedure to identify an appropriate control (non-ECO) firm for each ECO parent in our sample. To evaluate the accuracy of our matching procedure, we compare our ECO sample to the 354 control firms identified by the AI method in Table 3.3. The mean and median comparison tests between the two groups in terms of the significant firm-specific predictor variables in the probit model (*Log_sales, MTBV, Debt/Assets, Relative_entropy, Market_share, and Largest_segment_profit*)

show no statistically significant differences between our ECO parent sample and the matched control firms. These findings suggest that the selected control firms are very similar to the ECO parents in all important aspects, including their propensity to undertake ECO, but only the ECO parents carry out the restructuring. Two other variables significant in the probit model, *IPO_activity* and *Industry_sales_growth*, are stock market- and industry- related rather than firm-specific and hence excluded from this comparison.

[Insert Table 3.3 about Here]

3.4.3 Treatment Effects Results

We proceed with the evaluation of the average treatment effect of ECOs on the investment efficiency and valuation of the parents. The results from the analysis are presented in Table 3.4, Panels A and B for the analysis of change in allocative efficiency and valuation over periods respectively of (-2, +2) years and (-3, +3) years centred on the year of the ECO completion, $t = 0$. As defined in the methodology section, *Before* is the average for each conglomerate company over a period starting two (or three) years before and ending one year before the completion of the ECO. The variable *After* is the average for each conglomerate company over a period starting one year after and ending two (or three) years after the completion of the ECO, relative to the average of the matched sample. *Change* is the difference between *Before* and *After*.

[Please Insert Table 3.4 about Here]

We find that the average values of *RINV* and *RVA* before the performance of ECOs are negative but not significantly different from zero, i.e. companies that perform ECOs do not appear to be characterised by significant levels of investment inefficiency before the completion of the event. However, to gain a better understanding of whether investment

inefficiency existed before the ECOs, we also need to examine whether the investment efficiency improves following the ECO, after addressing the possible endogeneity. The analysis presented in Table 3.4, both Panels, demonstrates that the investment efficiency of the parent is improved during the first three years following an ECO. In particular, the *Change* coefficients for *RINV* (+0.02) and *RVA* (+0.01) measured over the window (-2, +2) years are statistically significant. Furthermore, *DinD* coefficient for *RINV* is positive (+0.01) over the (-2, +2) years event window and statistically significant (at the 10% level significance).

Table 3.4, Panels A and B indicate that there is also improvement in the parent's *EXVAL*. Specifically, this finding is supported by the positive and significant *Change* coefficient (+0.57) over the (-2, +2) years event window, and *DinD* coefficient (+0.53) over the (-3, +3) years event window for the variable *EXVAL*. These results provide support to our first hypothesis that allocative efficiency of parent firms following ECOs improves. The fact that parents are better able to allocate capital across different business segments following ECOs suggests that these pre-restructuring parents were suffering from inefficiency of their ICMs.

In Table 3.5 we repeat the analysis of the impact of ECO on conglomerate allocative efficiency and valuation with the use of the Dehejia and Wahba (1999, 2002) PSM technique in Panel A and the Heckman (1979) bias adjustment procedure in Panel B. We find consistent results. Our analysis shows that the *Change* coefficients of *RINV* and *RVA* are positive and statistically highly significant when using the PSM technique over the two- and three-year event window following ECO. We also find that the coefficient corresponding to the *DinD* variable is positive and significant over the (-3, +3) years event window and across the three measures of allocative efficiency when using this technique. The *DinD* variable for *EXVAL* is also significant over the (-2, +2) years window albeit at a lower level of significance at 10%.

[Insert Table 3.5 about Here]

We note that all coefficients associated with the variable *InvMills* presented in Table 3.5 are positive and significant. This finding highlights the importance of adjustment for the self-selection bias. In other words, the characteristics that lead companies to choose ECOs as a refocusing mechanism are likely on average to impact positively their allocative efficiency. Crucially, we also find that most of the Heckman treatment estimates (i.e. the coefficients corresponding to the variable *Heckman_Treated*) are positive and statistically significant in Table 3.5. These results demonstrate that there is a significant enhancement in the allocative efficiency of parent companies following ECOs and that this enhancement is due to the impact of the ECO event itself and not just due to the characteristics of the parent firms.

It is important to point out that the AI procedure shows that our analysis is unlikely to suffer from any asymptotic bias as the values of the *DinD Treatment Effects* coefficients with the bias adjustment are almost identical to the *DinD Treatment Effects* coefficients without the bias adjustment. This result suggests that our analysis based on the PSM in Table 3.5, Panel A is as reliable as the AI result in Table 3.4. Since the PSM result is stronger, in terms of statistical significance, and it is not tainted by any unadjusted asymptotic bias, it lends even stronger support for our hypothesis of investment efficiency improvement following ECOs. Our Heckman result in Table 3.5, Panel B is also stronger than the result based on the AI technique. Overall, although the methodologically superior AI matching procedure generates a weaker result, it does not detract from the reliability of the analysis based on the PSM and Heckman methods.

3.4.4 Analysis of Corporate Governance Characteristics

Our hypothesis 2 is that better corporate governance in the parent is associated with improvements of the parent company's ICM. To test the validity of this proposition, we examine the change in key internal governance characteristics such as board duality, board size,

board composition, and CEO compensation structure. We also investigate the change in key external governance characteristics such as analyst coverage, number of institutional investors, and stock ownership of institutional investors in our sample of ECOs. We do not estimate treatment effects in this section, and here the variable *Before_p* is the average of the given governance variable for each conglomerate company over a period starting two (or three) years before and ending one year before the completion of the ECO. Similarly, *After_p* is the average of the given governance variable for each conglomerate company over a period ending two (or three) years after the completion of the ECO. The variable *Change_p* is defined as the difference between *Before_p* and *After_p*.

Table 3.6, Panels A and B investigate the changes in the governance structure of parent firms over periods of respectively (-2, +2) and (-3, +3) years centred on the year of the ECO completion, $t = 0$. The results demonstrate that the ratio of non-executive to executive board members increases after the ECO over each of the two event windows that we consider. Specifically, we observe a positive and statistically significant change in the variable *Board_indep.*, amounting to +0.59 and +0.72 during the (-2, +2) and (-3, +3) years event windows respectively. At the same time, we find that *Board_size* decreases significantly by 0.40 and 0.46 during the (-2, +2) and (-3, +3) years event windows respectively following the ECO. These results suggest an improvement in the governance structure of the parent, as smaller board size could imply a better coordination among directors (Yermack, 1996) and more independent directors can lead to improved control, monitoring, and strategic leadership of the board (Gilson et al., 2001). Furthermore, we find that the *Analyst_coverage* increases significantly by 5.4 and 6.1 more analysts during the (-2, +2) and (-3, +3) year event windows respectively following the ECO. These results indicate that the parent management is subject to increased internal independent monitoring and more rigorous capital market scrutiny

following the ECO. These improvements in governance are likely to lead to reduced levels of asymmetric information between company insiders and company outsiders.

[Insert Table 3.6 about Here]

We observe no change in the average CEO's cash compensation during the (-2, +2) years but identify a significant increase over the (-3, +3) years window amounting to U.S. $0.208 million. We also observe a significant increase in the CEO's non-cash compensation during the (-2, +2) and (-3, +3) year windows. The latter increase in the CEO's compensation package also accounts for the largest proportion of increase in the total average CEO compensation in the parent firm. Specifically, our analysis demonstrates that the CEO's non-cash compensation increases on average by U.S. $1.22 million and U.S. $1.39 million over (-2, +2) and (-3, +3) years respectively. This is interesting, given that the parent company is likely to be a more focused business following the ECO. As a result, we expect that the CEO's financing and investment decisions are more likely to have a direct impact on the parent company's share price, and these actions will have a more direct impact on the CEO's non-cash compensation. It appears that the increase in non-cash compensation associated with the ECO leads to a better alignment between the interests of managers and interests of shareholders. This better alignment of interests could arguably improve the investment efficiency of the parent firm, thereby satisfying one of the key objectives of the ECO, which is to better align managerial and shareholder interests than in the more diversified parent. In sum, the analyses presented in this section provide supporting evidence that there are some considerable improvements in the internal and external governance characteristics.

Table 3.7, Panels A and B present the analysis of the change in corporate governance characteristics in the offspring firm in the first two- and three-year periods following ECO

completion respectively[13], bearing in mind that it was only possible for us to obtain observations for offspring firms after the ECO event. In this case, the variable *Before_o* is the value of the given governance characteristic for each offspring at $t = 0$. *After_o* is value of the governance variable for each offspring as of two (or three) years after the completion of the ECO. The variable *Change_o* is defined as the difference between *Before_o* and *After_o*.

The results show that, in the offspring, *Board_size* as well as the ratio of non-executive directors to executive directors (*Board_indep.*) tend to increase following ECO. Specifically, we observe a statistically significant increase of 0.65 and 0.22 in *Board_size* and *Board_indep.* respectively over the (0, +3) year period following ECO. *Board_size* also increases significantly over the period of (0, +3) years. These results suggest that as the carved-out units, as newly-established entities, tend to expand their sales and market share, they are also likely to recruit more directorial talent and increase their board size. Additionally, the increase in the proportion of independent directors suggests that the offspring companies tend to adopt a more independent board structure that is likely to lead to greater governance effectiveness by strengthening oversight and reducing conflicts of interest between board members.

[Insert Table 3.7 about Here]

Our analysis also shows that there is an increase in the number of institutional investors and the degree of analyst coverage over the (0, +2) and (0, +3) event windows following the ECO. Specifically, we observe a positive and statistically significant increase amounting to 0.56 and 0.45 in the number of institutional investors (*Number_of_instit._investors*) over the (0, +2) and (0, +3) event windows following ECO respectively. The *Analyst_coverage* of the

[13] We note that the data availability for different governance characteristics varies considerably. Each governance characteristic is tested based on the number of observations for which we have available data. For example, in Table 3.7, Panel A, data for analyst coverage are available for 206 offspring companies while data for the number of institutional investors is available for only 81 offspring companies. This large sampling variation needs to be kept in mind in assessing the significance of the offspring-related improvements.

offspring also increases by 2.5 and 2.8 analysts over the (0, +2) and (0, +3) event windows after the ECO respectively. These results demonstrate that the offspring companies are subject to strong capital market scrutiny that increases over time, thereby enhancing the external governance of the offspring. While the average CEO's compensation falls together with its equity and cash components over the (0, +2) and (0, +3) event windows after the ECO, this decrease is not significant. The CEO's tenure increases significantly by about 1.7 and 2.2 years on average during the over the (0, +2) and (0, +3) event windows following the ECO, perhaps to provide a stable leadership to the infant firms. This argument receives some support from the significant increase in the cases of overlap of the CEO and chairperson roles in these firms in the over the (0, +3) event window after the ECO. As a result, there appears to be a trade-off between leadership demands and rigorous governance. The internal and external governance improvements in the offspring firms, in conjunction with similar improvements in the parents, are consistent with such anticipated improvements acting as major motivators for the ECO decision. We next model the impact of these changes in governance characteristics on the parents' investment efficiency metrics in a multivariate framework[14].

3.4.5 Effect of Corporate Governance Changes on the Functioning of the Parent's ICM

We perform a regression analysis of the determinants of the change in investment efficiency and valuation of the parents following ECOs. The results are presented in Table 3.8, Panels A and B over the windows (-2, +2) and (-3, +3) years respectively centred on the year of ECO completion. For each parent company the change in investment efficiency or valuation is adjusted for the corresponding change in the matched control firm, where each control firm is identified using the AI matching estimator. For the purposes of the regression analysis we

[14] We do not model the direct impact of improvements in the offspring on the investment efficiency of their parents measured over windows starting before the ECO event and model only the impact of improvements in the parents.

measure the change in governance characteristics over a (-2, +2) and (-3, +3) years window of parent company and it is adjusted for the corresponding change in the matched control firm.

[Insert Table 3.8 about Here]

Overall, the results presented in Table 3.8 support our hypothesis 2 that improvements in the governance characteristics of parent firms are associated with the increase in investment efficiency observed following ECOs. We note that there was insufficient information for some of the companies in the matched control sample and, as a result, we could not include all measures of internal and external corporate governance quality measures in our regression model. In particular, our analysis shows that greater board independence (*Change_in_Board_indep.*), smaller board size (*Change_in_Board_size*), separation of the roles of CEO and chairperson (*Change_in_Board_duality*) as well as higher non-cash CEO compensation all significantly improve *RVA* measured over a window of (-2, +2) years. In addition, higher analyst coverage (*Change_in_Analyst_coverage*), smaller board size (*Change_in_Board_size*) and higher non-cash CEO compensation (*Change_in_CEO_non-cash_comp.*) significantly improve *RINV* over the same event window. Similarly, higher analyst coverage (*Change_in_Analyst_coverage*), smaller board size (*Change_in_Board_size*), non-duality of the roles of CEO and chairperson (*Change_in_Board_duality*) as well as higher non-cash CEO compensation (*Change_in_CEO_non-cash-comp.*) enhance *EXVAL*.

Over the longer event window that captures the period of three years before and three years after the ECO, we find that greater board independence (*Change_in_Board_indep.*), smaller board size (*Change_in_Board_size*), separation of the roles of CEO and chairperson (*Change_in_Board_duality*) as well as higher non-cash CEO compensation (*Change_in_CEO_non-cash_comp.*) are all significantly related to improvements in *RVA* and

EXVAL. Our hypothesis 2 of a positive impact of governance changes following ECOs on the investment efficiency and valuation of the parent firms is supported.

3.4.6 Secondary Event Analysis

ECO appears to be transitory organizational form that is eventually followed by secondary corporate event such as a spin-off, sell-off or re-acquisition (Desai et al., 2011; Perotti and Rossetto, 2007; Gleason, Madura, and Pennathur, 2006; Vijh, 2002; Klein et al., 1991). Perotti and Rosetto (2007) model the ECO as a strategic option portfolio with the re-acquisition and sell-off as the exercise strategy. The parent company will re-acquire the offspring when the value of the offspring increases while sell the offspring off when decreases.

Previous empirical studies examining secondary events have analysed shareholder returns using the conventional event study methodology at the original ECO and/or at the secondary event (Klein et al., 1991; Slovin and Sushka, 1998; Hulbert et al., 2002; Vijh, 2002; Otsubo, 2009). They have interpreted these returns to draw the implications for the original motivation for the ECO. None of the studies has, however, examined the real effects and the link between investment efficiency improvement and the secondary event. In this section, we conduct the additional analysis to explore this question.

We split our initial ECO sample, following Slovin and Sushka (1998), Otsubo (2009), and Colla, Ippolito, and Talamanco (2009), into four sub-samples based on the secondary event that follows each ECO. Spin-off is the event where the parent company distributes all shares of the offspring to its shareholders. Sell-off is the merger and acquisition event in which the parent sells part or full ownership of the carve-out entity to the third party. Re-acquisition is the group of parents that reacquire the part or all outstanding shares of the offspring. We firstly search the SDC Global New Issues database to identity the secondary offerings event and spin-off event and then search SDC Merger and Acquisition database to identify the subsequent sell-

off event and re-acquisition event. We find that most parent companies dilute part of ownership through seasoned equity offering (SEO)[15]. The Retention sub-sample thus includes cases where the status quo post ECO is retained and there is no subsequent secondary event and cases of partial SEO.

In Panel A of Table 3.9, we find that a large number of our sample parent firms fall under the category of retention. M&A activities (both sell-off and re-acquisition) represent the highest proportion of secondary events, amounting to more than 80% of all secondary events. This percentage is qualitatively similar to that reported in Klein et al. (1991), Vijh (2002), and Desai et al. (2011). We identify 30 spin-off transactions accounting for less than 14% of second event cases. In Panel B, we find that parents perform spin-off and sell-off achieve limited efficiency improvement in years (-2, +2) or (-3, +3) and no valuation gains at all. Parents either re-acquiring their offspring or retaining their ECO status significantly improve their investment efficiency and valuation consistently over the windows (-2, +2) years and (-3, +3) years. Especially, we find that the magnitude of excess value change for the re-acquisition group is higher than the retention group. The results suggest that parents who have made such gains exercise their call option and re-acquire the offspring or maintain the ECO status as it continues to yield significant benefits to the parents. It also implies that ECO is a reversible decision probably aimed at value discovery when the parent was unsure of the division's true value (Perotti and Rosetto, 2007; Desai et al, 2011). It requires the parent to re-evaluate the potential for synergy generation between the two businesses and allows it to re-acquire the offspring when the possibility of enhanced productive efficiency of a combined entity through scale/ scope economies exceeds the costs associated with re-acquisition.

[15] 62 parent performs a partial SEO which loosens the control of the parent firm while ECM monitoring is enhanced. 37 of 62 ECOs have equity retention data after SEO and on average, parent companies dilute 20% of shares in the SEO, and thus we classify the partial SEO into the retention group.

[Insert Table 3.9 about Here]

3.5 Conclusion

Prior studies such as Gertner et al. (2002), Ahn and Denis (2004), Dittmar and Shivdasani (2003), and Burch and Nanda (2003) investigate the impact of spin-offs and sell-offs on the functioning of the internal capital market of the parent company. Our study contributes to the literature by considering an alternative mechanism of restructuring, namely, equity carve-outs. We adopt the methodology in ÇW and account for the endogeneity of the carve-out decision by evaluating the change in the allocative efficiency of the internal capital market relative to the change in such efficiency which occurs in a group of control companies with similar characteristics and propensity to undertake ECO. Specifically, we account for the degree of diversification, size, liquidity, leverage, industry M&A and IPO activity as well as industry growth. Importantly, our analysis shows that carve-outs have a positive impact on the allocative efficiency of parent companies.

By accounting for the problem of endogeneity we demonstrate that the relative value added and relative investment ratio are enhanced following carve-outs in a significant way and that these results are not driven by any inherent characteristics associated with companies that choose to perform a carve-out, but by the carve-out itself. Importantly, we also demonstrate that the improvement in investment efficiency of parent firms is linked to increased capital market scrutiny and board independence as well as reduced board size in these companies following carve-outs. Our analysis shows that the enhanced allocative efficiency is further related to the fact that CEOs of the parent firms have stronger incentives to act in the best interest of shareholders since their compensation contracts are geared more towards non-cash based compensation following carve-outs. These findings contribute to the extant literature on refocusing by showing that the functioning of the ICM can be enhanced by augmenting the

level of monitoring from company outsiders as well as the internal governance mechanisms of the business rather than by merely reducing its size or industry diversity.

Our results contrast with the lack of impact of spin-offs and sell-offs in improving the allocative efficiency of conglomerate parents, as reported by ÇW and confirmed by our own unreported results[16]. Our analysis carries important implications for the corporate managers who seek to improve the investment efficiency of their companies by demonstrating that carve-outs could be a more effective mechanism to restructure company operations than spin-offs and sell-offs. The reasons for this differential impact on allocative efficiency of alternative re-focusing strategies merit future research.

[16] In unreported results we examine the change in allocative efficiency surrounding spin-offs and sell-offs using the same performance metrics as in our current paper. Our results suggest that conglomerates that perform spin-offs are characterized by significant levels of investment inefficiency before they embark on refocusing In line with the findings in ÇW, we find evidence that the ICM of the parent does not change over the two-year period following spin-offs and sell-offs. We find some evidence of deterioration in the investment efficiency of parents during the three-year period following sell-offs but not following spin-offs. We also repeat the analysis using the PSM matching procedure and the Heckman bias adjustment procedure and find no evidence of significant change in allocative efficiency once endogeneity and sample selection biases are allowed for. This lack of impact is consistent with the evidence reported by ÇW. These results are available from the authors.

Appendix 3.1: Variable definition

Variable	Description and source of data	Expected relation to likelihood of ECO
Equity_carve-out (ECO)	Dummy variable that is equal to one if the company performs a carve-out and zero otherwise. (Source: SDC)	N/A
Assets	Total assets of the conglomerate company.* (Source: Compustat)	N/A
Investment	Measures the capital expenditures of the conglomerate divided by the total sales in the year prior to carve-out completion.* (Source: Compustat)	N/A
Number_of_segments	Number of segments of the conglomerate company.* (Source: Compustat)	
Tobin's q	The numerator of *q* is calculated as the book value of assets minus book value of equity plus market capitalisation minus deferred taxes.* The denominator of q equals the book value of assets.* (Source: Compustat)	
Relative_entropy	For a firm operating in *n* industry segments, this takes into consideration (i) number of segments in which it operates, and (ii) relative importance of each segment in total sales. If P_i is the share of the *i*th segment in total sales, then $DT = \sum_{i=1}^{N} \left[P_i * \ln\left(\frac{1}{P_i}\right)\right]$ (Palepu, 1985; Daley, Mehrotra, and Sivakumar, 1997; Desai and Jain, 1999; Krishnaswami and Subramaniam, 1999).* (Source: Compustat)	+
Debt/Assets	A positive proxy for scope and incentive to expropriate debt holders and benefit stock holders. (Shleifer and Vishny, 1991; Parrino, 1997). Debt = long-term debt/ net assets.* (Source: Compustat)	+
Log_sales (Size)	Parent size proxy and measure of likelihood of ECO (Haynes, Thompson, and Wright, 2003). Measured as natural logarithm of Net Sales.* (Source: Compustat)	+
Market_share	Parent sales/3-digit (primary SIC-code) industry sales. Parent primary SIC code defined by Compustat.* (Source: Compustat)	+
Financing_gap	Proxy for parent's need for cash to finance future investment activities (Lang et al., 1995). (Cash flow plus net debt issued minus net capital expenditure)/Net sales.* (Source: Compustat)	+
EBITDA/Sales	A parent firm liquidity is measured as EBITDA/Net sales. (Source: Compustat)	-
Largest_segment_profit	Proxy for positive demand shock (Maksimovic and Phillips, 2002) operating profits of firm's largest segment/ its net sales.* (Source: Compustat)	+
Industry_sales_growth	Two-year industry sales growth measured as of year of carve-out completion, at parent's primary two-digit industry SIC code level and a proxy for unanticipated shifts in industry prospects (Çolak and Whited, 2007). (Source: Compustat)	+
M&A_activity	Positive proxy for liquidity of market for corporate assets (Schlingemann, Stulz, and Walkling, 2002). Value of all mergers, acquisitions, and acquisitions of majority interest (as defined by the SDC Platinum Database) in parent firm's two-digit industry and normalized by that industry's market capitalization.** (Source: SDC)	+
IPO_activity	Positive proxy for liquidity of market for new equity issues (Schlingeman et al., 2002). Market value of IPOs in parent firm's primary two-digit SIC code industry and normalized by that industry's market capitalization.** (Source: SDC)	+
MTBV	Market value of parent equity/ book value of equity as of one year before ECO completion.* (Source: Compustat)	+/-
RINV	Measure of whether the parent allocates capital to relatively high-growth i.e. high *q* segments. Low allocative efficiency could motivate an ECO (Çolak and Whited, 2007). See Appendix 3.2 for description and formulae used to calculate this variable.	-

	The numerator of q is calculated as the book value of assets minus book value of equity plus market capitalisation minus deferred taxes.* The denominator of q equals the book value of assets.* (Source: Compustat)	
RVA	Measure of whether the parent's capital allocation to a segment is correlated with the industry median q. Low allocative efficiency could motivate an ECO (Çolak and Whited, 2007). See Appendix 3.2 for description and formulae used to calculate this variable.* (Source: Compustat)	-
Excess_value (EXVAL)	Indirect proxy for allocative efficiency measured as the parent's market value of equity to sales ratio relative 3-digit SIC industry median adjusted market to sales ratio of segments in which parent operates. Low allocative efficiency could motivate ECO (Çolak and Whited, 2007). See Appendix 3.2 for description and formulae used to calculate this variable.* (Source: Compustat)	-
Board_duality	Dummy variable equal to one if the CEO of firm is also chairman of the board of directors and zero otherwise.* (Source: BoardEx, Edgar	-
Board_size	Number of board directors.* (Source: BoardEx and SEC Edgar)	-
Board_indep.	Number of non-executive directors/number of executive directors (Non-executive directors is used in BoardEx).* (Source: BoardEx ans SEC Edgar)	+
Number_of_instit._ investors	Number of institutional investors with a minimum of 5% ownership present on the company's share register (The institutional investor information is obtained by researching proxy statements).* (Source: SEC Edgar)	+
Share_of_instit._ investors	Proportion of shares owned by institutional investors.* (Source: SEC Edgar)	+
CEO_comp.	Total compensation of CEO in millions USD (Zajac and Westphal, 1994; Feldman, 2016).*).* (Source: BoardEx, Execucomp, and SEC Edgar)	
CEO_cash_comp.	Sum of salary and bonus (Zajac and Westphal, 1994; Feldman, 2016).* (Source: BoardEx, Execucomp, and SEC Edgar)	+/-
CEO_non-cash_comp.	CEO's total compensation *minus* his/her cash compensation (Zajac and Westphal, 1994; Feldman, 2016).* (Source: BoardEx, Execucomp, and SEC Edgar)	+
CEO_tenure	Number of years since the CEO was appointed to that position.* (Source: BoardEx, Execucomp, Edgar)	+
Analyst_coverage	Analyst coverage for a given year calculated as average of the monthly number of analysts who cover the given stock (Gilson et al., 2001).* (Source: IBES)	+

Note: * means as of the company's fiscal year end taken from its annual financial statements; ** means as of the end of the calendar year preceding the ECO.

Appendix 3.2: Definitions of RINV, RVA and EXVAL

We compute RINV as follows. We first calculate the median *q* of the pure play (i.e. single-segment) companies operating in the same three-digit SIC industry as a segment of the parent portfolio and then rank the segments by size of these *q*'s. Suppose the first k segments have industry median *q*'s greater than the sales-weighted average of all the segments' industry median *q*'s. Let S_j be the sales of segment *j*, w_j be the proportion of company sales made by segment *j*, I_j be the capital expenditure of segment *j*, and $\left(\frac{I}{S}\right)_j^{SS}$ be the capital expenditure to sales ratio of the median pure play company operating in the same three-digit SIC industry as segment *j*. Then, *RINV* is calculated as:

$$RINV_S \equiv \sum_{j=1}^{k} w_j \left\{\frac{I_j}{S_j} - \left(\frac{I}{S}\right)_j^{SS} - \sum_{i=1}^{n} w_i \left[\frac{I_i}{S_i} - \left(\frac{I}{S}\right)_i^{SS}\right]\right\} - \sum_{j=n-k+i}^{n} w_j \left\{\frac{I_j}{S_j} - \left(\frac{I}{S}\right)_j^{SS} - \sum_{i=1}^{n} w_i \left[\frac{I_i}{S_i} - \left(\frac{I}{S}\right)_i^{SS}\right]\right\} \quad (1)$$

where

$$\left[\frac{I_j}{S_j} - \left(\frac{I}{S}\right)_j^{SS}\right] \quad (2)$$

represents investment to sales ratio of segment *j* adjusted by its industry median and

$$\frac{I_j}{S_j} - \left(\frac{I}{S}\right)_j^{SS} - \sum_{i=1}^{n} w_i \left[\frac{I_i}{S_i} - \left(\frac{I}{S}\right)_i^{SS}\right] \quad (3)$$

represents the industry- and firm-adjusted investment to sales ratio. Eq. (1) implies that, after adjusting for industry- and firm-investment levels, $RINV_S$ will be higher when companies invest more in their high-q segments, i.e. when they are more efficient.

If q_j is the industry median *q* of segment *j*, the relative value-added measure that uses sales as the denominator of each ratio, *RVA* is:

$$\text{RVA} = \sum_{j=1}^{n} w_j (q_j - \bar{q}) \left\{\frac{I_j}{S_j} - \left(\frac{I}{S}\right)_j^{SS} - \sum_{i=1}^{n} w_i \left[\frac{I_i}{S_i} - \left(\frac{I}{S}\right)_i^{SS}\right]\right\} \quad (4)$$

where $\bar{q}$ is the sales-weighted average of all of the segment industry median *q*'s. To help understand the interpretation of *RVA* let us assume that we have a conglomerate firm where the sales of the different segments are all the same. In this case *RVA* represents the covariance between industry-adjusted segment investment and industry median *q*. Since the different conglomerate segments have typically different segment levels *RVA* can be thought of as the sales-weighted covariance between investment and *q*. Higher values of *RVA* indicate higher levels of investment efficiency.

This variable is defined as:

$$\text{Excess Value} = \left(\frac{V}{S}\right)_i - \sum_{j=1}^{n} w_j \left(\frac{V}{S}\right)_j^{SS} \quad (5)$$

where w_j is the proportion of company sales made by segment *j*, $\left(\frac{V}{S}\right)_j^{SS}$ is the median market value of equity to sales ratio for the three digit SIC-industry in which segment *j* operates, and $\left(\frac{V}{S}\right)_i$ is the market value to sales ratio for the entire conglomerate. Higher values of *EXVAL* demonstrate improvements in company valuation. *EXVAL* is, however, an indirect measure of investment efficiency and could be influenced by other value-relevant factors affecting the firm and not just change in investment efficiency.

Appendix 3.3: A note on the Abadie and Imbens (2006) matching procedure

We discuss the general problem of obtaining consistent treatment effect estimates here. Let T be a variable which takes the value of one if a company decides to perform a carve-out and zero otherwise. Let $S_n(T)$ be the level of investment efficiency as a function of T for observation n. Using this notation, $E(S_n(1)|\ T = 1)$ represent the expected effect of restructuring (the treatment) on the group of refocusing firms (treated group). Likewise, $E(S_n(0)|\ T = 1)$ represents the counterfactual expected effect of deciding not to refocus, given that the firm engaged in refocusing (i.e. treatment took place). In our analysis we examine the change in $S_n(T)$ relative to its level before the refocusing, which is denoted as $\Delta S_n(T)$. By taking the change in the investment efficiency we are able to control for time-invariant and unobservable differences between the refocusing and non-refocusing (control) subsamples. This procedure is similar to differencing to remove fixed effects in a panel data set.

We estimate the average impact of the decision to refocus on investment efficiency for a group of companies that actually decided to refocus, i.e. the average treatment impact on the treated:

$$\theta|_{T=1} \equiv E(\Delta S_n(1) - \Delta S_n(0)|T = 1 \quad (1)$$

Since we cannot directly measure the effect of both the decision to refocus and the decision not to refocus on the same company, $E(\Delta S_n(0)|\ T = 1)$ represents a hypothetical event that cannot be observed.

Previous studies on the impact of refocusing on company investment efficiency have measured:

$$E(\Delta S_n(1)|\ T = 1) \quad (2)$$

by averaging the difference in investment efficiency for refocusing companies before and after the refocusing event. The problem with this method is that, in any case apart from when $E(\Delta S_n(0)|\ T = 1) = 0$. The latter situation would happen if the companies that actually engaged in refocusing would not have experienced any change in investment efficiency in the absence of the refocusing. This condition would only be true if the act of refocusing is the sole way to enhance investment efficiency or if the refocusing companies have no other characteristics that impact investment efficiency. The first requirement is false and the second one is a matter that can be determined only empirically.

We need to make certain assumptions to estimate the unobservable part of the function: $E(\Delta S_n(0)|\ T = 1)$. The typical assumption in the treatment effects literature is that allocation to treatment is random, dependent on a group of observable pre-treatment characteristics (i.e. observable variables that distinguish between refocusing and non-refocusing firms), Z. Simple matching procedures use this assumption by matching each treated observation to one or more untreated observations with similar pre-treatment characteristics, Z. Then, $E(\Delta S_n(0)|\ T = 1)$ is estimated by taking the average of $\Delta S_n(0)$ over the matches (control subsample). This makes it possible to obtain an estimate of $\theta|_{T=1}$ by taking the difference between $\Delta S_n(1)$ and estimate of $E(\Delta S_n(0)|\ T = 1)$. This type of treatment effect estimation is usually performed without replacement (Dehejia and Wahba, 1999).

Simple matching estimators described above are asymptotically biased when the vector of company characteristics Z contains more than one variable. When the matches of treated and non-treated observations are not exact, the treatment effects estimator is asymptotically biased. Abadie and Imbens (2006) (AI) introduce matching with replacement to minimise the asymptotic bias and estimate a term that corrects for the bias. The bias correction is only necessary for the estimate of $E(\Delta S_n(0)|\ T = 1)$ as the term $E(\Delta S_n(1)|\ T = 1)$ can be observed directly and is an estimate of the difference between two components. The first component is the impact of treatment on the control subsample with perfect matching. The second component is the actual impact of treatment on the control subsample. To obtain these two terms it is necessary to estimate the conditional expectation of $\Delta S_n(0)$ given Z_n which is given by regressing $\Delta S_n(0)$ on Z_n based on the control subsample. To estimate the conditional expectation, we need to take $\widehat{\omega_0}(Z_n) \equiv \widehat{\beta_0} + \widehat{\beta_1} Z_n$, where $\widehat{\beta_0}$, a scalar, and $\widehat{\beta_1}$, a vector with the same dimension as Z_n, are the estimated coefficients from the regression. The bias corrected estimate of $E(\Delta S_n(1)|\ T = 1)$ is equal to the simple regression estimate presented above plus a component which we denote as $\widehat{\omega_0}(Z_n) - \widehat{\omega_0}(Z_i)$. This component is defined as the difference between the predicted values of $\Delta S_n(0)$ using a group of controls for the nth treated observation and the group of controls for its associated match.

Table 3.1: Sample statistics

Panel A: Sample distribution over time

Year	Frequency by year	Percent
1980s	68	19.2%
1990s	149	42.08%
After 2000	137	38.69%
Total	354	100%

Notes: The sample covers the period 1980 - 2013.

Panel B: Financial characteristics of ECO parents and non-refocusing firms

Variable	ECO Mean (A)	Controls Mean (B)	Difference A-B (t-stat)	ECO Median	Controls Median	Difference A-B (Pearson chi2)
Assets	34,662	33,077	1,585*** (11.821)	3,786	5,613	-1,827 (1.232)
Investment	0.078	0.057	0.021*** (3.730)	0.057	0.045	0.012 (1.491)
Number_of_segments	4.09	2.63	1.46*** (2.833)	4.00	2.00	2.00** (2.362)
Log_sales	8.077	5.056	3.021*** (21.672)	7.275	5.084	2.191*** (149.3)
MTBV	2.113	2.074	0.039** (2.023)	1.646	1.380	0.266*** (18.609)
Debt/Assets	0.287	0.205	0.082*** (10.058)	0.271	0.182	0.089*** (94.210)
EBITDA/Sales	0.156	0.092	0.064*** (6.473)	0.142	0.101	0.041*** (21.840)
Relative_entropy	0.930	0.598	0.332*** (11.305)	0.970	0.622	0.348*** (49.984)
RVA	-0.001	-0.022	0.021* (1.650)	-0.0003	-0.0002	-0.0001*** (18.724)
RINV	-0.0004	-0.006	0.006** (2.228)	-0.0002	0.0003	-0.0005*** (17.580)
EXVAL	-0.330	0.180	-0.510*** (-2.737)	-0.119	0.0648	-0.184*** (10.467)
Financing_gap	0.089	0.020	0.069*** (5.384)	0.064	0.049	0.015*** (8.270)
IPO_activity	0.003	0.004	-0.0002 (-0.550)	0.0008	0.0003	0.0005*** (2.703)
M&A_activity	0.076	0.150	-0.074 (-1.078)	0.041	0.039	0.002 (0.020)
Industry_sales_growth	-0.030	0.024	-0.055*** (-7.359)	0.025	0.031	-0.006*** (2.613)
Market_share	0.095	0.048	0.047*** (7.701)	0.056	0.005	0.051*** (126.877)
Largest_segment_profit	0.073	0.099	-0.026** (-2.178)	0.100	0.081	0.019** (4.655)
Sample size	354	3,695		354	3,695	

Notes: The sample covers the period 1980 - 2013. Assets are measured in millions of U.S. dollars. T-stats are provided for the mean comparison tests and Pearson chi2 statistics are provided for the median comparison tests in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% levels respectively.

Panel C: Additional ECO characteristics

Statistics	*Equity_ retained*	*Market_value_of_E CO (Million USD)*	*Market_Value_of_ Parent (Million USD)*	*Total_proceeds (Million USD)*	SameSIC3 ECO	Different SIC2 ECO	Same SIC2 but different SIC3 ECO
Mean	66.50%	2,519.159	21,178.497	584.925	-	-	-
Median	72.00%	311.400	5,649.530	96.855	-	-	-
Sample Size	184	259	244	354	155	115	84

Notes: The sample covers the period 1980 - 2013.

Table 3.2 : Probit model of likelihood of equity carve-out

Variable	Coefficients	Marginal Effects
Log_sales	0.218***	0.001***
	(13.37)	(9.788)
MTBV	0.029**	0.007**
	(2.268)	(2.284)
EBITDA/Sales	0.103	0.002
	(0.940)	(0.692)
Debt/Assets	0.228***	0.003***
	(9.891)	(7.331)
Relative_entropy	0.321***	0.001***
	(5.554)	(4.147)
RVA	0.281	0.001
	(0.907)	(0.443)
RINV	-0.012	-0.004
	(-0.137)	(-1.228)
EXVAL	0.004	0.0008
	(0.656)	(0.079)
Financing_gap	-0.089	-0.002
	(-1.035)	(-0.258)
IPO_activity	5.029**	0.059***
	(2.577)	(3.291)
M&A_activity	-0.231	-0.002
	(-1.325)	(-1.481)
Industry_sales_growth	-0.355*	-0.007*
	(-1.837)	(-1.939)
Market_share	-0.416**	-0.001**
	(-2.215)	(-2.482)
Largest_segment_profit	-0.326**	-0.003**
	(-2.277)	(-2.397)
Sample of carve-outs	354	
Control sample	3,695	
Pseudo R^2	0.329	

Notes: *RINV*, *RVA* and *EXVAL* are defined according to Eqs. (1), (4) and (5) in Appendix 3.2. For definitions of other variables see Appendxi 3.1. T-stats are reported in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% levels respectively.

Table 3.3: Covariates Balance

Variable name	Carve-outs Mean (A)	Controls Mean (B)	Difference A-B (t-stat)	Carve-outs Median	Controls Median	Difference A-B (Pearson chi2)
Log_Sales	8.077	7.468	0.609 (0.741)	7.275	5.735	1.540 (2.372)
MTBV	2.113	2.006	0.107 (0.816)	1.646	1.467	0.179 (1.582)
Debt/Assets	0.287	0.237	0.050 (1.258)	0.271	0.281	-0.010 (1.283)
Relative_entropy	0.930	0.933	-0.003 (-0.660)	0.970	0.940	0.030 (1.431)
Market_share	0.095	0.097	-0.002 (-1.149)	0.056	0.061	-0.005 (1.390)
Largest_segment_profit	0.073	0.080	-0.007 (-1.180)	0.100	0.108	-0.008 (0.188)
Sample size	354	354		354	354	

Notes: T-stats are provided for the mean comparison tests and Pearson chi2 statistics are provided for the median comparison tests in parentheses. The matched sample is obtained following Abadie and Imbens (2006). ***, ** and * indicate significance at 1%, 5% and 10% levels respectively.

Table 3.4: Change in investment efficiency and firm value of parents following ECO

Panel A: Change in allocative efficiency (-2, +2) years event window

	RINV	*RVA*	*EXVAL*
Level Treatment Effects			
Before	-0.0004	-0.001	-0.330
	(-0.080)	(-1.025)	(-0.914)
After	0.018**	0.007***	0.241
	(2.571)	(3.531)	(1.303)
Change	0.018**	0.008***	0.571**
	(2.545)	(4.147)	(3.440)
DinD Treatment Effects			
DinD	0.011	0.009*	-0.147
	(1.069)	(1.801)	(-0.817)

Panel B: Change in allocative efficiency (-3, +3) years event window

	RINV	*RVA*	*EXVAL*
Level Treatment Effects			
Before	-0.0004	-0.001	-0.330
	(-0.080)	(-1.023)	(-0.914)
After	0.011	0.004***	-0.644
	(0.164)	(4.013)	(-0.974)
Change	0.012	0.005**	-0.314
	(0.203)	(2.524)	(-0.502)
DinD Treatment Effects			
DinD	0.098	0.002	0.529***
	(0.685)	(0.511)	(3.977)

Notes: *RINV*, *RVA* and *EXVAL* are defined in Appendix 3.2. Sample size is 354 ECO parents and 354 control firms. The control sample is selected using the Abadie and Imbens (2006) matching procedure. *Before* is the average for each conglomerate company over a period starting two (or three) years before and ending one year before the completion of the ECO. The variable *After* is the average for each conglomerate company over a period starting one year after and ending two (or three) years after the completion of the ECO, relative to the average of a matched sample. *Change* is the difference between *Before* and *After*. *DinD treatment effects* are difference between change for treated observations and change for corresponding control observations. T-stats are reported in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% levels respectively.

Table 3.5: ECO effects on investment efficiency and firm value based on propensity score matching (PSM) and Heckman methodologies

Panel A: Treatment effects Adjusted for matched control firm efficiency using the Dehejia and Wahba PSM procedure

Change in allocative efficiency (-2, +2) years event window

	RINV	*RVA*	*EXVAL*
Level Treatment Effects			
Before	-0.0004	-0.001	-0.330
	(-0.080)	(-1.000)	(-0.914)
After	0.013*	0.024**	0.025
	(1.857)	(2.182)	(0.926)
Change	0.014***	0.025***	0.355***
	(3.500)	(5.000)	(2.934)
DinD Treatment Effects			
DinD	0.0231	0.013	0.050*
	(1.036)	(0.500)	(1.667)

Change in allocative efficiency (-3, +3) years event window

	RINV	*RVA*	*EXVAL*
Level Treatment Effects			
Before	-0.0004	-0.001	-0.330
	(-0.080)	(-1.000)	(-0.914)
After	0.017**	0.025**	0.155**
	(2.125)	(2.273)	(2.300)
Change	0.018***	0.026***	0.485***
	(4.500)	(4.333)	(2.580)
DinD Treatment Effects			
DinD	0.028*	0.002**	0.0603*
	(1.867)	(2.222)	(1.774)

Notes: Panel A and Panel B present the results of analysis of the effects of carve-outs on investment efficiency and firm value of parents. *RINV*, *RVA* and *EXVAL* are defined in Appendix 3.2. Sample size is 354 ECO parents and 354 control firms. The control sample is selected using the Dahejia and Wahba PSM procedure. *Before* is the average for each conglomerate company over a period starting two (or three) years before and ending one year before the completion of the ECO. The variable *After* is the average for each conglomerate company over a period starting one year after and ending two (or three) years after the completion of the ECO, relative to the average of a matched sample. *Change* is the difference between *Before* and *After*. *DinD treatment effects* are difference between change for treated observations and change for corresponding control observations. T-stats are reported in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% levels respectively.

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Panel B. Heckman bias-adjusted change in investment efficiency and firm value

Change in allocative efficiency (-2, +2) years event window

Variable	*RINV*	*RVA*	*EXVAL*
Heckman_Treated	0.027*	0.001	0.135***
	(1.929)	(0.200)	(5.625)
Heckman_Controls	-0.038***	-0.010***	-0.727**
	(-3.167)	(-2.500)	(-2.077)
InvMills	0.011***	0.002**	0.224**
	(3.667)	(2.000)	(2.113)

Change in allocative efficiency (-3, +3) years event window

Variable	*RINV*	*RVA*	*EXVAL*
Heckman_Treated	0.008**	0.003***	0.113***
	(2.000)	(3.000)	(5.136)
Heckman_Controls	-0.014***	-0.004***	-0.668***
	(-7.000)	(-6.667)	(-7.506)
InvMills	0.003***	0.0004**	0.206***
	(4.286)	(2.000)	(7.103)

Notes: *RINV*, *RVA* and *EXVAL* are defined in Appendix 3.2. The variables labelled '*Heckman_Treated'* correspond to the sum of $(\alpha+\beta_1)$ in the regression, Δ *Investment Efficiency*$= \alpha + \beta_1 D_i + \beta_2 InvMills + \varepsilon_i$, where *'*$\Delta$ *Investment Efficiency'* is the change in investment efficiency, D_i is a dummy variable equal to 1 when the sample company performs carve-out and 0 otherwise, *'InvMills'* is the coefficient on the variable used to adjust for self-selection bias in the Heckman regression. '*Heckman_Controls'* is value of α in the Heckman regression. T-stats are reported in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% levels respectively.

Table 3.6: Governance characteristics of ECO parents

Panel A: Event window (-2, +2) years

Variable	*Board_ duality*	*Board_ size*	*Board_ indep.*	*Number_of_ instit._ investors*	*Share_of_ instit._ investors*	*CEO_ comp.*	*CEO_ cash_ comp.*	*CEO_ non-cash_ comp.*	*CEO_ tenure*	*Analyst_ coverage*
Before_p	0.553***	11.529***	4.948***	1.979***	0.190***	4.899***	1.822***	3.153***	5.920***	11.021***
	(12.61)	(20.899)	(18.767)	(11.868)	(11.187)	(8.264)	(10.874)	(6.034)	(9.639)	(16.488)
After_p	0.541***	11.131***	5.534***	2.107***	0.179***	6.244***	1.856***	4.372***	5.560***	16.441***
	(12.357)	(22.744)	(19.971)	(10.879)	(10.084)	(9.024)	(10.177)	(6.894)	(15.148)	(19.184)
Change_p	-0.012	-0.398**	0.586***	0.127	-0.011	1.345***	0.034	1.218***	-0.359	5.420***
	(-0.467)	(-2.610)	(3.098)	(1.052)	(-0.857)	(3.356)	(0.294)	(2.906)	(-0.614)	(12.297)
Sample size	122	122	122	98	98	123	123	123	157	147

Panel B: Event window (-3, +3) years

Variable	*Board_ duality*	*Board_ size*	*Board_ indep.*	*Number_of_ instit._ investors*	*Share_of_ instit._ investors*	*CEO_ comp.*	*CEO_ cash_ comp.*	*CEO_ non-cash_ comp.*	*CEO_ tenure*	*Analyst_ coverage*
Before_p	0.585***	11.851***	4.962***	2.300***	0.190***	3.786***	1.642***	2.172***	6.270***	11.017***
	(12.840)	(17.330)	(17.126)	(12.723)	(10.104)	(9.714)	(10.268)	(6.555)	(10.192)	(15.169)
After_p	0.599***	11.387***	5.678***	2.371***	0.177***	5.394***	1.850***	3.560***	5.932***	17.108***
	(13.583)	(18.414)	(19.011)	(11.232)	(9.192)	(9.524)	(9.909)	(6.803)	(14.580)	(18.187)
Change_p	0.014	-0.464***	0.716***	0.070	-0.013	1.607***	0.208*	1.387***	-0.338	6.091***
	(0.498)	(-2.637)	(3.303)	(0.452)	(-0.888)	(3.902)	(1.723)	(3.307)	(-0.538)	(12.268)
Sample size	94	94	94	81	81	102	102	102	127	120

Notes: *Before_p* is the average of the given governance characteristic for each conglomerate company over a period starting two (or three) years before and ending one year before the completion of the ECO. Similarly, *After_p* is the average of the given governance variable for each conglomerate company over a period ending two (or three) years after the completion of the ECO. The variable *Change_p* is defined as the difference between *Before_p* and *After_p*. T-stats are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively

Table 3.7: Governance characteristics of ECO offspring

Panel A: Event window (0, +2) years

Variable	*Board_ duality*	*Board_ size*	*Board_ indep.*	*Number_of_ instit._ investors*	*Share_of_ instit._ investors*	*CEO_ comp.*	*CEO_ cash_ comp.*	*CEO_ non-cash_ comp.*	*CEO_ tenure*	*Analyst_ coverage*
Before_o	0.574***	7.515***	3.807***	1.839***	0.203***	2.589***	0.947***	1.678***	1.669***	3.493***
	(13.474)	(26.870)	(18.402)	(8.452)	(8.662)	(6.341)	(7.706)	(4.627)	(4.868)	(20.715)
After_o	0.576***	8.169***	4.019***	2.395***	0.233***	2.136***	0.910***	1.235***	3.397***	6.015***
	(13.679)	(28.820)	(20.610)	(10.891)	(10.543)	(6.566)	(9.816)	(4.375)	(9.803)	(16.865)
Change_o	0.007	0.654***	0.216**	0.555***	0.030	-0/453	-0.036	-0.442	1.728***	2.521***
	(0.446)	(3.916)	(1.978)	(3.603)	(1.332)	(-1.421)	(-0.458)	(-1.383)	(17.804)	(9.285)
Sample size	136	136	136	81	81	81	81	81	136	206

Panel B: Event window (0, +3) years

Variable	*Board_ duality*	*Board_ size*	*Board_ indep.*	*Number_of_ instit._ investors*	*Share_of_ instit._ investors*	*CEO_ comp.*	*CEO__ cash_ comp.*	*CEO_ non-cash_ comp.*	*CEO_ tenure*	*Analyst_ coverage*
Before_o	0.587***	7.611***	3.923***	1.855***	0.189***	2.665***	0.996***	1.710***	2.616***	3.467***
	(13.054)	(25.238)	(17.359)	(8.981)	(7.410)	(5.814)	(7.035)	(4.182)	(4.373)	(20.201)
After_o	0.860***	8.397***	3.968***	2.304***	0.228***	2.105***	0.971**	1.143***	4.849***	6.259***
	(27.095)	(28.381)	(16.635)	(10.453)	(9.378)	(6.050)	(7.9570)	(3.840)	(8.10)	(15.644)
Change_o	0.273***	0.785***	0.045	0.449**	0.039	-0.560	-0.024	-0.478	2.232***	2.792***
	(5.810)	(3.670)	(0.258)	(2.300)	(1.506)	(-1.535)	(-0.179)	(-1.582)	(6.740)	(8.524)
Sample size	121	121	121	69	69	81	81	81	121	189

Notes: *Before_o* is the governance characteristic for each offspring at $t = 0$. *After_o* is the governance variable for each offspring in two (or three) years after the completion of the ECO. The variable *Change_o* is defined as the difference between *Before_o* and *After_o* T-stats are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 3.8: Impact of changes in governance following ECO on investment efficiency and valuation of parents

Panel A: Analysis of change in investment efficiency and valuation over the event window (-2, +2) years

Variable	(1) *Change_ in_RINV*	(2) *Change_ in_ RVA*	(3) *Change_ In_EXVAL*
Change_in_Analyst_coverage	0.715***	0.002	6.034***
	(4.129)	(0.979)	(3.407)
Change_in_Board_indep.	0.005	0.188*	0.041
	(0.049)	(1.937)	(0.862)
Change_in_Board_size	-0.241***	-0.151	-0.984**
	(-2.813)	(-0.799)	(-2.301)
Change_in_Board_duality	-0.025	-0.799*	-0.897***
	(-1.811)	(-1.848)	(-2.920)
Change_in_CEO_non-cash_comp.	0.002***	0.015*	0.003**
	(3.551)	(1.957)	(2.235)
Change_in_CEO_cash_comp.	0.004***	0.003*	0.019
	(2.953)	(1.789)	(1.078)
Sample size	93	93	93
R^2	0.377	0.315	0.261

Panel B: Analysis of change in investment efficiency and valuation over the event window (-3, +3) years

Variable	(1) *Change_ in_RINV*	(2) *Change_ in_ RVA*	(3) *Change_ In_EXVAL*
Change_in_Analyst_coverage	0.195	0.0161	15.36**
	(0.804)	(1.061)	(2.573)
Change_in_Board_indep.	0.0340**	0.0236***	0.159**
	(2.224)	(2.942)	(2.252)
Change_in_Board_size	-0.219	-0.0406**	-9.129**
	(-0.193)	(-2.549)	(-2.095)
Change_in_Board_duality	-0.089	0.0575	-0.111**
	(-0.719)	(1.116)	(-2.055)
Change_in_CEO_non-cash_comp.	0.0136	0.0307***	0.829***
	(1.108)	(2.812)	(3.333)
Change_in_CEO_cash_comp.	-0.002	-0.001	0.212
	(-0.451)	(-0.808)	(0.651)
Sample size	81	81	81
R^2	0.181	0.253	0.183

Notes: The dependent variable in each model is the change in investment efficiency (RINV in Model 1 and RVA in Model 2) or valuation (EXVAL in Model 3) adjusted by the change in the matched control firm where each control firm is identified using the AI matching estimator. The independent variables in each model are also adjusted by the change in the matched control firm sample where each control firm is identified using the AI matching procedure. T-stats are reported in parentheses. ***, **, and * indicate statistical significance at a 1%, 5%, and 10% level, respectively.

Table 3.9: Secondary Events Analysis

Event	Number (%) of ECO
Spin-off	30 (8.5%)
Sell-off	82 (23.2%)
Re-acquisition	105 (29.6%)
Retention	137 (38.7%)
Total	354 (100%)

Notes: To identify the secondary events of the carve-out, we follow Slovin and Sushka (1998), Otsubo (2009) and Colla et al. (2009) and divide the secondary events into four groups. Spin-off is the event where the parent company distributes all shares of the offspring to its shareholders. Sell-off is the merger and acquisition event in which the parent sells the carve-out entity to the third party. Re-acquisition means that parent reacquires the part or all outstanding shares of the carve-out firm. In the secondary equity offering, parent company sells all or a part of shares of the carve-out the public market. We firstly search the SDC Global New Issues database to identity the SEO event and the spin-off event and then search SDC Merger and Acquisition database to identify the subsequent sell-off event and re-acquisition event. The Retention sub-sample represents cases where the status quo post ECO is retained and there is no subsequent secondary event and the cases of SEO.

Panel B: Average change in measures of investment efficiency and secondary events

Event	*Change_in_RINV*		*Change_in_RVA*		*Change_in_ EXVAL*	
	(-2, +2) years	(-3, +3) years	(-2, +2) years	(-3, +3) years	(-2, +2) years	(-3, +3) years
Spin-off	0.011	0.014*	0.0002	0.008**	-0.018	-0.028**
	(0.993)	(1.880)	(1.531)	(2.644)	(-0.915)	(-2.174)
Sell-off	0.002	0.005	0.016**	0.003**	-0.032	-0.017
	(1.192)	(0.635)	(2.302)	(2.509)	(-0.804)	(-1.541)
Reacquisition	0.018*	0.014**	0.007***	0.005***	0.054**	0.049**
	(1.966)	(2.522)	(2.668)	(2.948)	(2.183)	(2.183)
Retention	0.024***	0.012***	0.008***	0.006***	0.023**	0.014*
	(6.478)	(3.092)	(2.694)	(2.796)	(2.165)	(1.837)

Notes: The dependent variable in each model is the change in investment efficiency (RINV in Model 1 and RVA in Model 2) or valuation (EXVAL in Model 3) adjusted by the change in the matched control firm where each control firm is identified using the AI matching estimator. T-statistics are reported in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% levels respectively.

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