FORMAL GOVERNANCE DESIGN FOR CO-OPETITON IN THE CONTEXT OF CORPORATE VENTURE CAPITAL INVESTMENTS

by

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To my parents and my husband.

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ABSTRACT

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Entrepreneurial ventures face a trade-off when receiving corporate venture capital (CVC) financing. They need to give sufficient control rights to motivate and enable corporate investors to provide exclusive resources. However, giving control rights to CVCs whose strategic goals could cause a conflict of interest and lead to opportunism also puts the ventures at risk. This dissertation shows that third-party involvement with the design of passive control rights can be a solution to the trade-off.

By examining venture capital financing contracts in high-tech industries, Essay 1 found that veto power, a prevailing passive control right, of the third party can protect the vulnerable side in the cooperation without hurting the other side's incentive to contribute. Moreover, two types of veto rights are identified and found to have diverse responses to conflict-of-interest factors in CVC-entrepreneur relationships. The effects of knowledge overlap, CVC parents' research and development capability, and ventures' technological quality on the liable third party's veto power are studied. With a focus on the function of passive control rights, Essay 2 and Essay 3 maintain that allocating control rights can significantly affect the innovation of both CVC corporate parents and CVC-backed ventures under difference contingencies. In particular, as the aforementioned dilemma increases when CVCs' corporate parents and portfolio firms are competing in product markets, Essay 2 shows that ventures' innovation performance can benefit

from granting CVCs strong active control rights in the condition of low product market overlap and from granting CVCs strong passive control rights within a high product market overlap.

On the other hand, Essay 3 shows that CVCs' control rights will moderate the inverted U-shaped relationship between knowledge overlap and the innovation performance of the corporate parents such that the positive effect of knowledge overlap on CVC parents' innovation at lower levels of knowledge similarity will be less positive, and the negative effect of knowledge overlap on CVC parents' innovation at higher levels of knowledge similarity will be less negative, for CVCs with greater control power over their portfolio ventures. Moreover, the moderating effect of active control right is stronger than the moderating effect of passive control right under high degree of technological knowledge overlap between a CVC parent and the CVC's portfolio ventures. Meanwhile, the moderating effect of passive control rights is stronger than the moderating effect of active control right under high degree of technological knowledge overlap between a CVC parent and the CVC's portfolio ventures.

CHAPTER 1. INTRODUCTION

"No matter who you are, most of the smartest people work for someone else," the declaration of Bill Joy, Sun Microsystems cofounder, partially echoes the prevalence of inter-firm cooperation. Since competition is increasingly dynamic and so many industry boundaries have been blurred by technology, Joy's Law presents companies with a co-opetition dilemma – how do firms effectively convey novel ideas and resources from other firms, especially from those competing in the same market or technology domain? In this thesis, I arm to address the co-opetition issue by studying solutions to conflicts of interest caused by (potential) competition in innovation-oriented collaboration.

The concept of co-opetition, or competition-oriented cooperation (Dagnino and Padula, 2002; Ghobadi and D'Ambra, 2012), has drawn increasing attention in strategy field. Co-opetition defines a dual relationship of simultaneous competition and cooperation between firms (Brandenburger and Nalebuff, 1996), regardless of whether they are in horizontal or vertical relationships (Bengtsson and Kock, 2014). Before co-opetition was viewed as an important business strategy, literature on inter-firm relationships had traditionally studied competition and cooperation separately (M'Chirgui, 2005) and fail to portrait the entire interdependent relationships among firms (Padula and Dagnino, 2007): the competition viewpoint generally omitted the possible positive influence of interdependence on performance (Bouncken et al., 2015), and cooperation viewpoint basically considered competitive dynamics as negative impacts because of the associated risk of learning races, partner's opportunistic behavior, or knowledge spillovers (e.g., Kale et al. 2000). Since co-opetition was realized as an important business strategy, the phenomenon of co-opetition has been explained by various theoretical perspectives such as game theory (e.g. Ritala 2012), transaction cost theory (e.g. Ritala and

Hurmelinna, 2009), resource-based view of the firm (e.g. Mention, 2011), dynamic capabilities theory (e.g. M'Chirgui, 2005), knowledge based view of the firm (e.g. Luo et al. 2006; Mariani, 2007), institutional economics (e.g. Mione, 2009), and network theory (e.g. Tsai, 2002). And the effects of co-opetition have been widely discussed.

Being able to bring in many advantages for coopeting firms (Ghezzi et al., 2016), co-opetition can result in competitive performance (Bouncken and Fredrich, 2012) and, especially, better innovation performance (Quintana-García and Benavides-Velasco, 2004; Dubois and Frederiksson; 2008). However, prior studies show that competition tends to destabilize cooperation, mainly through driving opportunistic behavior such as hold-up, misappropriation, and shirking (Park and Russo, 1996; Harrigan, 1988; Oxley and Sampson, 2004) as well as causing concerns over knowledge leakage (Cassiman et al., 2009). The erosion of cooperation can be accelerated with the degree of market overlap between partners (Oxley and Sampson, 2004). As a result, cooperation between competing partners tends to be narrow-scope and short-lived (Gulati, 1995; Park and Russo, 1996; Park and Ungson, 1997; Chung et al., 2000; Oxley and Sampson, 2004). Governance mechanisms such as formal arrangements (Bengtsson and Kock, 2000; Enberg, 2012) are necessary elements for dealing with the tension in co-opetition. Notwithstanding their importance, research on governance mechanisms in co-opetition relationships is scant (Bouncken et al., 2015; Mariani, 2016).

The next section reviews the effects of co-opetition on innovation, the tension and research gaps in managing co-opetition relationships, and the framework as well as research context of this dissertation. The table presenting how the three essays of this dissertation complement previous studies is shown in the end.

1.1 Literature Review

Among the various effects of co-opetition, the influences of co-opetition on innovation are still barely concluded. Many studies advocate that co-opetition relationships enable several innovation-enhancing activities, including sharing of knowledge and resources (Bengtsson and Kock, 2000), integrative technologies (Gnyawali and Park, 2011), pro-actively pooled R&D processes (Walley, 2007), and team coordination and teamwork (Scarbrough et al., 2004). The similar experience and expertise between coopeting firms facilitate the development of a common knowledge base (Ritala and Hurmelinna, 2009), which increases these firms' innovation capacity (e.g. Quintana-Garcia and Benavides-Velasco 2004; Bonel and Rocco, 2007; Ritala, 2012; Ritala and Hurmelinna, 2009; Enberg 2012). Co-opetition functioning as a means for firms to share, absorb, and integrate external knowledge (Bradley et al., 2012; Lee and Johnson, 2010) also advances innovation by overcoming knowledge asymmetries among coopeting firms (e.g., Brolos, 2009) and improve these firms' effectiveness and efficiency (Chin et al. 2008). Supported by empirical results (e.g., Gast et al., 2015; Rodrigues et al.,2009; Bouncken and Fredrich, 2012), this vein of research shows positive effects by co-opetition on innovation (Dubois and Frederiksson, 2008; Bouncken and Fredrich, 2012; Park et al., 2014) and technological diversity (Quintana-García and Benavides-Velasco, 2004).

Nevertheless, as competition improves innovation mainly through the integration of knowledge from different sources, co-opetition allows an opportunism that arises when a firm uses knowledge spillovers in a one-way manner and appropriate another firms' key knowledge (Ritala and Hurmelinna, 2009; Nielsen and Lassen, 2012; Tracey, 2012). The firm can also take advantage of the jointly developed know-how for its own interests even though doing so can hurt its partner's interests (Bouncken and Kraus 2013; Pellegrin-Boucher et al. 2013). As a result, co-opetition puts firms at the risks of opportunism (Zerbini and Castaldo, 2007), learning races

(Larsson et al., 1998; Dussage et al., 2000), asymmetric learning (Kale et al., 2000), and potential misappropriation (Katila et al., 2008). These issues are particularly critical when dealing with coopetitive innovation, as they can impede the development of radical innovations (Cassiman et al., 2009). Consequently, the opposite stream of research points out that the transaction costs of co-opetition may be higher than transaction value (Walley, 2007; Bengtsson and Kock, 2000; Ghezzi et al., 2016), co-opetition with greater knowledge sharing can lead to a stronger negative effect on innovation than normal collaboration (Bouncken et al., 2013), and co-opetition may not be an inappropriate strategy for creating highly novel innovation unless for performing basic research and establishing standard settings (Nieto and Santamaria, 2007).

The tensions arising from competing and collaborating at the same time is a challenging task to handle (Bengtsson and Kock, 2014; Czakon et al., 2016; Fernandez et al., 2014; Raza-Ullah et al., 2014), requiring special attention (Dowling et al., 1996; Bonel and Rocco, 2007) and active management (Levy et al., 2003). Currently, two approaches have been developed to manage the tensions under co-opetition. The first approach is separation of collaboration. One common attempt is to balance the tradeoff between knowledge sharing and partner's potential knowledge appropriation by developing sharing rules for different types of knowledge. Loebbecke and Van Fenema (1998) provide knowledge sharing principles under co-opetition by introducing three additional dimensions to Van Hippel's (1994) analysis of the exchange of knowledge. Separation of collaboration can also be accomplished by entrusting collaboration to a third party or in functional terms (Bengtsson and Kock, 2000). Legal defense such as the intellectual property protection regime (Dushnitsky and Shaver, 2009) and social defenses (Hallen et al., 2014; Katila et al., 2008; Kim, 2014) can be used simultaneously with separation rules to moderate the co-opetition tension. Yet, separation commonly causes severe conflicts that

can only be eased by the second approach – integration (Chen, 2008; Das and Teng, 2000). Despite of the efforts, although literature on co-opetition recognizes the importance of balancing between competition and cooperation, how to implement and manage the double-edged sword (Bouncken and Fredrich 2012) is still an open issue (Bengtsson and Kock, 2014; Ghezzi et al., 2016). In particular, there are at least three important research gaps remained.

First, although appropriate governance forms and structures are needed for solving the contradictions inherent in co-opetition (Cassiman et al., 2009), very scarce attention has been paid to formal governance mechanisms in coopetitive relationships (Mariani, 2016). Suitable formal designs can nurture an innovative (Bosch and Postma, 2009; Sivadas and Dwyer, 2009) and fruitful relationship (Dilk et al., 2008; Muthusamy and White, 2005; Rutten et al., 2009; Teng and Das, 2008). In coopetitive interactions, formal governance plays an even crucial role to facilitate innovation (Steinicke et al., 2012) due to its impacts on multiple domains, from the design of control mechanisms and the participation modes of the cooperation partners (Teng and Das, 2008) to the value creation of the arrangement (Dyer and Singh, 1998). In other words, appropriate governance structure makes later interaction and coordination within the cooperation easier (Sampson, 2007). In a related study, Ritala and Hurmelinna (2009), focusing on the relationship between co-opetition and innovation, found that the extent to which a firm can protect its innovations against imitation positively affects the firm's ability to gain from co-opetition.

In spite of lacking comprehensive formal governance designs with practical plans, conceptual research on formal governance mechanisms has proposed several principles to deal with the tension of co-opetition. Gnyawali and Park (2011), for example, illustrated that three factors facilitate the success of co-opetition strategy: coopetitive mind-set, complementary

resources and capabilities, and coopetitive experience. Chin et al. (2008) have identified six dimensions of a hierarchical model that determine the generation of benefits in co-opetition relationships, including (a) management leadership, (b) long-term commitment, (c) conflict management systems, (d) trust, knowledge and risk sharing, (e) organizational learning, and (f) information system support. Enberg (2012) showed that a clear statement of work helps the development of frameworks to simultaneously enable and restrain knowledge sharing.

Although there are a few studies looking at how formal governance mechanisms are utilized to manage coopetitive interactions (Czakon, 2009; Lacoste, 2014), research has not fully understood this topic (Mariani, 2016). Particularly, empirical analyses on the contractual dimensions regarding to co-opetition are still scant (Dagnino and Rocco, 2009). The most relevant studies may be those tackling opportunism in cooperation relationships. However, imposing all kinds of safeguards and restrictions have been disproportionately viewed as the main tools to prevent opportunistic behaviors in this literature. Less attention has been drawn on the tools' side effects (such as loss of interactions) and the associated cost. As cooperative interactions between cooperating firms are the foundation of inter-firm learning and innovation creation (De Clercq and Sapienza, 2001), current methods of preventing opportunistic behaviors inevitably restrain the potential of value creation in partnering firms (e.g. Tiwana, 2008) in co-opetition relationships. A meticulous governance design that mitigates the dark side of rigorous governance mechanisms, while safeguarding against opportunistic behaviors needs to be developed.

Second, although the literature has touched on the effect of end-product market competition on cooperation results, less attention has been paid on the effect of factor market rivalry. Intangible resources and intelligent assets are nucleus of cooperation that targeting

innovation. In co-opetition relationships, the contradictions generally reflect the struggles between controlling knowledge and sharing knowledge (Bengtsson and Kock, 2014). One of the strategies that can be used to overcome the issues is precisely conducting agreements or contracts (Lacoste, 2014). Therefore, neglecting factor market competition, a governance design will likely fail to achieve its mission of securing a stable and prosper relationship. As the degree of competing territories tends to raise the safeguard efforts as well as associated opportunity cost, a comprehensive governance design should respond to the nuance of changing competitive intensity in all the main battleground areas.

Third, the literature has not provided clear guidelines for co-opetition between firms that hold unequal power or status outside of their cooperation boundary. Since firms often possess distinct resources and capabilities at different stages of their business evolution, it is commonplace for firms with different scales and stages to cooperate with each other to gain complementary resources. For example, by connecting with entrepreneurial ventures, incumbents can keep an eye on current technology and market trend (Dushnitsky and Lenox, 2006) that facilities their internal innovation activities. By connecting with established firms, young ventures can access to complementary assets and practical experiences (Katila et al., 2008) that takes time to accumulate. However, the distinct sets of resources and capabilities in partners also likely contribute to an unequal power or status outside of the cooperation boundary. The abundant resources and established network of a bigger firm, even if not being used in the cooperation, can exacerbate the threat of opportunism facing a smaller and younger partner. Consistently, prior studies on co-opetition also demonstrate the importance of co-opetition for knowledge-intensive fields such as technology industries (Carayannis and Alexander, 1999), especially for small and medium enterprises (SMEs) (Gnyawali and Park, 2009). Gnyawali and

Park (2009) stated that in the future, SMEs will be more likely to engage in co-opetition, with both similar size rivals and larger competitors. Despite of the importance, research has been limited in the context of entrepreneurial firms such as SMEs and new ventures (e.g. Harms et al., 2010). Therefore, it is important to generate a formal governance framework for managing co-opetition between firms with unequal power or status, especially for entrepreneurial firms (Gnyawali and Park 2009).

In this dissertation, I address these three research gaps using corporate venture capital (CVC) investments in high-technology industries as a theoretical context. In recent years, many companies have embraced CVC as a key model for external innovation, hoping to take a page from the success of ventures that have disrupted multiple industries. Although CVCs can assist the innovation performance as well as overall competitive performance of their portfolio ventures, the strategic goals of CVCs make the technology and knowledge-oriented financing particularly prone to the risk of opportunism and knowledge leakage (Dushnitsky and Lenox 2006; Katila et al. 2008). The CVC and portfolio venture relationship, double-edged sword for new ventures (Dushnitsky and Shaver, 2009), hence provides a suitable setting for this study. In addition, as CVC are becoming more common, especially among large companies, the scale gap between CVC corporate parent and CVC portfolio ventures also makes governance design extremely important to balance the imbalanced sides, and then to secure a reciprocal relationship.

1.2 Essays Summary

Essay 1 (Chapter 2) tests the role of third party involvement and passive control right, commonly shown in the form of veto right (Barney, 1994; Gamper and Lerner, 1996; Bengtsson, 2011), on tackling conflict of interests in a cooperative relationship. I articulate how the passive nature of veto right (Cumming, 2012) grants limited power to the right holders, and demonstrate how

introducing third party (i.e., independent venture capital) enables entrepreneurs to design passive control right to motivate and engage cooperating partners to devote to innovation activates while safeguarding against the partner's potential opportunistic behaviors. Specifically, I identify two types of passive control right – strategic veto rights and financial veto rights, and show how these two types are used independently in response to the tension associated with CVC investments.

Essay 1 adds to the literature on co-opetition by distinguishing an essential governance tool –passive control right – from other formal governance mechanisms, and demonstrating that it has been used to safeguard without installing huge constraints on competing partners. Moreover, this essay contributes to literature on strategic alliances by showing that the nuance characteristics of passive control right can be deliberately design to tackle different degrees of moral hazards. Essay 1, via highlighting the role of passive control right as a solution to principal-principal problem, also adds to the multi-agency (e.g., Hoskisson et al., 2002; Arthurs et al., 2008) . Finally, the Essay shows that entrepreneurial firms may cope with the co-opetition dilemma by introducing third party and allocating control right between investors.

In Essay 2 (Chapter 3), I examine how the allocation of control rights in general affects CVC's nurturing effects on innovation of the portfolio firms, and how the allocation of active and passive control rights affects CVC's nurturing effects on innovation under different contingencies. Entrepreneurial firms face a tension between relinquishing strong control right to CVCs to induce the investors' superior nurturing effect and giving weak control right to the CVCs to prevent potential opportunistic behaviors from the investors. Expending Essay 1 that demonstrates the role of passive control right in mitigating the tension, Essay 2 shows that appropriately designing the allocation of active and passive control right enhances CVC's

nurturing effects and thus help the CVC-backed ventures to achieve better innovation performance.

Beyond showing the functional difference between active control right and passive control right, Essay 2 complements other perspectives on innovation in entrepreneurial ventures by scrutinizing how governance arrangement moderates CVC's nurturing efforts on innovation of portfolio firms under difference contingencies. Furthermore, this study empirically proves that giving passive control rights to the competing CVCs can relieve the moral hazard concerns, enabling entrepreneurial ventures to engage in valuable collaborations with corporate investors who operate in the same market domain. This study also contributes to the strategic alliance research through testing the cooperative interactions between entrepreneurial ventures and their corporate investors, which can lead to various types of strategic relationships in a later stage.

In Essay 3 (Chapter 4), I examine how the allocation of control right in general mediate incumbent firms' exploration performance, and how the allocation of active and passive control rights affects a CVC's ability to boost its corporate parent's innovation performance under different contingencies. Consistent with the results of Essay 1 that demonstrate passive control right can be used to mitigate the tension between cooperation need and safeguard needs, Essay 3 further shows that in entrepreneurial financing, cooperating firms can use passive right design to achieve better innovation performance for not only the entrepreneurial firms (demonstrated in Essay 2), but also the investing incumbents.

Essay 3 contributes to research on corporate entrepreneurship by providing empirical evidence on formal governance designs that ease the limits of CVC investments. I test empirically for designing allocation of control rights that make exploratory search via CVC investments more effective, and show the distinct moderating effects of two control right types

under different contingencies. In other words, I bridge a link between the literatures exploring open innovation and corporate governance. I also contribute to alliance literature by showing that factor market rivalry can trigger significant concerns about opportunistic behaviors from partners.

Table 1. Research Gaps and Corresponding Essays

Research Gap	This Dissertation
Very scarce attention to formal governance mechanisms in coopetitive relationships.	Essay 1 scrutinizes the role of passive control rights in coopetitive relationships. Essay 2 and Essay 3 study how the allocation of passive control rights affect the innovation performance of coopetiting firms.
Less attention to the effect of factor market rivalry on innovation of coopetitive firms.	Essay 1 examines the influence of factor market rivalry between cooperating firms on formal governance design, particularly the allocation of passive control rights. Essay 2 and Essay 3 test the effect of technological relatedness on innovation of invested firms and investing firms, respectively.
Lack of clear guidelines for co-opetition between firms that hold unequal power or status outside of their cooperation boundary.	The three essays use CVC investments in high-technology industries as a theoretical context. As CVCs are typically backed by large incumbents with abundant resources, the CVC-entrepreneur relationships hence address the unequal power issue.

CHAPTER 2. THIRD-PARTY INVOLVEMENT WITH THE DESIGN OF PASSIVE CONTROL RIGHTS AS A SAFEGUARD IN ENTREPRENEURIAL FINANCING

2.1 Introduction

There is an old aphorism that fire is a good servant but a bad master. This concept is frequently applied to cooperation with powerful partners, and vividly captures the nature of a prevalent type of collaboration in entrepreneurial financing – corporate venture capital (CVC) investments. As many CVCs are backed by industry giants that have the ability to boost or devour the value of a venture, a CVC-entrepreneur relationship, like fire, needs constant control to prevent its transformation from beneficial helper into dangerous master. A venture may involve a liable third party to mitigate the imbalanced power embedded in the CVC-entrepreneur relationship. The role of veto rights, a specific tool for the third party to manage the double-edge sword, is scrutinized in this study.

Entrepreneurial ventures often need external finance and technological resources to overcome the costly process of developing and commercializing inventions (Evans and Jovanovic, 1989). As CVCs can provide resources that other investors cannot offer (Teece 1986; Dushnitsky and Lenox, 2005; Katila et al. 2008; Chemmanur et al., 2013), these corporate investors have become an important source of entrepreneurial financing (Dushnitsky, 2006; Gaba and Meyer, 2008), and gradually been viewed as an important nurturer of venture success (Stuart et al. 1999; Chesbrough, 2000; Ginsberg et al., 2003; Ivanov and Xie, 2010). Nonetheless, most CVCs possess strategic goals that can easily give rise to a conflict of interest between the focal venture and its corporate venture capital (CVC) investors, the diverging interests of the CVC investors and the focal firm in turn, might generate conflict of interests between CVCs investing

in the focal venture and the focal venture's other economic exchange partners such as independent venture capital (IVC) firms that invest in the focal venture (Hellmann, 2002; Ivanov and Masulis, 2011; Park and Steensma, 2012). The lack of alignment between the CVCs interests and those of the focal venture, in turn might lead to opportunism and misappropriation by the CVC investors (Katila et al., 2008). Above mentioned conflict of interests can grow throughout a cooperating relationship (e.g., Santos and Eisenhardt, 2008), diminishing the benefits that partners could have obtained. Therefore, CVC-backed ventures need to not only proactively maintain a channel to import CVCs resources, but also cleverly limit the CVC investor's potential opportunistic behaviors (Dushnitsky and Shaver, 2009; Katila et al., 2008).

To reduce the hazard of CVCs' potential opportunistic behavior and misappropriation, the literature on formal governance commonly suggests restricting corporate investors' active control rights such as ownership and board seats (e.g., Hall, 2002; Maula et al., 2009). However, since the allocation of control rights is entangled with partners' incentives (Grossman and Hart, 1986; Cumming and Johan, 2007) and ability (e.g. Berglöf, 1994; Maula et al., 2009) to engage in actives that would add value to the focal venture, it is not clear how ventures can safeguard themselves without hampering the CVCs' actions that will add value to the focal venture, i.e., CVC's nurturing activities. Neither do general suggestions from alliance governance literature, such as choosing an appropriate governance structure (e.g., Kale et al., 2000) and reducing alliance scope (Oxley and Sampson, 2004), provide effective protective guidance without inhibiting the sharing of valuable and private knowledge between firms (e.g., Tiwana, 2008).

A CVC investor might simultaneously have incentives to add value to the focal venture and to appropriate the venture's intellectual property. The goal of this paper is to analyze i) under what conditions the CVC's incentives to exploit a focal venture's intellectual property might

dominate its value adding incentives; as well as to analyze, ii) under what conditions the CVCs ability to act opportunistically is mitigated even if the CVC still has high incentives to exploit the venture's intellectual property. General safeguard mechanisms that restrict powerful corporate investors' (i.e., CVCs') involvement would inevitably hinder the CVCs' valuable nurture effect and the associated value creation for the ventures. In other words, although formal governance can be as important as informal governance to solve the tension in such co-opetitive relationships as in the CVC-focal venture relationship (Bengtsson and Kock, 2000; Cassiman et al., 2009; Enberg, 2012), our understanding about how formal mechanisms can be used to solve the above trade-off is still limited (Enberg, 2012; Bouncken et al., 2015; Mariani, 2016). Empirical analyses on the contractual dimensions regarding to co-opetition are particularly scant (Dagnino and Rocco, 2009).

In this study, I argue that independent venture capitals (IVCs) can act as a third party to mitigate the above trade-off. Specifically, IVCs can use passive control rights, a contractual remedy also known as veto rights, to solve this tension. Third-party involvement has been a solution to moral hazard problems in a variety of areas (e.g., Casamatta and Haritchabalet, 2007) and is especially prominent when the two parties involved in an economic exchange, such as CVC and the focal venture, have imbalanced power in terms of the parties' power/rights to engage in activities that might result in value-destroying outcomes for the focal venture (e.g., Bottazzi et al., 2009). Independent VCs (IVCs) are another type of venture capital investor that frequently invest in entrepreneurial firms, i.e., ventures. IVCs can be an ideal third party in entrepreneurial financing because, firstly, it is shown that under certain conditions IVCs' interests might be better aligned with those of the ventures (Katila et al., 2008) and hence, can be inconsistent with CVCs' (Filatotchev et al, 2006). To the extent than an IVCs interests are more

closely aligned with that of the focal venture, an IVC is expected to work with the focal venture to defend the focal venture against CVCs' opportunistic incentives to protect its own interests.

Secondly, the ventures, IVCs, and CVCs are the main players in entrepreneurial financing markets across different industries (Dushnitsky and Shaver, 2009), which makes IVCs a reasonable candidate for ventures to include as another economic exchange partner to access the necessary resources that the focal venture needs. Third, and most importantly, IVCs are normally entitled to use passive control rights. Most of the time, only preferred stockholders – generally IVCs and CVCs – have the right to veto (Bengtsson, 2011). Veto right is a formal contractual mechanism that can prevent certain actions from being taken in a venture (Cumming, 2012), representing a less direct way to exert power over management (Chahine and Goergen, 2011). Through these passive control rights, IVCs could curb CVCs' opportunistic behavior.

Statistical test results show that the allocation of veto rights between a CVC and IVCs in a venture is significantly affected by factors reflecting the trade-off pertaining to receiving CVC investment; namely the tension between CVC's value-adding effects versus the CVC's opportunistic incentives. Specifically, I identified two types of veto decisions (corporate- and business-level strategic decisions). The distribution of veto power over all types of decisions is strongly affected by technology-related factors. These results support the hypothesis that allocation of the passive control rights is used to respond to the tension associated with CVC financing.

This study is related to at least three streams of research. First, analyzing the strategic interactions between ventures and CVCs allows it to advance the alliance literature. Particularly, this study shows that concerns about CVCs' opportunistic behavior and misappropriation hazards trigger the specific safeguard mechanism – letting a third party have determinant power

over passive control rights. Meanwhile, the results also complement literature on co-opetition. Co-opetition defines a dual relationship of simultaneous competition and cooperation between firms (Brandenburger and Nalebuff, 1996). Although governance mechanisms such as formal arrangements (Bengtsson and Kock, 2000; Enberg, 2012) are necessary elements for dealing with the tension in co-opetition, current literature has not yet understood in depth how formal governance mechanisms are utilized to manage coopetitive interactions (Bouncken et al., 2015; Mariani, 2016). Particularly, empirical analyses on the contractual dimensions regarding to co-opetition are still scant (Dagnino and Rocco, 2009). By separating passive control rights from active control rights, this study shed some light on how contractual controls could be used in response to the co-opetition tension. Last but not least, this work advances research on the agency issue in entrepreneurial financial. Most attention on agency theory in financial contracting centers on principal-agency problem (i.e., inconsistent interests between investors and entrepreneurs) and the corresponding formal designs to moderate the problem. In this paper, I analyze the dynamics between the focal venture and its two different type of economic exchange partners in the private equity investment markets, namely CVC and IVC investors of the focal venture. Following various studies in the literature, I first point to the potential conflict of interest between a focal venture and CVC investor. Then, I show that under certain conditions the interests of the focal venture and IVCs are more closely aligned, which leads to a misalignment of interests between CVCs and IVCs. The misalignment of interests between CVCs and IVCs, in turn enables us to contribute to the studies on the principal-principal problems and contractual remedies to it. This paper also shows that a focal venture can leverage the potential conflict of interest between its different types of exchange partner to protect its own

interests. By doing so, I hope to promote a more comprehensive view of corporate governance decisions.

This paper proceeds as follows. The next section reviews the problems inherent in receiving CVC financing and explores the potential role of passive control rights in VC financing contracts. Section 3 develops a theory regarding the relationship between the above trade-off and the allocation of veto rights. Section 4 discusses the use of contract data, defines three different dimensions of veto decisions, and describes methodology. Section 5 presents the findings, and Section 6 presents the results and discusses the findings.

2.2 Literature Review

Corporate investors can be a valuable asset to entrepreneurial ventures. Compared to firms solely backed by IVCs, CVC-backed firms receive a higher valuation in both IPO (Stuart et al. 1999; Chesbrough, 2000; Ginsberg et al., 2003) and acquisition markets (Ivanov and Xie, 2010). Entrepreneurial ventures, or ventures from now on for the sake of brevity, also acknowledge CVCs' capability to bring in managerial and technical expertise, R&D and product support, marketing and distribution networks, and other resources at lower costs (Lantz et al, 2011). Since CVCs' involvement helps portfolio companies, i.e. ventures, learn from their corporate investors (Maula et al., 2009), ventures typically need to give CVCs certain control rights (e.g., board seats and shares) to motivate and enable these corporate investors to contribute their expertise (e.g., Berglöf, 1994; Maula et al., 2009). As the degree of CVC involvement affects the extent to which a CVC parent can benefit from its CVC investments (Wadhwa and Kotha, 2006), CVCs also tend to ask for a high degree of control power from their portfolio firms.

Nevertheless, unlike independent venture capitalists (IVCs), which mainly pursue financial returns, most CVCs possess strategic goals that can easily cause a conflict of interest

(Hellmann, 2002; Ivanov and Masulis, 2011; Park and Steensma, 2012). CVCs may prioritize their strategic goals, such as gaining access to new technology and enhancing corporate parents' competency (e.g., Siegel et al. 1988; Ernst et al., 2005; Dushnitsky and Lenox 2006; Benson and Ziedonis 2009), which might leasd the CVC engage in actions that might not be in the best interest of the venture that the CVC invested in (Bertoni et al., 2013). CVC investors who hold significant control rights can more easily push through decisions that are in line with the interests of the CVC's parent firm, yet might be conflicting with those of the focal entrepreneurial venture that the CVC has invested in and the other shareholders of the focal venture (Chahine and Goergen, 2011).

Therefore, although ceding control rights to CVCs is a precondition of obtaining great benefits from the corporate investors, entrepreneurial ventures need to be very careful about the amount of ownership and board seats held by CVCs (Hall, 2002). Reluctance in giving competing CVCs board involvement is especially common among entrepreneurial firms (Maula et al., 2009). Among shareholders, since IVCs' interests are better aligned with entrepreneurial firms' interests than with CVCs' (Katila et al., 2008), the above trade-off facing entrepreneurs could cause tension between IVCs and CVCs. Accordingly, the potential conflict of interest between CVCs and entrepreneurial firms could be a crucial factor in the allocation of veto rights between IVCs and CVCs. How the passive control rights are managed to handle conflicts of interest may largely determine whether CVC financing will be a blessing or a curse for a given entrepreneurial firm.

In the next section, I will point out some features of veto rights that make those rights a relevant solution to the trade-off, and then discuss several determining factors of the allocation of veto rights between IVCs and CVCs.

2.2.1 Veto Rights –Passive Control Rights

The right to veto is an important control right of venture capitalists (Barney, 1994; Gompers and Lerner, 1996; Bengtsson, 2011). It empowers the right holders to prevent certain actions from being implemented by the board of directors or top management team. While a section on veto covenants is ubiquitous in VC contracts, the design of veto covenants is strikingly diverse among contracts (Gompers and Lerner, 1996). Some veto decisions are included selectively, such as decisions that relate to selling or buying assets, changing business or competitive ability, changing the top management team or compensation, company exit, alliance formation, investment, and monitoring (Bengttson, 2011). However, previous studies of VC covenants mainly focus on the role of veto rights in responding to agency problems (Barney et al., 1994; Gompers and Lerner, 1996; Bengttson, 2011). Academic understanding of a comprehensive role for veto rights in VC funds is still limited (Braunerhjelm and Parker, 2010).

Some unique features make veto rights a promising solution to the aforestated trade-off. First, veto rights offer an indirect and less invasive way for investors to be informed about and participate in critical issues in a firm. The right holders can receive relevant information about veto decisions and block those decisions, but cannot initiate any other actions. Veto rights are hence passive in nature (Cumming, 2012). For entrepreneurial ventures, compared to ceding control rights to CVCs in a board room or ownership, granting corporate investors veto rights provides a safer way to include CVCs in critical decisions. It limits the way CVCs can respond (i.e., accept or veto), prevents CVCs from expanding their influence to issues beyond those covered by veto rights, and even enables the ventures to delay the time that CVCs receive relevant information. Ventures can withhold information from CVCs until an issue is mature enough to undergo the veto evaluation process, limiting the CVCs' ability to receive critical information or know-how before the initiation of the veto evaluation process. Since veto rights,

compared to active control rights, add additional constraints to the right holders while allowing their involvement in the ventures, ceding control rights to a corporate investor in the form of veto rights may hence help ventures to safeguard against the CVCs' possible misconduct without completely losing the benefits provided by CVCs. On the other hand, while control rights can be a factor driving a CVC's ability to nurture a venture, it may also boost the CVC's ability to exploit the same venture (described in more detail in the next section). The value of constraints posted by veto rights therefore grows with the potential value-adding, i.e., nurturing, value that the CVC investor has against the venture. As a result, I may observe a rise in a CVC's relative veto power (and correspondingly, a decrease in IVCs' relative veto power) when the increasing value of the CVC's nurturing boosts the venture's need to abdicate control rights to the CVC.

Second, despite the constraints, veto rights could, at least to some extent, motivate CVCs to contribute their expertise. Veto rights are an important form of control rights for VCs (Gomper and Lerner, 1996). Most of the strategic goals of CVCs can be highly relevant to veto decisions regarding portfolio companies, such as buying or selling assets, forming alliances, entering new businesses, and changing the top management team. Since CVCs may need to pay more than their IVC syndicates do to obtain the same degree of active control rights (e.g., ownership and board representatives) within their portfolio firms (Maula et al., 2009), claiming more veto power rather than fighting intensively for other active control rights could be an economical way for corporate investors to maintain their strategic goals, while gaining the trust of other shareholders. As a result, veto rights could be an apple in the eye of CVCs on the negotiation table. Furthermore, actively participating in the veto process by offering insights and support is an effective way for CVCs to influence a veto decision to favor their strategic goals. For example, a CVC needs to advocate its opinion on a veto decision by providing professional

comments that are backed by solid technical knowledge and industrial experience to persuade its IVC syndicates. By actively involving in the veto process, the CVC could also collect more information from entrepreneurs. As a result, passive control rights, like active control rights, shall be able to drive CVCs' nurturing efforts.

Finally, by introducing a reliable economic exchange partner such as independent VCs (IVCs), one can control the magnitude of CVCs' veto power by adjusting IVCs' veto power. Veto rights has a long history of being used as a protection mechanism for its holders (Cumming, 2012). For example, finance and law literature considers veto rights as an important safeguard for minority shareholders against expropriation by large-block shareholders (e.g., Easterbrook and Fischel, 1986). Banks typically include veto covenants in loan contracts to protect their interests. Similarly, since IVCs' interests are generally better aligned with ventures' (Katila et al., 2008) and veto rights are typically shared between IVCs and CVCs, IVCs can use veto rights to prevent certain actions from being taken by their powerful CVC syndicates. In other words, IVCs' veto rights can maintain the balance of power in the venture's board and limit the CVC's power in blocking the actions that might indeed add value to the venture.

2.2.2 Explanation of Specific Veto Rights Observed

The idea that IVC stepping in to protect venture from CVC's opportunism may work well for decisions where IVC's interests are better aligned with the venture than with the CVC. However, it wouldn't be expected to work for decisions where IVC's interests are better aligned with the CVC than with the venture. I may hence observe different patterns of control right allocation for different decisions, depending on whether the IVC's interests in that decision are better aligned with the venture or with the CVC.

Alliance provisions include decisions such as enter into JV or strategic alliance, enter into major transaction with nonaffiliate of the company, and enter into transaction with affiliate of the company. Another similar group – acquisition provisions – include decisions such as buying either the whole or partial share in another firm, buying another firm's assets other than regular purchases, and in-license. Lantz et al. (2011) show that developing joint projects, license, or acquisition of the venture can be a way for a CVC to guard against portfolio companies making technological breakthroughs in their corporate parents' competing markets. Therefore, IVC's interests in alliance and acquisition provisions tend to be better aligned with the venture or with the CVC.

Market overlap of business lines between the CVC parent and the venture has been viewed as an important factor that might increase the CVC's opportunistic incentives (Dushnitsky and Shaver, 2009), as a result, CVCs may try to influence or manipulate development directions of the venture in a way to maximize the CVC's parent firm, rather than maximizing the venture's value. In other words, a high market overlap increases opportunistic motives of the CVC investor. Therefore, the venture's decisions on creating a subsidiary, or changing business provisions (such as change current lines of business, enter a new line of business, and exit an existing business) could be subject to CVC's opportunistic threats.

Non-competition provision that targets actions that authorize any board members to partake in any business that compete with the business of the company may also be added to the investment contract to block direct competition from corporate investors. IVC's interests in these veto provisions may hence to be more closely aligned with the venture than with the CVC.

Since CVCs may use their portfolio ventures as a laboratory to examine new practice for their corporate parents (Lantz et al., 2011), it is possible that CVCs may push through

operational or organizational decisions that may be unnecessary or harmful to the ventures. Two types of veto decisions may be especially relevant: “approval & change of operating budget provisions” that are related to approval of the company's annual budget and business plan and making changes to the operating budget of the company, and “capital expenditure provision” that covers situations that incur of capital expenditure above a certain amount as outlined in the contract. Consistent with this argument, Battistini et al. (2013) found that conflicts of interest regarding investment decisions should be expected and accounted for in advance in CVC financing. Therefore, for these two types of decisions, IVC’s interests tend to be better aligned with the venture than with the CVC.

Share number related provisions that target actions that change total number of preferred stocks and/or total number of common stocks, exchange, reclassify or cancel any of the outstanding shares, and dividend provisions tend to influence preferred stock holders, i.e., both IVCs and CVCs, as a whole. Decisions such as liquidate or wind up, bankruptcy, and sell, lease, or license out all or substantially all assets of the company are also likely to affect both IVCs and CVCs’ financial interests in a similar manner. Therefore, for these corporate governance decisions, IVC’s interests hence tend to be better aligned with the CVCs than with the venture.

As a result, IVC’s passive control rights in general, and veto rights of IVCs in particular, can have high marginal value in limiting the CVC’s power to fulfill/implement its opportunistic motives that might destroy the venture’s value.

2.3 Theory and Hypotheses

2.3.1 Technology focus

There are many reasons supporting the premise that technology issues are at the crux of the tension in CVC-entrepreneur relationships. For entrepreneurial ventures, since it is widely

thought that most successful new ventures are rooted in commercializing technologies and innovation (Hall, 2002; Maula et al., 2005), technology is often highly valued in these firms. The value of corporate investors who are well known for helping their portfolio companies navigate technical issues (Hellmann and Puri, 2002) and achieve better innovation performance (Lantz et al., 2011) is hence elevated. Compared with IVCs, CVCs also play a stronger role in supporting technological development in their portfolio companies (Maula et al., 2005; Maula and Murray, 2011; Chemmanur et al., 2013). Therefore, CVCs' technological support can be a valuable asset to ventures. The more technological support an CVC can provide, the more irreplaceable the incumbent's CVC arm will be to a venture.

In regard to corporate investors, most CVCs are technology-driven investors (Dushnitsky and Lenox, 2005) seeking a window on technology (Wadhwa and Kotha, 2006) and emphasizing technological development in their portfolio companies (Cox, 2010). In fact, increasing CVC activity is a common response of incumbents to an intensifying race in innovation (Fulghieri and Sevilir, 2009). Large high-tech corporates that want to get hold of the most recent innovations often possess their own CVCs (Lantz et al., 2011), which invest primarily in high-tech areas but are not limited to their own domains. The technology focus of corporate investors also reflects on their target selection and self-identification. For example, CVCs tend to invest in entrepreneurial ventures with greater pre-funding innovative capabilities (Park and Steensma, 2013). Interviews of CVCs from the top 50 Forbes Global 2000 corporations reveal that CVCs identify corporate innovation as the main area where they can add value to their corporate parents (Battistini et al., 2013). This means that parent firms of CVCs indeed tend to use CVC investments in ventures to create an option to gain access to emerging technologies, which the CVC's parent firm can utilize to develop new technologies along with the parent firm's in-house R&D activities. This

strategy of leveraging external resources to develop new technologies can indeed help the CVC's parent firm substantially. Hence, being able to access the entrepreneurial ventures' technologies can lie at the core of a CVC's success. As a result, it is not surprising to find a close relationship between technology-related factors and CVCs' opportunistic incentives.

As technology issues are decisive in the success of both CVCs and their portfolio ventures, I postulate that technology-related factors can drive the tension in CVC-entrepreneur relationships. Particularly, the influence of knowledge overlap, the R&D capability of CVC parents, and the technological quality of the venture on the allocation of veto rights is scrutinized and discussed in the following sections.

2.3.1.1 The effect of knowledge overlap on veto rights allocation

Knowledge overlap could affect the allocation of veto rights through two opposite mechanisms – learning that creates CVCs' nurturing, i.e., value-adding, value and opportunistic concerns that undermine the (perceived) nurturing value. As I will discuss in this section, the two forces would cause an inverse-U shaped relationship between knowledge overlap and CVCs' nurturing value, which would, in turn, guild the allocation of veto rights between CVCs and IVCs.

Learning is a key benefit that a venture can receive form its CVC investor. Ventures could learn from their corporate investors in both operational and strategic dimensions. As knowledge overlap determines the ability of the firm to understand, absorb, use, and configure external technologies (Cohen and Levinthal, 1989, 1990, 1994), the knowledge overlap between a venture and its corporate investors could greatly affect the magnitude of the venture's learning experience in these two dimensions. In terms of practical operation, higher knowledge overlap enhances the relevance and applicability of CVCs' know-how, which is particularly

advantageous to high-tech ventures. Taking pharmaceutical firms as an example, the process of taking a drug from discovery to commercialization is a long and complex journey, requiring numerous tests over years. Even a slightly mistake can hamper a project from moving on. For example, a promising drug for treating Alzheimer's disease, Dimebon, failed to pass its Phase 3 trials mainly due to lack of full understanding of its fundamental molecular mechanisms (Nature Medicine, 2010). Being able to learn from professionals in relevant fields during the process can significantly increase ventures' chances of success. Furthermore, ventures can also learn strategic planning skills from their corporate investors. With an overlapping domain of technological expertise, CVCs can help assess the strategic decisions of their portfolio ventures. In the shared knowledge domain, a venture can thus learn the industry experience and know-how from its corporate investors to better predict the success of its plans, such as forming different types of alliances, adjusting lines of businesses, preventing myopic selling of intangible assets, and identifying assets that advance the venture's ongoing projects. However, although inter-firm learning can be enhanced by knowledge overlap, it tends to increase in a diminishing rate (e.g., Schulze and Brojerdi, 2012) because of the diminishing complementary benefits (Schoenmakers and Duysters, 2006).

Unlike the learning effects, the concerns over CVCs' potential opportunistic behavior tend to grow with knowledge overlap at an accelerating rate. It is because knowledge overlap also reflects the absorptive capability of a corporate investor in an inter-firm relationship, and is highly related to the incentive and ability of a CVC to behave opportunistically. For example, corporate parents with higher absorptive capabilities not only make more attempts to establish their own CVCs (Dushnitsky and Lenox, 2005), but are also more tempted to exploit and integrate the knowledge from their CVCs' portfolio companies (Benson and Ziedonis, 2009). In

addition, prior studies fund that firm size and firm age are positively related to exploitation activities, but not exploration activities (e,g., Isobe et al. 2004). Given the diverse approaches and corresponding know-how, corporate investors could still have strong incentive to explore the technologies of their portfolio ventures, even if they share the same knowledge base. Moreover, the relatively high marginal benefits from preventing lagging in important technological applications as well as potential disruptive innovation, and low marginal costs of obtaining knowledge from technologically closed ventures may trigger a CVC's misconduct, such as influencing portfolio companies to fit the CVC's strategic goals, which would greatly undermine CVCs' nurturing value. As the potential losses could become greater and more harmful to the ventures when CVCs operate in a similar technological domain, the opportunistic concerns are likely to grow faster under high knowledge overlap than under low knowledge overlap.

Consequently, as knowledge overlap increases, ventures' benefits from learning tends to raise with a diminishing rate and the opportunistic concerns tend to grow with an accelerating rate. The two effects would function simultaneously, causing an inverse-U shaped relationship between knowledge overlap and CVCs' nurturing value. Since motivating and enabling CVCs' nurturing value is the main reason of ceding control rights to corporate investors, the magnitude of CVCs' versus IVCs' veto power would reflect the amount of CVCs' nurturing contribution.

In the stage where knowledge overlap positively influence CVCs' nurturing effect, it is efficient to give CVCs strong veto power and give IVCs weak veto power for two reasons. Firstly, although corporate investors can contribute valuable expertise, managing the leakage of knowledge is still a critical concern for entrepreneurial firms (e.g., Kale et al., 2000; Oxley and Sampson, 2004). The process of inter-firm cooperation in high-tech industries often involves complex interactions that may not be noticed by partners (Fleming, 2001). Including a CVC

without restricting its involvement to certain areas, such as giving board seats to the corporate investor, which can then participate in all the important decisions in the venture, exposes the venture to the risk of losing critical know-how. As the threat of knowledge leakage spreads when the CVC's corporate parent possesses overlapping domains of technological expertise (Dushnitsky and Lenox, 2005; Katila et al., 2008), ceding veto rights, instead of active control rights, to the CVC can be a safe way to involve the corporate investor. Secondly, it is more efficient to reach a veto decision by granting more veto power to CVC investors that are able to provide more accurate insights to assist ventures due to higher knowledge overlap. IVCs may be willing to take relatively less veto power and let the CVC syndicate(s) play a major role in making veto decisions under these circumstances. However, in the stage where knowledge overlap negatively influence CVCs' nurturing contribution, it is more appropriate to give stronger veto power to IVCs than to CVCs to safeguard the ventures.

Since veto rights can be a clever tool for preventing potential conflict, I predict that IVCs' relative veto power will decline as CVCs' nurturing ability increases, but will eventually rise again when concerns about opportunism outweigh CVCs' potential nurturing value. Therefore, I propose the following hypothesis:

Hypothesis 1: The degree of technology overlap between the venture and the CVC parent has a U-shaped curvilinear effect on the relative veto power of IVCs (i.e., higher for extreme values of technology overlap, lower for intermediate values) for veto rights where the IVC's interests are more closely aligned with the venture than with the CVC.

2.3.1.2 The effect of R&D capabilities of CVC parents on veto rights allocation

R&D capabilities of CVCs is likely to have a curvilinear relationship with CVCs' nurturing value due to two opposite effects. It can diminish ventures' environmental uncertainty, which increases the value, but it can also create a threat to manipulate ventures' decisions, which decreases the value. The curvilinear relationship would largely shape the allocation of veto rights between CVCs and IVCs.

CVCs established by corporate parents with strong R&D capabilities usually have a larger resource pool to leverage and share with their portfolio companies. These CVCs can help ventures address as well as respond to uncertainty, which is especially beneficial to high-tech ventures that face great environmental uncertainty. Environmental uncertainty can result from lack of predictability (Cyert and March, 1963) and knowledge for decision-making (Duncan, 1972). Encountering unprecedented situations or facing unexpected results is common during an exploration process. For example, like many drugs, Sildenafil, a high-profit pill, was initially studied for usefulness in treating angina pectoris and hypertension, but its most lucrative function was not discovered until the drug's Phase I clinical trial. The success of Sildenafil required the capabilities of identifying the drug's additional function and rapidly assembling and redirecting different areas of expertise to pursue the opportunity. In fact, when exploring innovation, properly interpreting unexpected results can change the fate of a project, or even a venture. However, a potential operational or business opportunity can be easily ignored by a research team that focuses only on a narrow range of fields. As entrepreneurial firms typically lack large teams with diverse technical experts and other R&D resources, their chances of capitalizing on the opportunity alone, even if they notice it, are small. Additional possibilities that experienced corporate investors may discover, and the corresponding technology synergies that CVCs may create, are greatly appreciated by ventures and their other shareholders.

CVCs backed by technologically strong incumbents may gain a more accurate sense of technology developments, industry trends, and ways of dealing with legal institutions (e.g., the FDA) from the experiences of their corporate parents. These CVCs are likely more familiar than other investors with the processes of innovation and commercialization, and the common rules of success in these processes in various fields. They are also more likely to have precise technological and/or industrial insights into frontier technologies to assist portfolio companies. In other words, CVCs backed by technologically strong parents may have a superior ability to evaluate a venture's response to a changeable circumstance, for example, by pointing out and comparing options that were overlooked by entrepreneurs.

However, the positive effect from diminished environmental uncertainty is likely to grow at a decelerating rate with CVCs' R&D capabilities. It is because there are other factors that are more critical than environmental uncertainty is to the success of innovative activities (Souder and Chakrabarti, 1978), and there may be a limitation on how much resource that CVCs can leverage from their corporate parents to the ventures. Besides the fading effects of diminished environmental uncertainty boosting CVCs' nurturing value, high R&D capabilities of corporate investors can exacerbate the opportunistic concerns. A firm's R&D capability is positively related to the firm's absorptive capability. Following the same logic discussed in Hypothesis 1, when the R&D capability of a CVC parent increases to a certain extent, the above benefits of CVCs' nurturing effects may eventually be outweighed by a growing need to safeguard against the CVC's potential opportunistic behavior. Furthermore, high absorptive capability reduces the hurdles for CVCs to evaluate and acquire portfolio companies' technology, incentivizing these corporate investors to integrate the knowledge from their portfolio companies. As a result, R&D capabilities of corporate investors and CVCs' nurturing value are likely to form an inverse-U

shaped relationship. Following the same logic discussed in Hypothesis 1, the allocation of veto power would vary accordingly.

Firms may respond to uncertainty by forming alliances, creating a subsidiary, or changing a line of business. Most of their responses would tie in closely to the operating budget and capital expenditure of the ventures. Since all the above decisions can be covered in veto covenants, and since veto right holders are the ones that can make the final call on these decisions, CVCs that are expected to have better judgment on technical issues may obtain greater veto power than other investors do. Granting CVCs relatively high veto power can also smooth and speed up veto processes. In other words, before the marginal effect of corporate investors' R&D capabilities on CVCs' nurturing value turns negative, it is beneficial for ventures and their IVC investors to cede more veto power to CVCs. Once the marginal effect turns negative, IVCs may seek higher veto power to protect the interests of their portfolio companies when co-investing with CVCs whose corporate parents are extremely strong in R&D. I hence propose the following hypothesis:

Hypothesis 2: The R&D ability of the CVC parent has a U-shaped curvilinear effect on the relative veto power of IVCs (i.e., higher for extreme values of R&D ability, lower for intermediate values) for veto rights where the IVC's interests are more closely aligned with the venture than with the CVC.

2.3.1.3 The effect of technological quality of CVCs' portfolio companies on veto right allocation

Venture capitals encounter significant information asymmetry when financing entrepreneurial firms (Kaplan and Stromberg, 2003). They typically ask for control rights, including veto rights, from their portfolio companies to offset the uncertainty about the firm's quality (Broughman and Fried, 2010; Bengtsson, 2011). The higher the uncertainty VCs face, the more the control rights they ask for. IVCs, on the other hand, tend to remove some of these corporate governance

constraints from portfolio companies that can signal good quality and thereby lessen negotiation, contracting, and implementation costs.

Such a rule about firm quality and control requirements may not apply equally well to CVCs, especially when it comes to ventures with high technological quality. Most CVCs consider seeking a window on technology as their main investment objective (Wadhwa and Kotha, 2006; Benson and Ziedonis, 2009). Unlike IVCs, which emphasize commercializing innovation, CVCs focus more on technologies in their portfolio companies (Cox, 2010; Dushnitsky and Lexon, 2005). CVCs are hence more sensitive to decisions that could affect the technological development of those firms. As a result, even if an entrepreneurial firm can demonstrate its technological quality to CVCs, these corporate investors may still want to maintain their veto power in the venture to block potential deviations that do not align with their strategic goal(s). Moreover, high-quality ventures, especially those with superior research and development capabilities, are abler to disrupt the industries where CVCs' corporate parents operate. This could push CVCs to ask for more veto rights from those ventures. As IVCs have fewer incentives to fight for strong veto power from portfolio companies with high technological quality, it seems natural for CVCs to gain more veto power than IVCs do as the pre-investment technological quality of the venture goes up.

Yet, high technological quality indicates not only a reduced risk of VC investments, but also an increased potential for conflicts of interest between CVCs and other investors. The conflict may gradually emerge when the pre-investment technological quality of a firm is higher than a certain level, such that the firm may become a serious threat to industry incumbents (Lantz et al., 2011). As the high technological quality of a firm may induce CVCs to misappropriate technologies generated by the venture or to behave opportunistically (e.g.,

stealing know-how, or manipulating the venture's strategies to make the technologies more valuable to their parent corporations), IVCs may ask for greater veto power when the technological quality of the venture is at a higher level for security purposes. I hence propose the following hypothesis:

Hypothesis 3: The technological quality of the venture has a U-shaped curvilinear effect on the relative veto power of IVCs (i.e., higher for extreme values of technological quality, lower for intermediate values) for veto rights where the IVC's interests are more closely aligned with the venture than with the CVC.

2.4 Method

2.4.1 Data and Sample

The database contains information on established firms' CVC activity collected from Venture Economics' VentureXpert database, financing contracts (certificates of incorporation) from private equity data provider VCExperts, patenting activity from the Hall et al. (2001) dataset derived from the U.S. Patent Office, and alliance information from the Securities Data Company (SDC) Database on Alliances and Joint Ventures.

The contracts studied in this paper represent a subsample of the 1,139 contracts from CVC-backed high-tech U.S. companies between 1998 and 2013. To construct my sample, I first identified the population of CVC-backed high-tech U.S. companies through the SDC Thomson One dataset. I then searched the population of these companies in the VCExperts database, accessing financing contracts (certificates of incorporation) that venture-backed firms are required to file with other legal filings.

From the sample, I identified term sheets from rounds that were the first time the entrepreneurial firms received CVC financings. My final sample contains contracts from 296 CVC-backed firms, and all of the contracts possess the covenant portion. Comparable to other prominent research on entrepreneurial financing (e.g., Hellmann and Puri, 2002; Hsu, 2004; Bengtsson, 2011), I use 296 firms to represent typical CVC investment cases. Most contracts in my sample are from financing rounds conducted between 2002 and 2010.

Since I focus on first-round contracts of CVC financing, corporate investors only exist in the focal rounds in my sample, and all the "prior investors" in my sample are composed of only IVCs. Because each financing round issues a new class of preferred stock with a unique list of covenants, I am able to exclusively examine how IVC syndicates may use covenant design to respond to the concerns of opportunism and misappropriation caused by new CVCs.

In order to examine the argument that covenants can be used to mitigate concerns about CVCs' potential opportunistic behavior and misappropriation hazards, I exclusively focused on contracts from funding rounds during which entrepreneurial firms first received CVC investments and identified all the decisions covered by covenants in those contracts.

2.4.2 Dependent Variable

All 39 potential veto decisions listed in Bengtson (2011) are identified (Table 2). Each of them appears at least once in my sample of VC contracts. Since covenants cover a variety of veto decisions (Bengtson, 2011), an exploratory factor analysis (EFA) with varimax rotation was performed to detect multiple dimensions of veto provisions (Table 3). The number of factors to be retained was determined by examining the screen plot and the eigenvalue scores. The three factors that were extracted accounted for 54.61 percent of the variance in the data. Minimum

communality of 0.3 was adopted (Hair et al., 1998), while communalities generally exceeded 0.50.

Table 2. Types of IVC-exclusive or IVC-predominant veto rights observed in CVC syndicate contracts

Type of veto provision	Example quotation from contract	IVC's interests more closely aligned with
Alliance	Enter into joint venture or strategic alliance. Enter into major transaction with nonaffiliate of the company. Enter into transaction with affiliate of the company.	Venture
Creating a subsidiary	Creating a subsidiary.	Venture
Acquisition	Acquire another company or acquire shares in another company. Acquire assets (except as part of ordinary course of business). In-license.	Venture
Changing business	Change current line of business. Enter into new line of business. Exit current line of business.	Venture
Approval/change of operating budget	Make changes to the operating budget of the company.	Venture
Non-competition	Authorize any board members to partake in any business that compete with the business of the company	Venture
Capital expenditure	Incur capital expenditure above a certain amount as outlined in the contract	Venture
Changing rights of preferred shares	Rights of preferred shares	CVC
Exit	Liquidate or wind up. Enter into bankruptcy procedure. Subject to merger or acquisition. Sell, lease, or license out all or substantially all assets of company.	CVC
Amending contract	Amend COI.	CVC
Share number	Change total number of preferred stocks. Change total number of common stocks.	CVC
Exchanging/reclassifying/canceling shares	Exchange, reclassify or cancel any of the outstanding shares.	CVC
Dividend	Pay dividends. Dividend or distribution on junior stock	CVC

Table 3. Means, standard deviations, and correlations for variables

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Industry effect	0.79	0.40	1.00	-0.02	-0.07	-0.04	0.02	-0.12	-0.10	-0.04	.18**	-.20**	0.15	-.22**	-0.08
(2) CEO duality	0.13	0.33	-0.02	1.00	-0.02	0.13	0.06	-.22**	0.06	0.06	-0.10	0.07	-0.10	0.22**	-0.03
(3) Late round	0.57	0.49	-0.07	-0.02	1.00	0.49**	-0.13	-0.06	0.07	-0.15*	-0.11	-0.12	0.03	0.31**	-0.03
(4) Total IVC number	5.24	3.51	-0.04	0.13	0.49**	1.00	-0.05	-0.09	0.05	-.22**	-.40**	0.15*	-0.04	0.32**	-0.03
(5) Market competition	0.13	0.34	0.02	0.06	-0.13	-0.05	1.00	-0.10	0.08	0.05	-0.05	0.13	0.14	-0.00	0.07
(6) Log [venture's prior alliance experiences]	-0.84	1.69	-0.12	-.22**	-0.06	-0.09	-0.10	1.00	-0.02	0.02	0.13	0.05	0.16*	-0.11	-0.01
(7) CVC prior performance	0.38	0.48	-0.10	0.06	0.07	0.05	0.08	-0.02	1.00	0.11	0.02	-0.03	-0.10	0.17*	0.02
(8) Number of CVC directors	0.21	0.41	-0.00	0.06	-.15*	-.22**	0.05	0.02	0.11	1.00	0.04	-0.00	-0.08	-0.04	0.07
(9) CVC ownership	25.93	17.98	0.19**	-0.10	-0.11	-.40**	-0.05	0.13	0.02	0.04	1.00	-.29**	-0.02	-0.07	0.39
(10) Multiple CVCs	0.34	0.47	-.20**	0.07	-0.12	0.15*	0.13	0.05	-0.03	-0.00	-.29**	1.00	0.01	0.10	0.51
(11) Technology overlap	0.19	0.28	0.15	-0.10	0.03	-0.04	0.14	0.15*	-0.10	-0.08	-0.02	0.01	1.00	-0.07	0.07
(12) R&D capability of CVC parent	7.00	9.95	-.22**	.22**	.31**	0.32**	-0.00	-0.11	0.17*	-0.04	-0.07	0.10	-0.07	1.00	0.11
(13) Technological quality of venture	2.11	0.81	-0.08	-0.03	-0.03	-0.03	0.07	-0.01	0.02	0.07	0.06	0. 04	0.13	0.11	1.00

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Three factors concerning veto rights were identified by factor analysis (Table 4). It appears that the three factors show concern about qualitatively different types of veto decisions. Decisions based on the first two factors are related to different aspects of strategic issues such as alliance formation, acquiring assets, and changing business (Factor I) as well as investment and non-competition provisions (Factor II). Meanwhile, corporate governance issues such as basic protection, disbursement, and issuance (Factor III). I will refer Factor I decisions as corporate-level strategic veto rights, Factor II decisions as business-level strategic veto rights, and Factor III decisions as corporate governance veto rights. Consistent with the observation in Bengtsson (2011), corporate governance veto rights are more commonly included in the contracts. This may reflect the prevalence of traditional agency problems and minority issues in entrepreneurial firms. As has been confirmed in finance and law literature, corporate governance veto rights, which cover the protection of preferred stockholders' interests and the disbursement and issuance of stock, play a big role in protecting minority shareholders and in responding to the traditional principal-agency problem (e.g., Easterbrook and Fischel, 1996).

As discussed earlier, corporate-level strategic veto rights (Factor I) and business-level strategic veto rights (Factor II) mainly cover decisions where IVC's interests are better aligned with the venture than with the CVC, while corporate governance veto rights (Factor III) largely include decisions where IVC's interests are better aligned with the CVC than with the venture. Therefore, as my hypotheses test the idea that IVCs step in to protect the venture against CVCs' potential opportunistic behavior, these hypotheses apply to business and corporate strategy factors, but not to the corporate governance factor.

Table 4. Varimax rotated factor pattern [a]

Veto Provision	Corporate -level Strategic Provision (Factor I)	Business-level Strategic Provision (Factor II)	Corporate Governance Provisions (Factor III)	Communalities
Alliance provision	**0.75**	0.16		0.58
Creating a subsidiary provision	**0.73**			0.54
Acquisition provision	**0.72**	0.13		0.54
Changing business provision	**0.52**	0.40	0.12	0.44
Approval & change of operating budget provision		**0.76**		0.58
Non-competition provision	0.15	**0.73**		0.56
Capital expenditure provision	0.33	**0.71**		0.61
Changing rights of preferred shares provision		0.10	**0.83**	0.71
Exit provision	0.24	-0.22	**0.76**	0.68
Amending contract provision	0.14		**0.75**	0.58
Share number provision			**0.74**	0.56
Exchanging/reclassifying/canceling shares provision			**0.58**	0.34
Dividend provision	-0.17	0.17	**0.57**	0.38
Eigenvalue	2.12	1.93	3.05	
Percent of variance	16.31	14.81	23.49	
Cumulative percent of variance	39.80	54.61	23.49	

[a] Bold print indicates the largest factor loading for each covenant provision.

IVCs' veto power is the dependent variable of this study. A counting measure was conducted for capturing the fine difference in veto power between these two types of VCs. A hypothetical scenario presented below helps illustrate the rational of weighting.

Covenants grant veto rights to investors for each veto decision in one round or multiple rounds, voting as a single class. Since this study focused on initial rounds when ventures first accepted CVC financings, there is at least one corporate investor investing in the focal rounds,

while no corporate investors can be found in any of the 'prior rounds'. For example, let us assume that a venture has already raised two founding rounds (Series A and Series B) and is currently raising its Series C founding round. Series A and B preferred stock holders are composed solely of IVCs, and Series C preferred stock holders include at least one new joining corporate investor. This hypothetical firm's Series C founding contract specifies that action X shall not be taken without first obtaining the approval of the majority of Series A preferred stockholders (voting as a separate class), action Y shall not be taken without first obtaining the approval of the majority of all the preferred stockholders (i.e., stock A, B, and C holders voting as a separate class), and action Z shall not be taken without first obtaining the approval of the majority of Series C preferred stockholders (i.e., focal round investors, voting as a separate class). Since there is no CVC involved before the focal round (Series C), the new-joining CVC can only affect veto decisions over action X and action Y, but not action Z.

In other words, which series of investors has the veto rights will directly affect the relative veto power between IVCs and CVCs. Compared to CVCs, IVCs would have the greater power to determine whether to veto over action X, since the new- joining CVC cannot get involved in this veto decision. IVCs would have the second-largest veto power to veto decision Y, whereas the new- joining CVC could participate, but would have to make the veto decision grouped with all the IVCs in Series A, B, and C. IVCs would possess the least veto power (while CVCs possess the largest veto power) on action Z, where the incoming CVC can participate in vetoing the decision with a less diluted voice. In other words, the CVC only needs to negotiate with its focal round co-investors and not those in the prior round(s). Considering the above effect, I separate decisions that only IVCs have the right to veto ($j = 1$ in the equation below)

from decisions that IVCs and CVCs share the right to veto. The number of veto decisions specified in a contract is used to profile IVCs' relative veto power:

$$VP_{ij} = \sum_{k=1}^{n} D_{ijk} ,$$

where D_{ijk} represents the number of factor i veto decisions granted to group j investors to vote together as a separate class (i = 1 or 2; j = 1 or 2); i = 1 stands for corporate strategy decisions, i = 2 stands for business strategy decisions, j = 1 stands for veto decisions that do not involve CVCs (i.e., without focal round preferred stockholders), j = 2 stands for veto decisions that involve CVCs and focal round investors (IVCs), and each k stand for a unique veto decision.

I use both VP_{i1} and VP_{i2} for hypothesis testing.

2.4.3 Independent variables

Technology overlap between an investee venture and a corporate investor is included as an independent variable because it can raise both the threat of the corporate investor exploiting intangible assets of the venture (Dushnitsky and Lenox, 2005; Katila et al., 2008) and the potential benefits that the same investors can contribute to the venture. The angular measure (Jaffe, 1986) was employed to calculate technology overlap.

Patent stock (the sum of all patents applied for from 1963 to the investment year using the NBER's version of U.S. Patent Office Data) was used as another independent variable. Patents representing the strength of a firm's internal R&D are commonly used for approximating knowledge capital (Hall et al., 2001) and hence the firm's ability to absorb external knowledge (e.g., Dushnitsky and Lenox, 2006). In the CVC financing setting, the internal R&D strength of a CVC's corporate parent also represents the size of the technology pool the CVC can leverage and use to help its portfolio companies.

Patent stock (Dushnitsky and Lenox, 2006) was used to measure technological quality of entrepreneurial firms. *Company patent stock* is calculated as the sum of all patents applied for from 1963 to the investment year using the NBER's version of U.S. Patent Office Data (Hall et al., 2001). Patents commonly serve as quality signals to decrease informational imperfections and present a separate set of advantages in strategic factor markets (Barney, 1986, 1991). As a result, patents can improve the access or terms of trade of entrepreneurial firms (Hsu, 2013). Patent stock was adopted here rather than the number of citations the patent receives before the investment date, which can be a proxy for patent quality of an entrepreneurial firm (Jaffe and Trajtenberg, 2002). This was done because the patents of young firms are all likely to have a relatively shorter period to be cited, and the number of patent citations for those firms may not significantly differ from firm to firm.

2.4.4 Control variables

A series of controls were established in this study for attributes of the CVC financing round, CVC-backed entrepreneurial firms, corporate investors, and entrepreneurial-CVC relationships that may influence the allocation of control rights between VC syndicates.

Power can be defined as the ability of one party to influence the behavior of others to create outcomes favored by the influencing party (Pfeffer and Salancik, 1978). Powerful CVCs have stronger ability to pursue their strategic goals, even at the expense of investee companies and IVC syndicates. The strength of a CVC therefore would affect how many veto rights IVCs need to curb the CVC's potential opportunistic behavior. According to Finkelstein (1992), prestige power and ownership power demonstrate two important dimensions of VC power. Prestige power can be derived from prior performance of a VC in the capital market (Sorenson and Stuart, 2001). The effect of this power has been shown in the financing process where

funding from high-prestige VCs is more likely to be accepted and entrepreneurial firms are more willing to pay a higher premium in the form of valuation discounts for these VCs (Hsu, 2004). *CVC's prior performance*, measured by the number of portfolio companies that went public prior to focal investments (Park and Steensma, 2012), was used to control for the prestige power of the CVC. Meanwhile, *CVC's ownership* and *the number of CVC directors*, two commonly used proxies for the related influence of various shareholders on venture behavior (e.g., Lappalainen and Niskanen, 2012; Hoskisson et al., 2002), were also controlled in this study. The former represents the percentage of shares a CVC holds during the financing round; the latter represents how many board directors of a venture represent the corporate investor.

Concerns about conflict of interest when making certain decisions could be mitigated (e.g., exit decisions) or exacerbated (e.g., investment decisions) when there are multiple CVCs co-investing in a firm. A dummy variable *multiple CVC* was used to control for these possible effects. It was coded as 1 if there were more than one corporate investors co-investing in a focal round, and coded as 0 if there was only one CVC in the round. In addition, I control for firm financing status by adding a dummy variable – *late round*. *Late round* was coded as 1 when the focal round belonged to late financing rounds of the venture and was coded as 0 otherwise. *The number of IVC investors in the round* is also controlled in the regression model.

At the dial level, the *product market overlap between a CVC parent and a venture* was controlled. The variable was coded as 1 if the venture and the CVC's corporate parent shared the same SDC code, and it was otherwise coded as 0.

At the firm level, the pre-funding number of alliances, CEO duality, and the operating industry of an entrepreneurial firm were controlled. *A log of a venture's pre-funding number of alliances* was used to control for the relative bargaining power of an entrepreneurial firm. This

bargaining power may stem from the general quality of the venture (Park and Steensma, 2012), the existing alternatives to corporate investors for resources, and the ability of the venture to find external partners who could provide resources similar to those its corporate investors provide. This variable was calculated by counting the number of alliances a firm was involved in before the investment date. It may complement or take the place of the IVCs' veto power.

As covenants may be used simultaneously to mitigate principal-agency problems (e.g., Bengtsson, 2011), a dummy variable for *CEO duality* of an entrepreneurial firm at the funding year was introduced. The variable was coded 1 when the CEO was also the chairman of the board and was otherwise coded 0.

Moreover, a dummy variable indicating the industry where an entrepreneurial firm operated was introduced to control for the industry effect. It was coded as 1 if a company belonged to the 'health care' category in the SDC Thomson One dataset and was coded as 0 if a company belonged to the 'IT' industry in the dataset.

2.4.5 Statistical method

Since the decision to receive CVC investments may not be exogenous, I control for the endogeneity problem by using an instrument variable approach (Hausman, 1978). In the first stage, I used a Probit regression to estimate the likelihood of matching between a particular CVC and a particular venture. I use 'geographic availability of CVCs' as an instrument to address the endogeneity problem in the investment relationship between CVCs and the ventures. Geographical availability of investors has been used as an instrumental variable to solve the endogeneity problem in investment relationships under a variety of contexts (e.g., Berger et al., 2005; Hellmann et al., 2008; Ozmel and Guler, 2015). The geographical availability of CVCs measured as the total number of CVCs investing in a particular venture's local geographic

market in a given year. Following Sørensen (2007), the selection model includes all possible pairs (including realized and unrealized) between CVCs and high-tech U.S. companies between 1998 and 2013. A realized pair occurs in the financing round where a venture first received CVCs' investments. The dependent variable in the selection model takes on 1 for realized paris and takes on 0 for unrealized ones.

The results of the above selection model were used to calculate the inverse Mills ratio. The inverse Mills ratio was then included along with the other controls in the second stage to calculate ventures' innovation performance. Therefore, the coefficients in all the second-stage models indicate a valid treatment effect on the innovation performance of the ventures.

In the second stage models, I examined the negative binomial regression for all the realized pairs between the CVCs and the ventures. I adopted a negative binomial model because the variance of the dependent variable (*veto power of IVCs*) exceeds its mean, which could cause the problem of over-dispersion in the Poisson regression, and could consequently bias downward the estimated standard errors (Haunschild and Beckman, 1998; Kogut and Zander, 1992). Since the negative binomial model can overcome the over-dispersion problem and account for the omitted variable bias, it was used in regression to test the above hypotheses.

2.5 Results

The negative binomial regression results are shown in Tables 6 to 9. The tables cover results for disaggregate veto provisions, in the order of corporate-level strategic veto decisions and business-level strategic veto decisions. All the results are summarized in Table 5.

Table 5. Summary of results

	Dependent Variable			
	IVC-Exclusive Veto Rights Over:		IVC-Predominant Veto Rights Over:	
Independent Variable (Hypothesis #)	Corporate strategy decisions (Tables 5 & 6)	Business strategy decisions (Tables 7 & 8)	Corporate strategy decisions (Tables 5 & 6)	Business strategy decisions (Tables 7 & 8)
Technology overlap (H1)	**H1 supported**	H1 not supported	H1 not supported	**H1 supported**
CVC parent's R&D capability (H2)	**H2 supported**	**H2 supported**	**H2 supported**	**H2 supported**
Technological quality of venture (H3)	H3 not supported	H3 not supported	**H3 supported**	**H3 supported**

My first hypothesis posited a curvilinear relationship between IVCs' veto power and the knowledge overlap between a CVC parent and a venture. Veto rights over corporate-level strategic decisions are tested in Model 3 and Model 5 (Table 6) for IVC-solely right holders, and in Model 7 and Model 10 (Table 7) for CVC-included right holders. Hypothesis 1 is fully supported by the full-model analysis on veto decisions solely made by IVCs, and partially supported by that on veto decisions dominantly made by IVCs. Meanwhile, veto rights over business-level strategic decisions are examined in Model 12 and Model 15 (Table 8) for IVC-solely right holders, and in Model 17 and Model 20 (Table 9) for CVC-included right holders. Hypothesis 1 is partially supported by full-model analysis on veto decisions solely made by IVCs, but fully supported by that on veto decisions dominantly made by IVCs. The tables indicate a curvilinear relationship between knowledge overlap and the two types of IVCs' strategic veto rights, basically supporting Hypothesis 1.

My second hypothesis suggested a curvilinear relationship between the R&D ability of a CVC's corporate parent and the veto power of IVC syndicates. This hypothesis is tested in Model 3 and Model 5 (Table 6) for corporate-level strategic veto decisions hold solely by IVCs,

and in Model 8 and Model 10 (Table 7) for the same strategic veto decisions hold dominantly by IVCs. For business-level veto decisions, Hypothesis 2 is tested in Model 13 and Model 15 (Table 8) for IVCs-only scenario, and in Model 18 and Model 20 (Table 9) for IVCs-dominant scenario. Similar to the effect of knowledge overlap, the tables indicate a curvilinear relationship between CVCs' R&D capability and the two types of IVCs' strategic veto rights, highly consistent with my prediction (with most $p < 0.001$).

My final hypothesis suggested a curvilinear relationship between a venture's technological quality and IVCs' veto power. Veto rights over corporate-level strategic decisions are tested in Model 4 and Model 5 (Table 6) for IVC-solely right holders, and in Model 9 and Model 10 (Table 7) for CVC-included right holders. In addition, veto rights over business-level strategic decisions are examined in Model 14 and Model 15 (Table 8) for IVC-solely right holders, and in Model 19 and Model 20 (Table 9) for CVC-included right holders. According to the allocation of by these two kinds of strategic veto decisions, the results show that Hypothesis 3 is strongly supported in the IVCs-dominant scenario, but not in the IVCs-solely scenario.

Table 6. Estimation results of corporate-level strategic veto decisions made solely by IVCs investors (without CVCs) from multivariate analyses

Independent variable	(1)	(2)	(3)	(4)	(5)
Intercept	-0.495 (0.779)	0.991 (0.568)	0.029 (0.986)	1.351 (0.584)	1.882 (0.431)
Industry effect	-0.831 (0.194)	-0.902 (0.150)	-1.440* (0.029)	-0.835 (0.193)	-1.475** (0.021)
CEO duality	1.892** (0.011)	2.325** (0.003)	1.589** (0.033)	1.725** (0.023)	1.741** (0.029)
Late round	-0.363 (0.480)	-0.401 (0.445)	0.091 (0.866)	-0.340 (0.507)	0.030 (0.954)
Total IVC number	0.301* (0.087)	0.190 (0.302)	0.379** (0.031)	0.326* (0.064)	0.322* (0.080)
Market competition	0.606 (0.404)	0.704 (0.415)	0.521 (0.466)	0.712 (0.327)	0.846 (0.316)
Log [venture's prior alliance experiences]	0.241* (0.099)	0.231 (0.146)	0.219 (0.143)	0.214 (0.156)	0.228 (0.169)
CVC prior performance	-1.428** (0.660)	-0.922 (0.703)	-0.812 (0.857)	-1.562** (0.643)	-0.225 (0.701)
Number of CVC directors	0.323 (0.596)	0.468 (0.470)	0.503 (0.403)	0.391 (0.520)	0.826 (0.198)
CVC ownership	0.057 (0.314)	0.029 (0.594)	0.068 (0.225)	0.057 (0.318)	0.042 (0.434)
(CVC ownership)^2	0.000 (0.357)	0.000 (0.610)	-0.001 (0.303)	0.000 (0.411)	0.000 (0.526)
Multiple CVCs	-0.686 (0.248)	-0.589 (0.334)	-0.888 (0.131)	-0.705 (0.234)	-0.976 (0.109)
Technology overlap		-5.527* (0.051)			-5.940** (0.041)
(Technology overlap)^2		4.892 (0.122)			5.294* (0.099)
R&D capability of CVC parent			-0.222** (0.002)		-0.236*** (0.001)
(R&D capability of CVC parent)^2			0.005** (0.004)		0.005** (0.002)
Technological quality of venture				-1.546 (0.482)	-0.158 (0.941)
(Technological quality of venture)^2				0.244 (0.649)	-0.023 (0.965)
F Value	1.590*	2.080**	2.190**	1.650*	2.500***
Adj R-Sq	0.137	0.179	0.173	0.145	0.230

N=296. *p < 0.10; **p < 0.05; ***p < 0.001

Table 7. Estimation results of corporate-level strategic veto decisions made dominantly by IVCs from multivariate analyses

Independent variable	(6)	(7)	(8)	(9)	(10)
Intercept	2.492 (0.278)	2.916 (0.251)	2.912 (0.207)	10.087*** (0.001)	12.092*** (0.001)
Industry effect	-0.900 (0.279)	-1.055 (0.250)	-1.264 (0.147)	-0.577 (0.478)	-1.120 (0.223)
CEO duality	0.340 (0.724)	-0.462 (0.683)	0.054 (0.956)	0.821 (0.394)	-0.693 (0.544)
Late round	0.673 (0.314)	0.588 (0.444)	0.818 (0.252)	0.597 (0.359)	0.630 (0.415)
Total IVC number	-0.122 (0.592)	-0.119 (0.659)	-0.094 (0.685)	-0.069 (0.758)	0.060 (0.821)
Market competition	0.012 (0.989)	1.166 (0.356)	-0.025 (0.979)	0.168 (0.856)	1.234 (0.311)
Log [venture's prior alliance experiences]	0.021 (0.913)	-0.007 (0.974)	0.052 (0.793)	0.162 (0.398)	0.202 (0.398)
CVC prior performance	-1.238** (0.623)	-0.935 (0.703)	-0.871 (0.687)	-1.472** (0.643)	-0.234 (0.700)
Number of CVC directors	0.387 (0.625)	-0.017 (0.985)	0.530 (0.505)	0.451 (0.559)	0.480 (0.603)
CVC ownership	0.047 (0.522)	0.037 (0.637)	0.055 (0.452)	0.077 (0.286)	0.091 (0.242)
(CVC ownership)^2	0.000 (0.803)	0.000 (0.973)	0.000 (0.732)	0.000 (0.570)	0.000 (0.572)
Multiple CVCs	1.749** (0.024)	1.874** (0.036)	1.598** (0.040)	1.628** (0.031)	1.450* (0.099)
Technology overlap		-5.854 (0.158)			-5.367 (0.199)
(Technology overlap)^2		8.904* (0.055)			8.746* (0.060)
R&D capability of CVC parent			-0.143 (0.132)		-0.193* (0.052)
(R&D capability of CVC parent)^2			0.004* (0.096)		0.005** (0.034)
Technological quality of venture				-10.033*** (0.000)	-11.540*** (0.000)
(Technological quality of venture)^2				2.457*** (0.000)	2.769*** (0.000)
F Value	1.160*	1.420*	1.210*	2.100**	2.280***
Adj R-Sq	0.118	0.138	0.122	0.169	0.214

N=296. *p < 0.10; **p < 0.05; ***p < 0.001

Table 8. Estimation results of business-level strategic veto decisions made solely by IVCs investors (without CVCs) from multivariate analyses

Independent variable	(11)	(12)	(13)	(14)	(15)
Intercept	-2.489*	0.253	-1.971	-1.074	1.590
	(0.091)	(0.860)	(0.173)	(0.604)	(0.422)
Industry effect	0.374	0.254	-0.155	0.423	-0.194
	(0.483)	(0.623)	(0.776)	(0.431)	(0.711)
CEO duality	1.181*	2.088***	0.855	1.234***	1.638**
	(0.057)	(0.001)	(0.165)	(0.052)	(0.013)
Late round	0.083	0.246	0.401	0.075	0.529
	(0.845)	(0.570)	(0.370)	(0.862)	(0.233)
Total IVC number	0.374**	0.042	0.430**	0.385***	0.153
	(0.011)	(0.783)	(0.003)	(0.009)	(0.314)
Market competition	1.481**	1.353*	1.415**	1.518**	1.425**
	(0.015)	(0.059)	(0.017)	(0.013)	(0.042)
Log [venture's prior alliance experiences]	0.299**	0.214	0.307**	0.317**	0.263*
	(0.014)	(0.104)	(0.013)	(0.012)	(0.056)
CVC prior performance	-0.934*	-0.297	-0.435	-0.962*	0.309
	(0.521)	(0.553)	(0.530)	(0.523)	(0.555)
Number of CVC directors	0.171	-0.444	0.349	0.190	-0.137
	(0.736)	(0.408)	(0.484)	(0.709)	(0.796)
CVC ownership	0.044	0.005	0.055	0.049	0.024
	(0.347)	(0.907)	(0.236)	(0.304)	(0.588)
(CVC ownership)^2	0.000	0.000	0.000	0.000	0.000
	(0.526)	(0.907)	(0.427)	(0.492)	(0.669)
Multiple CVCs	-0.327	-0.056	-0.520	-0.348	-0.410
	(0.508)	(0.911)	(0.285)	(0.482)	(0.415)
Technology overlap		-4.190**			-4.875**
		(0.074)			(0.042)
(Technology overlap)^2		3.336			4.090
		(0.202)			(0.124)
R&D capability of CVC parent			0.199***		-0.200***
			(0.001)		(0.001)
(R&D capability of CVC parent)^2			0.005***		0.005***
			(0.001)		(0.001)
Technological quality of venture				-1.755	-1.164
				(0.341)	(0.516)
(Technological quality of venture)^2				0.413	0.271
				(0.359)	(0.532)
F Value	2.100**	1.830**	2.800***	1.820**	2.270***
Adj R-Sq	0.149	0.154	0.192	0.144	0.204

N=296. *p < 0.10; **p < 0.05; ***p < 0.001

Table 9. Estimation results of business-level strategic veto decisions made dominantly by IVCs from multivariate analyses

Independent variable	(16)	(17)	(18)	(19)	(20)
Intercept	0.835 (0.552)	1.679 (0.272)	1.281 (0.355)	3.928** (0.045)	5.752*** (0.006)
Industry effect	0.064 (0.899)	-0.365 (0.507)	-0.254 (0.627)	0.182 (0.720)	-0.559 (0.312)
CEO duality	0.195 (0.741)	0.306 (0.652)	-0.133 (0.821)	0.342 (0.568)	-0.172 (0.802)
Late round	0.451 (0.270)	0.452 (0.328)	0.488 (0.256)	0.427 (0.293)	0.376 (0.419)
Total IVC number	0.012 (0.933)	-0.076 (0.640)	0.024 (0.865)	0.035 (0.799)	0.012 (0.940)
Market competition	-0.548 (0.343)	-0.369 (0.627)	-0.570 (0.316)	-0.473 (0.411)	-0.415 (0.571)
Log [venture's prior alliance experiences]	0.057 (0.626)	-0.041 (0.767)	0.116 (0.329)	0.104 (0.385)	0.126 (0.380)
CVC prior performance	-0.832* (0.368)	-0.285 (0.467)	-0.465 (0.526)	-0.962* (0.577)	0.351 (0.580)
Number of CVC directors	0.361 (0.457)	-0.099 (0.861)	0.513 (0.285)	0.396 (0.411)	0.243 (0.662)
CVC ownership	-0.014 (0.760)	-0.023 (0.631)	-0.005 (0.909)	-0.003 (0.950)	0.007 (0.877)
$(\text{CVC ownership})^2$	0.000 (0.267)	0.001 (0.191)	0.000 (0.351)	0.000 (0.343)	0.000 (0.425)
Multiple CVCs	0.980** (0.038)	1.058** (0.049)	0.826* (0.077)	0.933** (0.047)	0.682 (0.197)
Technology overlap		-4.5187* (0.070)			-4.327* (0.086)
$(\text{Technology overlap})^2$		7.105** (0.011)			7.205*** (0.010)
R&D capability of CVC parent			-0.132** (0.020)		-0.130** (0.029)
$(\text{R\&D capability of CVC parent})^2$			0.004*** (0.004)		0.004*** (0.003)
Technological quality of venture				-3.934** (0.024)	-4.758** (0.012)
$(\text{Technological quality of venture})^2$				0.941** (0.027)	1.112** (0.015)
F Value	1.290*	1.870**	1.920**	1.520*	2.610***
Adj R-Sq	0.113	0.156	0.149	0.129	0.228

N=296. *p < 0.10; **p < 0.05; ***p < 0.001

The effect of multiple CVC syndicates

According to the results, having multiple CVCs in a financing round has none or a negative effect on IVCs' power over veto decisions that are solely made by IVCs, but has a significant positive effect on IVCs' power over veto decisions that CVCs are also involved in. In other words, the problem of conflict of interest may not be mitigated, but could rather be exacerbated by having multiple CVCs co-investing in a firm; CVC co-investors may not exercise mutual forbearance in possible opportunistic behaviors toward their portfolio companies. The lack of mutual forbearance may because benefits stemming from ventures' strategic decisions could be shared among multiple corporate investors. For instance, CVC co-investors may harmoniously support a venture to enter a business or to initiate an R&D project via alliances or other transactions, and then share the benefits of these actions, if successful.

2.6 Conclusions and Implications

Entrepreneurial firms face a problem when receiving corporate venture capital (CVC) funding. On the one hand, they may need to give some control rights to motivate corporate investors to contribute their expertise. On the other hand, the strategic goals of corporate investors are likely to raise conflicts of interest; giving CVCs control rights may put ventures under expropriation risk. A more suitable governance arrangement needs to be developed to address this trade-off.

This study demonstrates that the trade-off between safeguarding conflicts of interest and ceding control of entrepreneurial firms can turn into a principal (IVC)-principal (CVC) conflict, which could become particularly acute when cooperation involves asymmetric power relations, and the allocation of veto rights between principals can be a solution to both issues. Specifically, I found that there are different types of veto decisions – corporate-level strategy and business-level strategy. This study expands our understanding of how covenants serve as important

governance mechanisms in VC financing by showing additional functions of veto rights. Veto rights bear the role of mitigating not only principal-agency problems but also principal-principal problems. Technology-related factors should be major determinants of covenant design in a CVC setting.

This study also shows a way that entrepreneurial firms can cooperate with IVCs to curb CVCs' potential opportunistic behavior and/or misappropriations. Since the tension between safeguards and value generation can be found in various types of cooperation, a similar design may apply to different forms of alliances. In fact, covenants are also common in different types of alliance contracts. Additional effects of tension sources and entangled connections on covenant design need to be explored.

CHAPTER 3. CONTROL RIGHT ALLOCATION AND INNOVATION PERFORMANCE: A CONTINGENCY PERSPECTIVE

3.1 Introduction

Innovation is a fundamental source of value creation, and is considered as one of the most important topics in the field of entrepreneurship (e.g., Oksanen and Rilla, 2009; Belloc, 2012). Entrepreneurial firms often require external financial and technical support to overcome considerable challenges in the process of developing and commercializing innovation. As a result, corporate venture capitals (CVCs) that can provide resources specifically tailored to ventures' innovation activities (Kim and Mahoney, 2010; Park and Steensma, 2012) have become an important source of entrepreneurial financing (Dushnitsky, 2006; Gaba and Meyer, 2008). While CVCs are broadly believed to have a superior ability to foster innovation in their portfolio firms (e.g., Hellmann and Puri, 2002), entrepreneurial firms face a serious challenge of safeguarding against opportunism and potential misappropriation when receiving CVCs' assistance. How the tension between CVCs' value creation and ventures' value protection is managed significantly affects the degree to which an investee venture could benefit from its CVC investors (e.g., Maula et al., 2009).

The root causes of the tension between value creation and value capture in the CVC setting are conflicts of interest and the difficulty of allocating controls to balance benefits and risk. Most CVCs have strategic goals that can easily lead to misaligned interests between the corporate investors and their portfolio firms (Hellmann, 2002; Ivanov and Masulis, 2011; Park and Steensma, 2012), which could tempt CVCs to conduct opportunistic behavior in the innovation creation process (Zerbini and Castaldo, 2007; Bouncken and Kraus, 2013; Pellegrin-Boucher et al., 2013) and to misappropriate the venture's innovation in the value claiming stage

(Katila et al., 2008). These concerns over conflicts of interest cause a predicament for entrepreneurial firms to develop a formal framework to interact with CVCs: On one hand, ventures need to give CVCs sufficient control rights to motivate and enable them to provide their expertise and unique resources that are critical to innovation (e.g., Grossman and Hart, 1986; Kaplan and Strömberg, 2004; Cumming and Johan, 2007; Bolton and Faure-Grimaud, 2010). On the other hand, due to the potential for conflicts of interest, giving control rights to CVCs also increases their ability to steal or snatch the value of innovation from the ventures (e.g., Hellmann, 2002).

The tension between value creation and value capture is heightened when involving competing CVCs whose corporate parents and portfolio firms are operating in the same (or similar) product markets (Dushnitsky and Shaver, 2009). Compared with non-competing CVCs, competing CVCs could be even more beneficial to a venture's innovation performance as they can provide more accurate advice and more relevant resources. However, conflicts of interest are also more likely to occur between competing CVCs and their portfolio companies. As a result, control rights not only facilitate these competing CVCs to realize their superior nurturing abilities (e.g. Berglöf, 1994; Maula et al., 2009), but also enable them to appropriate the value of the ventures more easily (e.g., Chahine and Goergen, 2011). Whether a dominant competing CVC is a superior blessing or a disguised curse to ventures is hence unclear. Without remedies to ease the tension, markets for CVC investments may fail while entrepreneurial firms may decline valuable collaborative relationships with corporate investors (Dushnitsky and Lenox, 2005).

Designing formal governance mechanisms can be an effective way to moderate the tension in such co-opetition relationships (Bengtsson and Kock, 2000; Cassiman et al., 2009; Enberg. 2012). This approach is especially useful for relationships that aim to deliver innovation

(Steinicke et al. 2012). However, as literature on formal governance has traditionally treated competition and cooperation separately (M'Chirgui, 2005; Padula and Dagnino, 2007; Bouncken et al., 2015) and mainly focused on one at a time, our understanding about how to design formal governance mechanisms, especially contractual designed (Dagnino and Rocco, 2009), to solve the co-opetition tension is still limited (Enberg, 2012; Bouncken et al., 2015; Mariani, 2016). In particular, current safeguard suggestions such as partially depriving CVCs' control rights would unavoidably sacrifice CVCs' nurturing effect (e.g., Tiwana, 2008) and thus are difficult to implement by ventures that seek corporate investors' support to foster their innovation.

In this paper, I show that instead of indiscriminately limiting the control rights held by CVCs, entrepreneurial ventures can depend on allocating different types of control rights to CVCs. Specifically, active control rights like ownership and board representatives and passive control rights, such as veto rights, are both considered as common and important control tools used by venture capitals – VCs, including independent venture capitals (IVCs) and CVCs (Gomper and Lerner, 1996; Bengtsson, 2011). Active control rights allow the right holders to initiate plans and be actively involved in information- gathering and decision-making processes. Meanwhile, passive control rights enable the right holders to force their opinions on a group of pre-identified decisions, which are listed in a contract, with constraints on the form of opinions (i.e., to accept or veto a decision) and on the time they receive relevant information (i.e., veto-right holders may not be able to receive information about a decision until the decision is mature enough to undergo the veto evaluation process). Since allocating insufficient control rights to VCs can diminish their nurturing efforts, relinquishing passive control rights to competing CVCs may be a practical way for entrepreneurs to cooperate with powerful corporate investors. Inasmuch as passive control rights can be used as an alternative to active control rights in

motivating competing CVCs, the degree to which CVCs could facilitate innovation performance of their portfolio firms under different contingencies will depend on the design of control right allocation.

Therefore, in this study, I aim to advance the research on governance design and entrepreneurial innovation by examining different control rights and their ability to shape CVCs' nurturing effect on ventures' innovation. In particular, I aim to answer two research questions: First, how does the allocation of control rights in general affect CVCs' nurturing effect on the innovation of CVC-backed ventures? Second, how does the allocation of active and passive control rights, separately, affect CVCs' nurturing effect on innovation under different contingencies?

In addition to exploring the role of different control rights on entrepreneurial innovation, I complement previous perspectives with regard to entrepreneurial ventures' innovation in two more ways. First, recent research has emphasized the nurturing role of corporate investors on enhancing the innovation of entrepreneurial ventures (e.g., Chemmanur et al., 2014) but have not paid much attention to how governance arrangements affect CVCs' nurturing effort on firm innovation. Mystudy extends this stream of research by demonstrating that the allocation of control rights can significantly influence the innovation of CVC-backed firms under different contingencies. Furthermore, research on CVC investments has generally focused on the importance of safeguards against CVCs' potential opportunistic behavior by limiting CVCs' active control rights (e.g., Hellmann, 2002; Masulis and Nahata, 2009; Maula et al., 2009). I believe that withholding control rights from competing CVCs would diminish their nurturing effect. Granting passive control rights to competing CVCs can resolve the abovestated tension, thus enabling entrepreneurial ventures to participate in valuable collaborations with corporate

investors operating in the same market domain. Second, I contribute to the research on alliances via scrutinizing the relationship between entrepreneurial ventures and their corporate investors, which can eventually lead to other types of strategic relationships. This study particularly shows that concerns about CVCs' potential opportunistic behavior can be lessened by properly designing the allocation of control rights.

3.2 Theory and Hypotheses

Compared to IVCs, CVCs play a dominant role in nurturing the technological development of portfolio companies (Maula et al., 2005; Maula and Murray, 2011). CVCs are recognized for their ability to help their portfolio firms navigate through technical issues (Hellmann and Puri, 2002) and create innovation (Lantz et al., 2011). Compared to IVC-backed firms, CVC-backed firms generate more patents, which also receive more citations (Chemmanur et al., 2014).

Previous studies have proposed several reasons for CVCs' superior ability to nurturing innovation. Unlike other investors, CVCs tend to offer more support that is particularly fit to startups' innovation activities (Kim and Mahoney, 2010; Park and Steensma, 2012). Young ventures also recognize CVCs' capability to provide technical expertise, as well as research and development support, at lower costs (Lantz et al, 2011). The unique compensation and organizational structure of CVCs enables them to be more supportive of potentially risky innovative activities. With a relatively unrestrained capital supply and unlimited life span, CVCs generally have longer investment horizons than IVCs do, making CVCs a reliable source of support for time-consuming innovation activities in new ventures. Furthermore, the lack of high-powered performance-based compensation schemes enables CVCs to be more failure-tolerant than IVCs are (Manso, 2011) and thus more generous in providing young ventures additional time to overcome the temporary setbacks that arise in the innovation process.

3.2.1 Technology Relatedness and CVCs' Nurturing Effect

CVCs' nurturing effect on portfolio firms' innovation may be more prominent when the portfolio firms and the CVC corporate parents share high knowledge relatedness, which is defined as the degree of compatibility and similarity of knowledge between two organizations (Scholl, 1992, 2003). High knowledge relatedness suggests that an organization's existing knowledge base relates well to the new knowledge to be assimilated (Grant, 1996). The similarity between two organizations' knowledge bases, dominant logics, and organizational systems contributes to their ability to recognize, assimilate, and exploit external knowledge from one another (Lane and Lubatkin, 1998). Knowledge acquisition and assimilation between the portfolio firm and the corporate investor may be facilitated to the extent that the pair share some overlapping technological knowledge (Kale and Singh, 2007; Yli-Renko et al., 2001). Therefore, high technology relatedness helps the portfolio firm absorb industry and technology knowledge from its corporate investors that may prove to be valuable in the innovation process.

Technology relatedness between a CVC's portfolio firms and corporate parent also empowers said CVC to better understand the quality of the portfolio firms' R&D projects and subsequently provide custom-made technology and industry expertise that can stimulate innovation. In other words, high knowledge relatedness can enhance a CVC's ability to provide appropriate support and proper advice, which is particularly beneficial for young ventures' innovation. For example, in biotechnology firms, the drug discovery and development process is long and complex and requires firms to perform various tests over years to commercialize a drug. Overlooking a single detail or misevaluating just one step can prevent a project from continuing. For instance, a drug that could potentially treat Alzheimer's disease, Dimebon, failed to pass its Phase 3 trials primarily because of a lack of understanding about its fundamental molecular mechanisms (Nature Medicine, 2010). Therefore, seeking advice from professionals in relevant

fields during the creation process may significantly increase the innovation success of portfolio ventures. An experienced CVC can help ventures operating within its specialized field by offering relevant knowledge and experiences from its corporate parents. Sharing a knowledge domain with portfolio companies improves both the quality and the relevance of the CVC's contributions. As a result, I predict the following relationship between the technology relatedness and innovation performance of the portfolio ventures.

Hypothesis 1: A technology overlap between a CVC's corporate parent and the CVC's portfolio firms has a positive relationship with the innovation performance of the CVC-backed ventures.

3.2.2 Allocation of Control Rights and CVCs' Nurturing Effect

Realizing the superior nurturing effect of CVCs on innovation may depend on the allocation of control rights in the CVC-backed firms. As active investors, VCs, including IVCs and CVCs, typically have control rights independent from their cash flow rights (Gompers, 1997; Kaplan and Strömberg, 2003). The amount of control rights are held by CVCs influences both their ability and motivation to support portfolio firms' innovation activities.

Entrepreneurial firms need to allocate certain control rights to CVCs so that these corporate investors can contribute their expertise (e.g. Berglöf, 1994; Maula et al., 2009). In particular, control right allocation within a venture determines the ability of said venture's decision-makers to allocate resources to the innovation process (e.g., Lazonick and Prencipe, 2005). Furthermore, during the innovation process, holding sufficient control rights facilitates decision-makers to mitigate risks by reducing asymmetric information problems (e.g., Long and Malitz, 1985; Williamson, 1988; Lazonick, 2007). As a result, the amount of control rights held by decision-makers affect their ability to properly assess innovation projects and offer resources.

Allocation of control rights within the venture also influence these decision-makers' incentives to invest in the innovation process (e.g., Lazonick and Prencipe, 2005). Prior studies have found that the effort level of VC investors positively correlates with the magnitude of control rights held by the VCs, which are more likely to provide value-added services and advice (e.g., Kaplan and Strömberg, 2004; Cumming and Johan, 2007) as their control increases (Grossman and Hart, 1986; Cumming and Johan, 2007). In general, entrepreneurs agree to relinquish control in order to enhance VCs' effort level (Bolton and Faure-Grimaud, 2010). Since the degree to which a venture can acquire knowledge from its investors is primarily determined by the dyadic firms' willingness to share information (Nahapiet and Ghoshal, 1998), giving CVCs greater control rights will likely enhance their willingness to help and share knowledge and know-how that are valuable to ventures' innovation processes.

In line with the idea that control rights can boost investors' willingness and ability to contribute, empirical research has also found that CVCs' control rights positively affect the extent to which their portfolio companies learn from these CVCs (Maula et al., 2009). Therefore, I predict the following relationship between the control rights held by CVCs and CVCs' nurturing effect on portfolio firms' innovation.

Hypothesis 2: Giving CVCs more control rights positively affects the innovation performance of the CVCs' portfolio firms.

3.2.3 Allocation of Control Rights Dilemma

However, relinquishing control rights to CVCs may expose portfolio firms to risk. In contrast to IVCs, whose only investment goal is to pursue high financial returns, CVCs typically invest on behalf of their corporate parents and have a strategic goal to enhance their competitive advantage by bringing them new technologies or ideas (MacMillan et al., 2008). Said strategic goal can

easily create possible conflicts of interest between the CVCs and their portfolio firms (Ivanov and Masulis, 2011; Park and Steensma, 2012), particularly when the portfolio firms and CVCs' corporate parents are competing within the same market (Hellmann, 2002). As a result, competing CVCs may be motivated to use their corporate parents' profound technology and industry knowledge to exploit their portfolio firms, instead of nurture them (Chemmanur et al., 2014). Although relinquishing control rights to corporate investors will likely boost CVCs' nurturing effect, entrepreneurial firms must be wary about the amount of control rights held by CVCs (Hall, 2002), especially competing ones (Maula et al., 2009).

Control right allocation is commonly used to resolve any holdup problems resulting from differing objectives between entrepreneurs and VCs (Burchardt et al., 2016) and thus seems sensitive to the potential conflicts of interest perceived in the VC financing relationship (e.g., Bengtsson, 2011). The method with which allocation of control rights handles those potential conflicts critically determines whether the portfolio firms can actually benefit from CVCs' superior nurturing effect on innovation. As VCs generally hold different types of control rights in their portfolio companies, I discuss how the allocation of different types of control rights may affect CVCs' nurturing effect and the portfolio firms' subsequent innovation performance.

3.2.3.1 Active Control Rights and Passive Control Rights

In order to influence the strategic directions of their portfolio firms, VCs frequently possess control rights in the form of ownership, board rights, or veto rights (Burchardt et al., 2016). Ownership and board rights give VCs the ability to actively participate in portfolio firms' decision-making and can thus be considered active control rights, while veto rights only grant investors the power to prevent certain actions from being implemented by the firms but not initiate their own and thus are considered passive control rights (Cumming, 2012). That is,

although both active and passive control rights represent important types of VCs' control power (Gomper and Lerner, 1996; Bengtsson, 2011), users are more restricted with veto rights. This difference may make CVCs that hold one type of control rights more beneficial to its portfolio firm's innovation performance than CVCs that hold the other type of control rights with varying degrees of conflicts of interest.

With high market overlap, i.e., when a CVC's corporate parent and the CVC's portfolio firm compete in the same product market, passive control rights can stimulate and enable the CVC to contribute its expertise while safeguarding the portfolio firm against potential opportunistic behavior by imposing certain restrictions on the CVC's involvement. A competing CVC holding considerable control rights may force decisions that are in its own interests but damage the venture's interests (Chahine and Goergen, 2011). In contrast, veto rights, an important form of passive control rights of VCs (Barney et al., 1994; Gomper and Lerner, 1996; Bengtsson, 2011), allow the right holders to receive relevant information about veto decisions while restricting their influence on these decisions; therefore, the right holders are informed about and indirectly participate in critical issues within a firm. Compared to ceding control rights to CVCs in the board room or through ownership, granting corporate investors veto rights provides a safer way for entrepreneurial ventures to include CVCs in critical decisions while limiting the ways CVCs can respond (i.e., accept or veto) and preventing them from expanding their influence to issues beyond veto right coverage. When the degree of market overlap results in a high risk of conflicts of interest to a CVCs' portfolio firms, granting the competing CVC passive control rights may be better at allowing the portfolio firm to enjoy CVCs' superior nurturing on innovation.

With low market overlap, i.e., when a CVC's portfolio firms and its corporate parent operate in different product markets, active control rights create greater flexibility than passive control rights do with regard to the CVC contributing its industry and technology expertise. As a non-competing CVC is less likely to damage the interests of its portfolio firms while pursuing its strategic goals (Dushnitsky and Lexon, 2005; Hellmann, 2002), providing active control rights to the CVC enable it to intensify its influence and contribute its own resources and expertise to the development of its portfolio firms more effectively. Without the high risk of potential conflicts of interest caused by market overlap, CVCs with active control rights may be able to better nurture the portfolio firms' innovation than CVCs that hold passive control rights. Therefore, I predict the following relationships between control right allocation and CVCs' nurturing effect on portfolio firms' innovation with varying degrees of conflict of interest.

Hypothesis 3(a): With low product market overlap, i.e., low dilemma severity, granting CVCs strong active control rights positively moderates the effect of technological relatedness between a venture and its corporate investor on said venture's innovation performance.

Hypothesis 3(b): With high product market overlap, i.e., high dilemma severity, granting CVCs strong passive control rights positively moderates the effect of technological relatedness between a venture and its corporate investor on said venture's innovation performance.

3.3 Methods

3.3.1 Sample and Data

The database contains information on established firms' CVC activity collected from Venture Economics' VentureXpert database, financing contracts (certificates of incorporation) from

private equity data provider VCExperts, patenting activity from the Hall et al. (2001) dataset derived from the U.S. Patent Office, and alliance information from the Securities Data Company (SDC) Database on Alliances and Joint Ventures.

The contracts studied in this paper represent a subsample of the 1,139 contracts from CVC-backed high-tech U.S. companies between 1998 and 2010. First, in order to create the sample, I identified the population of CVC-backed high-tech U.S. companies through the SDC Thomson One dataset. Then I searched the population of these companies in the VCExperts database, accessing financing contracts (certificates of incorporation) that venture-backed firms are required to file with other legal filings. While cost considerations prevent this data set from including all CVC investments, it is still a large sample that represents key company and CVC characteristics.

I were able to identify all contracts from the initial stage when entrepreneurial firms first receive CVC financing from this larger sample. My final sample consists of contracts from 307 CVC-backed firms, all of which possess the covenant portion. The size of 307 contracts is similar to the sample sizes of recent venture capital studies, like Kaplan and Strömberg (2003) and Bengtsson (2011). Most contracts in my sample come from financing rounds conducted between 2002 and 2010.

3.3.2 Variables and Measurement

Dependent variables. In line with previous studies (Seru, 2014), I use a patent-based measurement to evaluate the innovation performance of CVCs' portfolio firms. Patent-based metrics can represent both observable and unobservable innovation performance by depicting not only actual innovation outputs but also the effectiveness with which a firm uses its innovation inputs (Chemmanur et al., 2001).

The number of patent applications filed within five years after a portfolio firm received its first CVC financing is used to measure the *innovation performance of the portfolio firm*. Data on entrepreneurial firms' patents are obtained from the NBER Patent Citation database (Hall et al., 2001). The results for patent applications filed within this time window are similar to the results for patent applications filed within either four years or six years.

Independent variables. My first hypothesis considered whether technology relatedness between a CVC's corporate parent and its portfolio firm can foster CVCs' nurturing effect on innovation. *Technology relatedness* between the investee company and the corporate investor is included as an independent variable because it can potentially raise not only the threat of corporate investors exploiting intangible assets and knowledge (Dushnitsky and Lenox, 2005; Katila et al., 2008) but also the benefits that the same investors can contribute. I used the angular measure (Jaffe, 1986) to determine the technology overlap.

In Hypothesis 2, I proposed that CVC control rights had positive effects on the innovation performance of portfolio firms. I consider both the active and passive control rights that can be held by CVCs. *CVC ownership,* a commonly used proxy for control power and the related influence of various shareholders (e.g., Lappalainen and Niskanen, 2012; Hoskisson et al., 2002), was used to represent a CVC's active control rights. CVC ownership measures the percentage of shares that a CVC holds during the financing round. With regard to the passive nature of veto rights (Cumming, 2012), I use CVCs' veto power to proxy CVCs' passive control rights. I measured veto power using *CVC veto power,* with a weight method to measure the variable. I provide a hypothetic scenario below to illustrate the rationale of weighting.

Veto rights over each veto decision can be held by investors in one round or by investors in multiple rounds who vote as a single class. Since I focused on initial rounds when ventures

first accepted CVC financings, at least one corporate investor was investing in the focal rounds, while no corporate investors can be found in prior round(s), i.e., any rounds before the focal round. Take a venture that has already raised two founding rounds (Series A and Series B) and is currently raising its Series C founding round as an example. No CVC was involved in Series A or Series B, but at least one CVC would participate in the Series C funding. This hypothetical firm's Series C founding contract may specify that action X shall not be taken without first obtaining the approval of the majority of Series A preferred stockholders (voting as a separate class), action Y shall not be taken without first obtaining the approval of the majority of all the preferred stockholders (i.e. stock A, B, and C holders voting as a single separate class), and action Z shall not be taken without first obtaining the approval of the majority of Series C preferred stock holders (i.e., focal round investors, voting as a separate class).

The group with the veto right will directly influence the relative veto power between the CVC and other investors. Compared to non-CVC investors, the CVC would have no veto rights over action X, since only prior round investors can be involved in this veto decision. The CVC has some veto power against decision Y by coming up with a veto decision with the other non-CVC investors from Series A, B, and C. However, the CVC would possess the greatest veto power on action Z, making the veto decision with fewer non-CVC investors and thus a less diluted voice. In this hypothetical scenario, one may notice that calculating a CVC's veto power only by counting the number of covenants would be inappropriate without considering which round(s) of investors has the veto. Therefore, to more accurately capture CVCs' veto power, the number of veto decisions specified in a contract is weighted as follows:

$$CVC\ veto\ power = \sum_{i=1}^{4} W_i D_i,$$

where D_i represents the number of veto decisions granted to group i investors to vote together as a separate class (i = 1, 2, 3, 4); i = 1 stands for focal round preferred stockholders; i = 2 stands for focal round and some prior round preferred stockholders; i = 3 stands for focal round and all the prior round preferred stockholders; and i = 4 stands for prior round preferred stockholders. W_1, W_2, W_3, and W_4 were set at 4, 3, 2, and 1, respectively, to reflect the CVC's veto power in each veto decision.

Control variables. I established a series of controls in this study with regard to attributes of the CVC financing round, CVC-backed entrepreneurial ventures, corporate investors, and entrepreneurial-CVC relationships that may influence the portfolio firm's innovation.

I controlled for the number of CVC directors, i.e., *CVC director*, in this study. While not many CVCs in my sample had board seat(s) in entrepreneurial ventures, especially for competing CVCs, I still control for the CVC's board representative because it has been commonly used to represent the related influence of various shareholders on venture behaviors (e.g., Lappalainen and Niskanen, 2012; Hoskisson et al., 2002).

CVC Patent stock (the sum of all patents applied for from 1963 to the investment year using the NBER version of U.S. Patent Office Data) was adopted as another control variable. Patents that represent the strength of a firm's internal R&D are often utilized to determine knowledge capital (Hall et al., 2001) and indicate the firm's ability to absorb external knowledge (e.g., Dushnitskya and Lenox, 2006). Among the CVC financing setting, the internal R&D strength of a CVC's corporate parent also signifies the size of the technology pool that the CVC can leverage and use to help its portfolio companies, which may affect their innovation performance.

CVC's prior performance, which I determined using the number of portfolio companies that went public prior to focal investments (Park and Steensma, 2012), was employed to control for the CVC's prestige power. CVCs with a good reputation are more likely to create more benefits for their portfolio firms than other CVCs (Lerner, 1994; Hsu, 2004). I decided to control for CVCs' reputation because it may increase their nurturing effect on innovation.

I further control for firm financing status by adding another variable – *venture age*. The age of a firm may influence its innovation performance because firm age is related, to a certain extent, to the level of resources and experience that the firm can apply to its innovation process (Huergo and Jaumandreu, 2004). I defined this variable as the number of years from the founding of the firm to the year of observation.

Patent stock (Dushnitsky and Lenox, 2006) was adopted to evaluate the technological quality of entrepreneurial firms. Meanwhile, I calculated *venture patent* as the sum of all patents applied for from 1963 to the investment year using the NBER version of U.S. Patent Office Data (Hall et al., 2001). Patents often function as quality signals to reduce informational imperfections (Haeussler et al., 2009) and provide a separate set of advantages in strategic factor markets (Barney, 1986, 1991). Therefore, patents can improve entrepreneurial firms' access or terms of trade (Hsu, 2013). I decided to use patent stock here, instead of the number of citations that the patent receives before the investment date, which can serve as a proxy for the patent quality of an entrepreneurial firm (Jaffe and Trajtenberg, 2002). I did this because the patents of young firms are more likely to have a relatively shorter period to be cited, and the citation number of patents in those firms may not differ significantly from firm to firm.

Log [venture's prior alliance experiences], which is the natural logarithm of a venture's pre-funding number of alliances, was adopted to control for alternative external resources that

the portfolio firm may obtain through alliances. I calculated this variable by counting the number of alliances in which a firm was involved prior to the investment date.

At the dial level, the *product market overlap between a CVC's corporate parent and the CVC's portfolio firm* represents the potential conflicts of interest between the corporate investor and the CVC-backed venture. The degree of market overlap is high if the venture and the CVC's corporate parent have the same SDC code. Otherwise, the degree of market overlap is considered low.

Furthermore, I control for the geographic distance between a CVC's corporate parent and its portfolio firm, which is measured as the natural logarithm of the great circle distance between the headquarters of the firms (i.e., *Geographic proximity*). The interactions and relationships among firms in a geographic cluster can facilitate innovation (e.g., Narula and Santangelo, 2009), so I controlled for whether or not the firms were located in a cluster.

3.3.3 Statistical Methods

Since the decision to receive CVC investments may not be exogenous, I control for the endogeneity problem by using an instrument variable approach (Hausman, 1978). In the first stage, I used a probit regression to estimate the likelihood of matching between a particular CVC and a particular venture. The results of this selection model are shown in Table 10. I use 'geographic availability of CVCs' as an instrument to address the endogeneity problem in the investment relationship between CVCs and the ventures. Geographical availability of investors has been used as an instrumental variable to solve the endogeneity problem in investment relationships under a variety of contexts (e.g., Berger et al., 2005; Hellmann et al., 2008; Ozmel and Guler, 2015). I used geographical availability of CVCs as an instrument also because it is correlated with the likelihood of matching between a particular CVC and a particular venture,

but not correlated with the innovation performance of the venture (Berger et al., 2005; Hellmann et al., 2008). The geographical availability of CVCs measured as the total number of CVCs investing in a particular venture's local geographic market in a given year. Following Sørensen (2007), the selection model includes all possible pairs (including realized and unrealized) between CVCs and high-tech U.S. companies between 1998 and 2010. A realized pair occurs in the financing round where a venture first received CVCs' investments. The dependent variable in the selection model takes on 1 for realized paris and takes on 0 for unrealized ones.

Table 10. First-stage selection model for the match between CVCs and the venture

	First-stage selection model
Intercept	23.11***
	(-2.05)
CVC director - 0/1	-1.03
	(0.10)
CVC's investment experience	0.00
	(-2.00)
Venture age	0.01
	(0.03)
CVC parent patents	0.00
	(-0.01)
Venture patents	0.00
	(-0.01)
Log[venture's prior alliance experiences]	0.01*
	(-0.01)
Geographic proximity	0.89
	(-1.01)
Instrumental variable (Number of IVCs in venture's local geographic market)	0.01*
	(0.00)

The results of the above selection model were used to calculate the inverse Mills ratio. The inverse Mills ratio was then included along with the other controls in the second stage to calculate ventures' innovation performance. Therefore, the coefficients in all the second-stage models (Table 12 to 14) show unbiased estimates of the treatment effect of the relative standing on the venture's innovation performance.

In the second stage models, I examined the negative binomial regression for all the realized pairs between the CVCs and the ventures. I adopted a negative binomial model because the variance of the dependent variable (*innovation performance of the portfolio firm*) exceeds its mean, which could result in over-dispersion problems in the Poisson regression and consequently bias the estimated standard errors downward (Haunschild and Beckman, 1998; Kogut and

Zander, 1992). Since I can overcome the over-dispersion problem and account for the omitted variable bias by adopting the negative binomial model, said model was used in the regression to test the aforementioned hypotheses.

3.4 Results

Table 11 shows the descriptive statistics and correlations of the variables used in my analyses. Approximately 33% of the entrepreneurial firms in my sample accepted financing from competing CVCs, while 67% only received funds from CVCs whose corporate parents operated in different markets. Regarding active control rights, CVCs possessed an average of 25% of total ownership in a single portfolio firm, with 21% of the corporate investors in my sample holding board seats in their portfolio firms. With regard to passive control rights, the average veto power held by CVCs was 2.28. CVCs with more investment experience and whose corporate parents hold more patents tend to obtain stronger veto power. In general, evidence of multicollinearity is not found in the estimated models as the variables are only modestly correlated, and the variance inflation factor (VIF) for the variables are all less than or equal to 2.20.

Table 11. Descriptive Statistics

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) CVC veto power	2.28	0.33	1.00												
(2) Venture age	4.57	0.49	-0.02	1.00											
(3) Geographic proximity	15.24	3.51	0.13	**0.49**	1.00										
(4) Market Overlap	0.33	0.34	0.06	-0.13	-0.05	1.00									
(5) Log[venture's prior alliance experiences]	-0.84	1.69	-0.22	-0.06	-0.09	-0.10	1.00								
(6) CVC's investment experience	0.38	0.48	0.06	0.07	0.05	0.08	-0.02	1.00							
(7) CVC director	0.21	0.41	0.06	-0.15	-0.22	0.05	0.02	0.11	1.00						
(8) CVC ownership	25.93	17.98	-0.10	-0.11	-0.40	-0.05	0.13	0.02	0.04	1.00					
(9) Technological relatedness	0.19	0.28	-0.10	0.03	-0.04	0.04	0.15	-0.10	-0.08	-0.02	1.00				
(10) CVC parent patents	7.00	9.95	**0.22**	**0.31**	**0.32**	0.00	-0.11	0.17	-0.04	-0.07	-0.07	1.00			
(11) Venture patents	2.11	0.81	-0.03	-0.03	-0.03	0.07	-0.01	0.02	0.07	0.06	0.13	0.11	1.00		
(12) Technology relatedness × CVC veto power	0.07	1.23	1.00	-0.02	-0.07	-0.00	0.02	-0.12	-0.10	0.04	0.18	-0.20	0.15	1.00	
(13) Technology relatedness × CVC ownership	7.25	5.93	0.02	1.00	-0.02	0.13	0.06	**-0.22**	0.06	0. 06	0.10	0.07	-0.10	0.22	1.00

N=355. $p<0.05$ in bold.

Table 12 shows the results of the second stage models, where I run negative binomial regression models to estimate the effect of control rights allocation on portfolio firms' innovation performance. In Table 12, Model 1 depicts the baseline specification of control variables, where I control for characteristics of ventures, CVCs, CVC parents, and the deal, along with the inverse Mills ratio. Models 2 to 4 improves on this model with the direct effects of the hypothesized variables, Models 5 and 6 add the two interaction terms in sequence, and Model 7 shows the complete model with all interactions estimated at once.

With Hypothesis 1, I propose that technology overlap between a CVC's corporate parent and portfolio firm has a positive relationship with the venture's innovation performance. The multivariate estimation results (Model 7) verify that a portfolio firm's innovation performance is greater when the technology relatedness between a CVC's corporate parent and its portfolio firms is high. Specifically, when everything is at its median, a one standard deviation increase in technology relatedness increases the likelihood of patent number increase by about 1 percent. Therefore, H1 is supported. In Hypothesis 2, I propose that giving CVCs more control rights positively impacts a venture's innovation performance. The multivariate estimation results show that the passive control rights (Model 3) held by CVCs are positively related to the portfolio firms' innovation performance; the same effect was not found for active control rights (Model 4). The influence of passive control rights (i.e., CVC veto power) is more significant than that of active control rights (i.e., CVC shareholding). The same results are observed in the full model (Model 7).

Table 12. Negative Binomial Regression Estimation Results for Pooled Sample

Variables	Model (1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	11.26*** (2.53)	12.18*** (2.08)	10.21*** (1.41)	10.08*** (2.73)	11.20*** (1.89)	7.25*** (2.06)	9.91*** (2.00)
Technology relatedness	—	0.49* (0.34)	—	—	1.08** (0.51)	0.96** (0.40)	1.16** (0.73)
CVC veto power	—	—	1.08* (1.09)	—	0.85 (0.60)	0.88 (0.17)	0.74† (0.83)
CVC shareholding	—	—	—	0.36 (0.22)	0.53 (0.16)	0.47† (0.20)	0.31 (0.13)
Technology relatedness × CVC veto power	—	—	—	—	1.64 (0.76)	—	1.42* (1.01)
Technology relatedness × CVC shareholding	—	—	—	—	—	0.19† (0.11)	1.26 (0.15)
CVC director - 0/1	0.08 (0.01)	0.06 (0.05)	0.04 (0.04)	0.07 (0.03)	0.10 (0.08)	0.09 (0.08)	0.09 (0.09)
CVC's investment experience	−2.32 (2.95)	−3.68 (5.10)	−1.32 (3.21)	−2.64 (3.09)	−1.38 (4.18)	−1.61 (3.46)	−1.11 (4.54)
Venture age	0.08 (0.12)	0.08 (0.11)	0.09 (0.11)	0.09 (0.08)	0.12 (0.21)	0.05 (0.19)	0.05 (0.07)
CVC parent patents	0.23* (0.17)	0.28 (0.19)	0.31* (0.31)	0.31 (0.27)	0.28 (0.22)	0.30* (0.11)	0.22† (0.12)
Venture patents	0.26* (0.13)	0.31** (0.19)	0.25** (0.12)	0.28** (0.11)	0.19** (0.09)	0.21** (0.12)	0.21** (0.19)
Log[venture's prior alliance experiences]	0.17† (0.11)	0.14 (0.10)	0.19 (0.15)	0.16 (0.11)	0.14 (0.11)	0.17 (0.09)	−0.14 (0.11)
Geographic proximity	1.10 (1.10)	2.13 (0.60)	1.94 (1.01)	2.09 (0.78)	1.98 (0.55)	1.92† (0.48)	1.95* (0.60)
Inverse mills ratio	-0.07* (-23.56)	-0.19* (-15.18)	-0.21 (-28.71)	-0.04 (-46.03)	-0.17 (-30.96)	-0.10 (-42.40)	-0.17† (-19.13)
F value	3.28**	2.41***	2.53**	3.02***	3.71**	3.48*	3.99**
Pseudo R^2	0.17	0.14	0.19	0.22	0.26	0.16	0.18

Note: N=355 (CVC-backed high-tech U.S. companies between 1998-2010).
*** p<0.001, ** p<0.01, * p<0.05, † p<0.1.

With Hypotheses 3, I propose that the effect of control right allocation on CVCs' nurturing effect depends on certain contingencies. In particular, Hypothesis 3(a) suggests that with low product market overlap, i.e., low dilemma severity, granting a CVC strong active control rights positively moderates the effect of the technological relatedness between a venture and corporate investor on the innovation performance of said venture, while Hypothesis 3(b) suggests that with high product market overlap, i.e., high dilemma severity, granting a CVC strong passive control rights positively moderates the effect of the technological relatedness between a venture and a corporate investor on said venture's innovation performance. To test the effect of control right allocation under contingencies, I divided the samples into two groups: one includes samples with high market overlap between a corporate investor and its portfolio venture; the other includes samples with low market overlap. The regression results for samples with high and low market overlap are shown in Table 13 and Table 14, respectively[1].

Comparing the full model (Model 5) in Table 13 and Table 15, the estimated coefficient of the relationship between the interaction term of technology relatedness and CVC veto power (i.e., Technology relatedness × CVC veto power) and the estimated coefficient of the portfolio firm's innovation performance are both positive and significant, indicating that CVCs' passive control rights further enhance the positive impact of technology relatedness on ventures' innovation performance under both conditions. However, when everything is at its median, a one standard deviation increase in CVCs' passive control rights increases the impact of technology relatedness on the likelihood of ventures' patent number increase by 1.62 percent under high market overlap (Model 5 in Table 13), but only increase by 1.26 percent under low market overlap (Model 5 in Table 14). Table 15 summaries that the 95% confidence interval of the

[1] Table 3 shows the pooled regression results, representing samples with both high and low market overlap.

estimated coefficient under high market overlap, 1.52 to 1.71, is significantly higher and not overlapping with the 95% confidence interval of the estimated coefficient under low market overlap, 1.16 to 1.35, indicating that CVCs' passive control rights allow for a stronger nurturing effect of CVCs on their portfolio firms' innovation with high market overlap. Therefore, Hypothesis 3(a) is supported.

Model 5 in Table 13 and Model 5 in Table 14 also show that the estimated coefficient of the interaction technology relatedness and CVC shareholding and the estimated coefficient of portfolio firms' innovation performance are both positive and significant, reflecting that CVCs' active control rights further enlarge the positive impact of technology relatedness on ventures' innovation performance under both conditions. Yet, when everything is at its median, a one standard deviation increase in CVCs' active control rights increases the impact of technology relatedness on the likelihood of ventures' patent number increase by 1.18 percent under high market overlap (Model 5 in Table 13), which is lower than the increase magnitude – 1.24 percent – under low market overlap (Model 5 in Table 14). Moreover, the 95% confidence interval of the interaction term with high market overlap are 1.17 to 1.19, while the 95% confidence interval of the interaction term with low market overlap are 1.02 to 1.22 (Table 15). The former confidence interval is non-overlapped and significantly lower than the latter confidence interval in the same model, indicating that CVCs' active control rights allow for a stronger nurturing effect of CVCs on their portfolio firms' innovation with low market overlap. The statistical result is thus consistent with Hypothesis 3(b).

Table 13. Binomial Regression Estimation Results (Under High Market Overlap)

Variables	Model				
	(1)	(2)	(3)	(4)	(5)
Intercept	7.68***	7.52***	9.12***	7.36***	8.17***
	(2.39)	(2.63)	(1.20)	(2.01)	(2.36)
Technology relatedness	—	0.51**	1.07**	0.98**	1.29***
		(0.33)	(0.53)	(0.41)	(0.55)
CVC veto power	0.80	1.11	1.04	1.19†	0.99*
	(0.91)	(0.68)	(0.75)	(1.31)	(1.90)
CVC shareholding	0.27	0.24*	0.33	0.28†	0.31*
	(0.26)	(0.20)	(0.79)	(0.16)	(0.12)
Technology relatedness × CVC veto power	—	—	1.57*	—	1.62**
			(0.59)		(0.51)
Technology relatedness × CVC shareholding	—	—	—	1.14**	1.18*
				(0.13)	(0.10)
CVC director - 0/1	0.10	0.11	0.12*	0.11	0.13
	(0.07)	(0.07)	(0.08)	(0.05)	(0.08)
CVC's investment experience	−3.54	−2.19	−2.15	−1.44	−1.26
	(4.01)	(4.04)	(3.28)	(4.08)	(4.51)
Venture age	0.10	0.09	0.10	0.06	0.04
	(0.09)	(0.12)	(0.12)	(0.11)	(0.08)
CVC parent patents	0.31**	0.31*	0.27†	0.30*	0.26
	(0.11)	(0.18)	(0.10)	(0.19)	(0.11)
Venture patents	0.28**	0.22**	0.19**	0.28**	0.24**
	(0.11)	(0.12)	(0.07)	(0.11)	(0.13)
Log[venture's prior alliance experiences]	0.18*	0.16	0.17	0.17	0.15
	(0.16)	(0.12)	(0.22)	(0.13)	(0.11)
Geographic proximity	2.01*	1.89*	1.67	1.90*	1.73**
	(0.59)	(1.11)	(1.10)	(1.21)	(0.38)
Inverse mills ratio	-2.28	-4.00	-6.19	-2.21	-3.17†
	(-18.34)	(-25.63)	(-29.95)	(-23.01)	(-10.98)
F value	2.15**	1.78**	1.85***	1.53**	2.03**
Pseudo R^2	0.14	0.13	0.14	0.15	0.16

Note: N=118 (CVC-backed high-tech U.S. companies between 1998-2010).
*** p<0.001, ** p<0.01, * p<0.05, † p<0.1.

Table 14. Negative Binomial Regression Estimation Results (Under Low Market Overlap)

Variables	Model				
	(1)	(2)	(3)	(4)	(5)
Intercept	10.01***	9.45***	8.54***	9.20***	6.38***
	(1.23)	(2.86)	(2.03)	(2.58)	(2.37)
Technology relatedness	—	0.82**	1.19***	0.69**	1.80***
		(0.25)	(0.41)	(0.29)	(0.65)
CVC veto power	0.66	0.68	0.79*	0.95*	0.84*
	(0.92)	(0.81)	(1.34)	(0.81)	(0.70)
CVC shareholding	0.14	0.16	0.14	0.14*	0.15*
	(0.15)	(0.20)	(0.39)	(0.11)	(0.10)
Technology relatedness × CVC veto power	—	—	1.13*	—	1.26*
			(0.65)		(0.77)
Technology relatedness × CVC shareholding	—	—	—	1.32*	1.24†
				(0.36)	(0.15)
CVC director - 0/1	0.60*	0.67	0.62	0.88	0.76
	(0.07)	(0.06)	(0.08)	(0.09)	(0.06)
CVC's investment experience	−3.44	−1.19	−0.05	−1.17	−1.09
	(4.90)	(3.94)	(4.18)	(4.53)	(4.44)
Venture age	0.10	0.1	0.11	0.07	0.06
	(0.10)	(-0.09)	(0.12)	(0.07)	(0.10)
CVC parent patents	0.23***	0.31**	0.24†	0.30*	0.23
	(0.10)	(0.17)	(0.13)	(0.10)	(0.09)
Venture patents	0.27***	0.24**	0.21***	0.19**	0.16**
	(0.15)	(0.26)	(0.07)	(0.05)	(0.14)
Log[venture's prior alliance experiences]	0.12	0.14	0.16	0.19	−0.14
	(0.10)	(0.11)	(0.07)	(0.07)	(0.12)
Geographic proximity	2.08*	1.95†	2.16	1.86*	1.92
	(0.31)	(0.42)	(0.43)	(0.58)	(0.67)
Inverse mills ratio	4.26	2.52	2.09	3.21	1.37
	(-27.00)	(14.89)	(-27.71)	(21.33)	(28.25)
F value	1.35*	1.49*	1.52*	1.67**	1.75**
Pseudo R^2	0.20	0.21	0.23	0.24	0.23

Note: N=237 (CVC-backed high-tech U.S. companies between 1998-2010).
*** p<0.001, ** p<0.01, * p<0.05, † p<0.1.

Table 15. Summary of Negative Binomial Regression Estimation Results Under Low and High Market Overlap

Variables and ratio	Estimated coefficient and ratio	
	High market overlap	Low market overlap
Technology relatedness × CVC veto power	1.62** (0.51)	1.26* (0.77)
Higher bound of 95% confidence interval	*1.71*	*1.35*
Lower bound of 95% confidence interval	*1.52*	*1.16*
Technology relatedness × CVC shareholding	1.18* (0.10)	1.24† (0.15)
Higher bound of 95% confidence interval	1.19	1.25
Lower bound of 95% confidence interval	1.17	1.22
The ratio of estimated coefficient	1.45	1.02

In addition to compare the confidence intervals of the same type of control rights between high- and low-market overlap groups, I also test whether the impact of passive control rights relative to active control rights differs across groups. I can do so by comparing the ratio of estimated coefficient across groups (Train, 1998: 237; Hoetker, 2007). The ratio of coefficients of passive- to active-control rights' interaction effect (i.e., βTechnology relatedness× CVC veto power /β Technology relatedness × CVC shareholding) is 1.45 under high market overlap (Model 5 in Table 4) and 1.02 under low market overlap (Table 6). Thus, the positive moderation effect of passive control rights is stronger under high market overlap condition than under low market overlap condition.

3.4.1 Endogeneity

As any attempt to establish a causal link between governance arrangements in entrepreneurial financing and the later-stage innovation performance of the entrepreneurial firm must deal with a variety of endogeneity concerns, I also acknowledge the limitations of my empirical analysis. In

particular, a link between past governance arrangement and post-investment innovation performance could reflect unobserved heterogeneity in a venture's or investors' characteristics that is correlated to both contract design and the innovation of the venture.

To control for the endogeneity issue, I first control for various factors both for the venture and corporate investors such as firm age, patent count, prior alliance, prior investment experience, venture's board structure, and geographic proximity, which might affect both the allocation of passive control rights and the innovation performance of the venture. Second, I conduct instrumental variable analyses, where I use the geographic availability of CVCs as an instrument. Investors' geographical availability has been widely used as an instrumental variable to address the endogeneity issue in investment relationships (e.g., Berger et al., 2005; Hellmann et al., 2008; Ozmel and Guler, 2015). Geographic availability of CVCs should affect the bargaining power of the corporate investor, which in turn affect the allocation of passive controls among investors, yet it is not a measure of the underlying quality of the venture , and hence should not directly affect innovation performance of the venture. I use a two stage OLS regression for the instrumental variable analysis.

3.5 Conclusion

Researchers in the field of entrepreneurship have attempted to analyze the effect of CVC investments on the innovation performance of CVCs' portfolio firms (e.g., Hellmann and Puri, 2002). Such researchers can be assigned to two groups: (1) Those who highlight the importance of the complementary assets that CVCs can offer have an optimistic tone with regard to CVC involvement (e.g., Grossman and Hart, 1986; Kaplan and Strömberg, 2004; Cumming and Johan, 2007; Bolton and Faure-Grimaud, 2010); and (2) those who emphasize the risk and opportunistic concerns of CVC investments understand the reluctance of entrepreneurs to cede control to

corporate investors (Hellmann, 2002; Ivanov and Masulis, 2011; Park and Steensma, 2012). The variety of research has indicated that how entrepreneurial firms manage their relationships with CVCs (e.g., Maula et al., 2009), especially how they divide control rights between corporate investors and other shareholders, is crucial to the extent to which they can benefit from CVC investments. Therefore, a more comprehensive governance design is necessary for tackling the dilemma of allocating control rights to CVCs. Based on previous studies focusing on passive control rights (e.g., Gomper and Lerner, 1996; Bengtsson, 2011), I have extended the existing research on entrepreneurial financing by specifying and considering the function of passive control rights on resolving the aforementioned dilemma.

By analyzing the data of 307 CVC-backed firms, I supported my first hypothesis. The technology overlap between a CVC's corporate parent and its portfolio firms has a positive relationship with the venture's innovation performance. Furthermore, in support for Hypothesis 2, I discovered that giving CVCs more control rights positively impacted the innovation performance of their portfolio ventures. In particular, I showed that astutely allocating active control rights and passive control rights can increase the benefits of CVCs' nurturing effect. More specifically, with low product market overlap, giving CVCs strong active control rights positively moderated the effect of technological relatedness between a venture and a corporate investor on said venture's innovation performance, while with high product market overlap, providing strong passive control rights to CVCs positively moderated the effect of technological relatedness between a venture and a corporate investor on said venture's innovation performance.

CHAPTER 4. HOW DO INCUMBENTS LEARN FROM CORPORATE VENTURE CAPITAL INVESTMENT? CONTROL RIGHT ALLOCATION AND INVESTING FIRM INNOVATION RATES

4.1 Introduction

Innovation is important to the sustainability of organizational performance (Roberts, 1999) and the survival of the firm (Cefis and Marsili, 2005). As firms are limited in their ability to create innovation purely via internal research activities (Hagedoorn, 1993; Cohen and Levinthal, 1990), they often build knowledge sharing relationships with external partners. Inter-firm relationships have also grown fast across countries and industries. As a result, their influence on innovation have attracted great academic attention (Schildt et al., 2005). As corporate venture capital (CVC) investments have gradually been viewed as a channel for incumbents to access to knowledge from innovative ventures (e.g., Keil et al., 2004; Dushnitsky and Lenox, 2005), I aim to examine the influence of CVC on innovation creation in this study.

Although research has begun to focus on the aggregate influence of interfirm relationships on an organization's innovation and other performance (Lavie, 2007; Ozcan and Eisenhardt, 2009; Sarkar et al., 2009; Shane, 2001), studies on the characteristics of portfolios and the moderating effects of control allocation have still been largely missing. The allocation of controls matters because control rights provide the main way through which corporate investors can learn from their portfolios, thus influencing how much investors can enhance innovation via their CVC investments. Despite this importance, research attention on this topic is limited.

In this study, I address this gap by examining whether and how the impact of knowledge overlap on corporate investors' innovation depends on the allocation of control rights within CVCs' portfolio firms. My baseline hypothesis is that the increase in technological knowledge

overlap is beneficial for corporate investors' innovation performance in initial levels, but eventually turning negative beyond moderate levels. I also argue that the magnitude of controls held by corporate investors over their portfolio ventures will negatively moderate the influence of knowledge overlap on CVC parents' innovation.

Since scholars commonly adopt dyadic-level approaches to examine how differences between partners influence firm innovation (Sampson, 2007), I used data on 238 dyadic-level relationships in high-technology industries during the period of 1998 to 2010 to test my hypotheses. My results show that, other things being equal, there is an optimum point beyond which the contribution of knowledge overlap to corporate investors' innovation declines. In addition, CVCs' high involvement in their portfolio ventures via holding greater control rights may be able to moderate this decline under high technological knowledge overlap. The moderating effect of active controls is stronger than that of passive controls.

This study has at least three theoretical contributions. First, it contributes to open innovation literature. How firms explore and utilize external knowledge to improve its innovation performance is an important topic of open innovation studies (West and Bogers, 2014). Although CVCs have been considered as a promising vehicle to learn from ventures (Dushnitsky, 2006) and to achieve open innovation (MacMillan et al., 2008), research on how CVCs impact their corporate parents' innovation is still at its beginning stage. In particular, knowledge creation from CVC investments has its limitation (Dushnitsky and Lenox, 2005), but less attention of open innovation literature has been on how the costs of external knowledge for organizations' innovation are moderated (West and Bogers, 2014) as well as on the potential moderating effects of the allocation of controls within CVC-backed ventures. This study thus

could shed some light on open innovation literature by examining whether and how the allocation of different types of control rights affect corporate investors' innovation.

Second, I extend the corporate entrepreneurship literature by empirically examining innovation performance from the perspective of the corporate investors and showing that the relationship between knowledge overlap between CVC parents and their portfolio ventures and knowledge creation is curvilinear. More importantly, unlike prior studies, which largely overlooks how the formal governance mechanism implemented in CVCs' portfolio ventures may moderate the knowledge-overlap's effect on firm performance, I found the influence of knowledge overlap on innovation depends on the type and magnitude of control rights held by CVCs.

Third, this study also contributes to research on firm innovation and interorganizational learning by showing how the allocation of active control rights (e.g., ownership) and passive control rights (e.g., veto rights) moderates the influence of knowledge overlap on firm innovation. Prior research has not examined either of these moderating effects.

This study also aims to provide practical insights to CVC investors. My results might inform corporate investors about the factors that can help maximize their strategic returns from CVC investments under different conditions.

4.2 Theory and Hypotheses

Innovation is an important tool for established firms to sustain competitive advantage in markets (Schumpeter, 1942; Arrow, 1962). However, internal forces of incumbents have gradually become insufficient to support continuous innovations in a dynamic world (Tushman and Anderson, 1986; Henderson, 1993). Exploring knowledge outside of the firm boundary for innovation has been a recommended practice from numerous studies (e.g., Dyer and Nobeoka,

2000). Among external exploration tools, corporate venture capital (CVC) has been suggested by both scholars and industry expertise as a valuable method to access to external knowledge (Gompers and Lerner, 1998; Dushnitsky and Lenox, 2005) and has been adopted by an increasing number of incumbents (Chesbrough, 2002).

CVC is a useful vehicle for incumbents to gain a window onto technologies in a wide range of ventures (Siegel et al., 1988; Chesbrough and Tucci, 2002) and to stimulate internal innovation activities. Accessing to new technologies can benefit the incumbents regardless of whether the venture's technology developing process eventually leads to a lucrative result. Specifically, corporate investors can gain insights for future business and technology trends from successful projects (Chesbrough, 2002) and can gain warning about possible pitfalls in the technology domain from failed projects (McGrath, 1999; Chesbrough, 2002).

Although many studies have proved the importance of technological knowledge for innovation creation (Cohen and Levinthal, 1990; Petersen et al., 2005; Schoenmakers and Duysters, 2006), the effect of technological knowledge overlap on innovation performance has received limited scholarly attention in the CVC context. Unlike knowledge in general, technological knowledge focuses on scientific, applied, and experimental know-how, and is essential for product and process innovation (Liyanage and Barnard, 2003; Sammarra and Biggiero, 2008). Technological knowledge overlap measures how similar and compatible the technological knowledge of individuals or organizations is (Scholl, 1992, 2003).

4.2.1 Technological knowledge overlap and CVC's learning effect

Technological knowledge overlap may have a mixed effect on the innovation performance of CVC parents. A moderate technological knowledge overlap may contribute to an increased innovation of CVC parents through two mechanisms. First, CVC investments expand the

corporate parents' knowledge base from which the parent firms may generate innovation. When investing in ventures with different technological knowledge, incumbents increase not only the amount but also the variety of knowledge flows into themselves. To the extent that innovation requires integration of diverse knowledge (Arrow, 1974) and new combinations of existing knowledge (Cohen and Levinthal, 1990), proliferating the variety of knowledge base by obtaining different knowledge enhances the possibility of new combination. Distance technological knowledge may also stimulate firms to address problems with novel approaches (Ahuja and Katila, 2001). Therefore, a moderate knowledge overlap in the set of portfolio ventures grows incumbent's knowledge stock, leading to more potential knowledge configurations (Kogut and Zander, 1992) and advancing the likelihood that the established firms would create breakthrough innovations.

Second, accessing to different technological knowledge may improve absorptive capacity (Cohen and Levinthal, 1990) of CVC parents. Learning new technologies and observing the technology development process give investing incumbents market attractiveness of relevant technologies as well as technological insights, through which the incumbents can better evaluate the success rate of innovation in the potential technical fields. The finely-horned sense of identifying and evaluating valuable technological resources in turn helps assimilation of additional external knowledge (Ahuja and Katila, 2001), creating a virtuous spiral to learn from future CVC investments.

The exploration of external technological knowledge, however, is likely featured by negative marginal returns with too high or too low knowledge overlap. With low knowledge overlap (i.e., when knowledge distance beyond a certain point), CVC parents may face a tightening absorptive ability. Prior studies on absorptive ability suggest that common knowledge

is essential for firms to grate new knowledge into their knowledge base (Lane and Lubatkin, 1998; Mowery et al., 1998; Inkpen, 2000). In other words, to be beneficial to innovation of CVC parents, the technological knowledge of CVC portfolio ventures needs to relate to the CVC parents existing technological knowledge. In addition, limitation of CVC managers' cognitive capabilities may also contribute to the negative marginal returns of distanced technological knowledge beyond a certain point. The large amount of information about potentially promising investment ventures and the novel technologies being developed in these ventures can be overwhelming for CVC managers. The unfamiliar of technologies in the potential targeting firms can further exacerbate the burden of corporate venture capitalists. Since information overload constrains a firm's ability to effectively manage portfolio ventures (Keil et al., 2004), limited cognitive capabilities can hinder CVC parents' learning process after a certain point.

On the other extreme, CVC parents may face a challenge of co-opetition when tending to learn from ventures that compete in the same technology domain (i.e., when there is no knowledge distance). Sharing overlapping technological knowledge may facilitate knowledge acquisition and assimilation between the portfolio firm and the corporate investor (Kale and Singh, 2007; Yli-Renko et al., 2001). Nonetheless, high level of technological knowledge overlap can increase the threat of knowledge leakage (Dushnitsky and Lenox, 2005; Katila et al., 2008). The concerns of knowledge leakage and CVC's relevant opportunistic behaviors make ventures more apt to hesitate including competing CVCs in critical decision making processes and knowledge transferring activities (e.g., Hellmann, 2002; Dushnitsky and Lenox, 2005; Masulis and Nahata, 2009).

As empirical studies on alliance commonly conclude an inverted U-shaped relationship between technological knowledge overlap and innovation performance (Grant, 1996; Ahuja and

Katila, 2001; Laursen and Salter, 2006; Cowan and Jonard, 2009), I suggest a similar trend can be found in the CVC financing context and therefore hypothesize:

Hypothesis 1: The degree of technological knowledge overlap between a CVC parent and portfolio firms has an inverted U-shaped relationship to innovation performance of the CVC parent.

4.2.2 Moderating effect of control right allocation

The effect of technological knowledge overlap on the investing incumbent's innovation performance could also be determined by the allocation of control rights in CVC-backed ventures. Control rights define the level of involvement in decision makings in the portfolio venture and the level of interactions with the venture (e.g. Wadwa and Kotha, 2006). As active investors, venture capitals (VCs), including CVCs, typically possess control rights independent from their cash flow rights (Kaplan and Strömberg, 2003). Since technological knowledge overlap has a curvilinear relationship with CVC parents' innovation performance, the moderating effect may vary in different stages of the relationship.

I argue that when CVC parents and ventures share expertise in a similar technology domain, where knowledge overlap is positively related to CVC parents' innovation performance, control rights are likely to enhance learning and exert positive moderating influence. Control rights such as securing board seats or board observation, and utilizing dedicated liaisons are the main mechanisms that corporations learn from their portfolio ventures (Dushnitsky and Lenox, 2005). To the extent that successful learning depends on close interaction between personnel in organizations (Daft and Lengel, 1986), control right matters because it enables CVC managers to directly interact with R&D personnel or top managers in the ventures, and hence to transfer back useful information about the venture's key activities and technologies to the CVC's corporate

parent. Moreover, holding control rights helps CVC to build knowledge sharing routines with the venture. Knowledge-sharing routines are defined as repeated activities for multiple and intensive interactions between parties (De Clercq and Sapienza, 2001), which enables the transfer of complex information (Lind and Zmud, 1995) and enhances interorganizational knowledge creation (Cohen and Levinthal, 1990; Dyer and Singh, 1998; Grant, 1996). As accessing to new technologies and knowledge are the most common purpose of CVC investments (Wadhwa and Kotha, 2006), holding great control rights allows CVCs to effectively build formal knowledge-sharing channels with the venture to facilitate the knowledge transfer process. Furthermore, since communication frequency and intensity determine the quality of knowledge-sharing routines (De Clercq and Sapienza, 2001), holding great control right also legitimate CVCs to communicate frequently to improve the quality of knowledge-sharing in various ways. Consistent with this argument, CVC managers holding great control rights are also found helpful for developing learning relations that benefit both entrepreneurial firms and the corporate investors (Basu et al., 2011). As a result, CVCs' control rights are likely to further enhance the positive effect of technological knowledge overlap when a CVC's parent and portfolio have similar knowledge domain.

When CVC parents and ventures have quite different technical expertise, however, control rights held by CVCs may instead hinder the positive relationship between knowledge overlap and CVC parents' innovation performance. It is because CVCs typically target young and privately held companies (Gompers and Lerner, 1998) whose intangible assets are difficult to evaluate (Coff, 1999), particularly in contexts where CVCs' and ventures' knowledge bases are distant from each other. Given the difficulty of evaluating the quality of technologically distant ventures, making high initial commitments – such as holding great controls of portfolio

firms (Wadhwa and Basu, 2013) – to technologically distant ventures may thus be harmful to the corporate investors' innovation performance for two reasons. First, high-level of controls can lead to corporate investors' overconfidence on their portfolio ventures' quality and/or technologies (e.g., Benson and Ziedonis, 2010), which could cause the technology-distant CVCs to pursue follow-up investments more arbitrarily. It can also cause these CVCs to neglect potential strategic cautions of the ventures. For example, "owner's curse" is one consequence of CVCs' overconfidence on their portfolio ventures (Benson and Ziedonis, 2010), where existing shareholders are likely to overbid with the aim of inducing higher bids from others (Burkart, 1995). Since finding potential acquisition targets and exploring to new technologies are the main goals of many corporate investors (Benson and Ziedonis, 2009), a CVC's overconfidence on technology-distant ventures may be even more harmful because the follow-up investments such as acquisition and new internal projects inspired by CVC investments can be expensive and have prolong influence on the investing corporates. Moreover, holding great controls over knowledge distant ventures is likely to consume more cognitive capacities of corporate investors than holding the same level of controls over technologically similar ventures. Cognitive occupation may adversely affect the corporate venture capitalists' ability to evaluate other investment cases and to manage other portfolio ventures. The disadvantages of making high initial commitments to technologically distant ventures may hence outweigh the advantages of earning controls over these ventures.

According to the above arguments, I suggest the following moderating effect of control rights:

Hypothesis 2: CVCs' control rights will moderate the inverted U-shaped relationship between knowledge overlap and the innovation performance of the

corporate parents such that the positive effect of knowledge overlap on CVC parents' innovation at lower levels of knowledge similarity will be less positive, and the negative effect of knowledge overlap on CVC parents' innovation at higher levels of knowledge similarity will be less negative, for CVCs with greater control power over their portfolio ventures.

4.2.2.1 Effects of Active Control Rights and Passive Control Rights

Although I suggest that control rights generally have a negative moderating effect on CVC parents' innovation under high degree of technological knowledge overlap, the magnitude of moderating effect may vary between active and passive controls. Active control rights include board seats and ownership, while negative control rights refer to veto rights commonly held by venture capitalists (Barney, 1994; Gomper and Lerner, 1996; Bengtsson, 2011). Veto rights empower the right holders to prevent certain actions from being implemented by the board of directors or top management team. In general, active control rights grant the right holders stronger power on strategic decisions of a venture than passive control rights do. The difference mainly stems from the limitation on exercising passive control rights. Specifically veto right holders can only receive relevant information about veto decisions and block those decisions, but cannot initiate any other actions (Cumming, 2012). The limitation may restrict CVCs' ability to influence the R&D direction in CVCs' portfolio ventures and build knowledge sharing routine with the ventures. On the other hand, the allocation of active control rights is found to be determinative of decision-makers' ability to deploy resources to innovation activities (e.g., Lazonick and Prencipe, 2005). A CVC holding great control right can direct its portfolio firms to purse project that are well-aligned with goals of its corporate parent; that is, to make portfolio

firms more valuable to the investing incumbent. CVCs with strong active control rights over their portfolio firms. Participating in board meetings is also an important mechanism that corporate investors learn from their portfolio firms. As a result, the moderating effects of active control rights may be stronger than the moderating effects of passive control rights.

However, Entrepreneurial ventures may expose themselves to a risk when relinquishing control right to technologically competing CVCs. Unlike most of other investors whose main investment goal is to pursue high financial returns, CVCs typically invest on behalf of their corporate parents and have a strategic goal to enhance the competitive advantage of their parents by bringing new technologies or ideas (MacMillan et al., 2008). The strategic goal can easily give rise to possible conflicts of interest between the CVC and its portfolio firm (Ivanov and Masulis, 2011; Park and Steensma, 2012), especially when the portfolio firm and CVC's corporate parent are competing in the same field (Hellmann, 2002). For entrepreneurial ventures that share high technological knowledge overlap with CVC corporate parent, the competing CVC who hold considerable active control rights may push through decisions that are in their own interests but are detrimental to the venture and its other shareholders (Chahine and Goergen, 2011). Therefore, entrepreneurial ventures may worry about CVCs' opportunistic behaviors (e.g., Dushnitsky and Shaver, 2009) and restrain competing CVCs' control power (Hall, 2002; Maula et al., 2009).

To solve the effects of ventures' concerns about a CVCs' opportunistic behaviors, the CVC may ask for different types of control rights to facilitate its learning process from a technologically closed venture. Specifically, VCs commonly possess control rights in the form of ownership, board rights, and/or veto rights to influence the strategic direction of the portfolio firm (Burchardt et al., 2016). Ownership and board rights enable VCs to actively participate in

decision makings of portfolio firms and can be considered as active control rights, while veto right grants investors the power to prevent, rather than initiate, certain actions from being implemented by the board of directors or top management team and hence can be considered as passive control right (Cumming, 2012). Both active and passive control rights represent important forms of VCs' control power (Gomper and Lerner, 1996; Bengtsson, 2011), but veto right adds more restrictions to the right holder. This difference may lead to unequal moderating effects of active and passive control right under different circumstances. For entrepreneur's perspective, compared to ceding control rights to CVCs in board room or ownership, granting corporate investors veto right provides a safer way for entrepreneurial ventures to include CVCs in critical decisions, while limit the way CVCs can respond (i.e., accept or veto) and prevent CVCs from expanding their influences to issues beyond veto right coverage. For the investing incumbent's perspective, veto right still allows the investor to be informed and participate in critical issues in the venture less directly. When competition causes a high threat of conflicts of interest to a CVCs' portfolio firms, holding passive control right may be a better way for the competing CVC to maintain the information flow and interactions with the portfolio venture. I hence propose the following hypothesis:

Hypothesis 3(a): The moderating effect of active control right is stronger than the moderating effect of passive control right under high degree of technological knowledge overlap between a CVC parent and the CVC's portfolio ventures.

Hypothesis 3(b): The moderating effect of passive control rights is stronger than the moderating effect of active control right under high degree of

technological knowledge overlap between a CVC parent and the CVC's portfolio ventures.

4.3 Method

4.3.1 Data and sample

The database contains information on established firms' CVC activity collected from Venture Economics' VentureXpert database, financing contracts (certificates of incorporation) from private equity data provider VCExperts, patenting activity from the Hall et al. (2001) dataset derived from the U.S. Patent Office, and alliance information from the Securities Data Company (SDC) Database on Alliances and Joint Ventures.

The contracts studied in this paper represent a subsample of the 1,139 contracts from CVC-backed high-tech U.S. companies between 1998 and 2013. To construct my sample, I first identified the population of CVC-backed high-tech U.S. companies through the SDC Thomson One dataset. I then searched the population of these companies in the VCExperts database, accessing financing contracts (certificates of incorporation) that venture-backed firms are required to file with other legal filings. Despite that this study does not include all the CVC participating rounds due to cost consideration, it does represent typical CVC investing rounds.

I identified contracts in rounds where entrepreneurial firms first receive CVC financings. My final sample includes contracts from 238 CVC-backed firms, and all of the contracts possess the covenant portion. The sample size in this study is comparable to the sample sizes in other entrepreneurial financing studies (e.g., Bengtsson, 2011). Most contracts in my sample are from financing rounds conducted between 2002 and 2010.

Since I focus on first-round contracts of CVC financing, corporate investors only exist in the focal rounds in my sample, and all the "prior investors" in my sample are composed of only

IVCs. Because each financing round issues a new class of preferred stock with a unique list of covenants, I am able to exclusively examine how IVC syndicates may use covenant design to respond to the concerns of opportunism and misappropriation caused by new CVCs.

In order to examine the argument that covenants can be used to mitigate concerns about CVCs' potential opportunistic behavior and misappropriation hazards, I exclusively focused on contracts from funding rounds during which entrepreneurial firms first received CVC investments and identified all the decisions covered by covenants in those contracts.

4.3.2 Variables and Measurement

Dependent variables. Empirical studies have used many ways to measure innovation performance of the firm (Hagedoorn and Cloodt, 2003). Among them, patents (Griliches, 1990) are perhaps the most highly used measurement. In line with previous studies (Seru, 2014), I use a patent-based measurement to evaluate the innovation performance of CVCs' corporate parents. Patent-based metrics can represent both observable and unobservable innovation performance by depicting not only actual innovation outputs but also the effectiveness with which a firm uses its innovation inputs (Chemmanur et al., 2001).

The number of patent applications filed within five years after a CVC invested in a portfolio venture is used to measure the *innovation performance of the CVC's corporate parent*. Data on CVC parents' patents are obtained from the NBER Patent Citation database (Hall et al., 2001). The results are similar to dependent variables with either four year or six year time windows.

Independent variables. My first hypothesis considered whether technological knowledge overlap between a CVC's corporate parent and its portfolio firm could foster the corporate investor's innovation performance. *Technological knowledge overlap* between the investee

company and the corporate investor is included as an independent variable because it can affect the absorptive capability (Cohen and Levinthal, 1990) and learning between cooperating partners (e.g., Ahuja and Katila, 2001; Kogut and Zander, 1992). I used the angular measure (Jaffe, 1986) to determine the technology overlap.

In Hypothesis 2, I proposed that CVC control rights have negative moderating effects on the relationship between knowledge overlap and corporate investors' innovation performance. I consider both the active and passive control rights that can be held by CVCs. *CVC ownership,* a commonly used proxy for control power and the related influence of various shareholders (e.g., Lappalainen and Niskanen, 2012; Hoskisson et al., 2002)*,* was used to represent a CVC's active control rights. CVC ownership measures the percentage of shares that a CVC holds during the financing round. With regard to the passive nature of veto rights (Cumming, 2012), I use CVCs' veto power to proxy CVCs' passive control rights. I measured veto power using *CVC veto power,* with a weight method to measure the variable. I provide a hypothetic scenario below to illustrate the rationale of weighting. Since I need to compare the coefficients between the moderating effects of active and passive control rights to test Hypothesis 3, I further standardize the two measurements. That is, for each of the measurement, I first subtracted them by the mean, and then divided them by the standard deviation.

Veto rights over each veto decision can be held by investors in one round or by investors in multiple rounds who vote as a single class. Since I focused on initial rounds when ventures first accepted CVC financings, at least one corporate investor was investing in the focal rounds, while no corporate investors can be found in prior round(s), i.e., any rounds before the focal round. Take a venture that has already raised two founding rounds (Series A and Series B) and is currently raising its Series C founding round as an example. No CVC was involved in Series A

or Series B, but at least one CVC would participate in the Series C funding. This hypothetical firm's Series C founding contract may specify that action X shall not be taken without first obtaining the approval of the majority of Series A preferred stockholders (voting as a separate class), action Y shall not be taken without first obtaining the approval of the majority of all the preferred stockholders (i.e. stock A, B, and C holders voting as a single separate class), and action Z shall not be taken without first obtaining the approval of the majority of Series C preferred stock holders (i.e., focal round investors, voting as a separate class).

The group with the veto right will directly influence the relative veto power between the CVC and other investors. Compared to non-CVC investors, the CVC would have no veto rights over action X, since only prior round investors can be involved in this veto decision. The CVC has some veto power against decision Y by coming up with a veto decision with the other non-CVC investors from Series A, B, and C. However, the CVC would possess the greatest veto power on action Z, making the veto decision with fewer non-CVC investors and thus a less diluted voice. In this hypothetical scenario, one may notice that calculating a CVC's veto power only by counting the number of covenants would be inappropriate without considering which round(s) of investors has the veto. Therefore, to more accurately capture CVCs' veto power, the number of veto decisions specified in a contract is weighted as follows:

$$CVC\ veto\ power = \sum_{i=1}^{4} W_i D_i$$

where D_i represents the number of veto decisions granted to group i investors to vote together as a separate class (i = 1, 2, 3, 4); i = 1 stands for focal round preferred stockholders; i = 2 stands for focal round and some prior round preferred stockholders; i = 3 stands for focal round and all the prior round preferred stockholders; and i = 4 stands for prior round preferred stockholders.

W_1, W_2, W_3, and W_4 were set at 4, 3, 2, and 1, respectively, to reflect the CVC's veto power in each veto decision.

Control variables. I established a series of controls in this study with regard to factors that could influence corporate investors' innovation.

CVC Patent stock (the sum of all patents applied for from 1963 to the investment year using the NBER version of U.S. Patent Office Data) was adopted as another control variable. Patents that represent the strength of a firm's internal R&D are often utilized to determine knowledge capital (Hall et al., 2001) and indicate the firm's ability to absorb external knowledge (e.g., Dushnitskya and Lenox, 2006). Among the CVC financing setting, the internal R&D strength of a CVC's corporate parent also signifies the size of the technology pool that the CVC can leverage and use to help its portfolio companies, which may affect their innovation performance.

CVC's prior performance, which I determined using the number of portfolio companies that went public prior to focal investments (Park and Steensma, 2012), was employed to control for the CVC's prestige power. CVCs with stronger reputation are more likely to gain more power over for their portfolio firms (Hsu, 2004). I decided to control for CVCs' reputation because it could help the corporate investors to gain more information and knowledge from their corporate investments.

I further control for firm financing status by adding another variable – *Investor age*. The age of a firm may influence its innovation performance because firm age is related, to a certain extent, to the level of resources and experience that the firm can apply to its innovation process (Huergo and Jaumandreu, 2004). I defined this variable as the number of years from the founding of the firm to the year of observation.

Log [investor's prior JV& alliance experiences], which is the natural logarithm of a CVC parent's number of JV and alliances before the focal investment, was adopted to control for alternative external resources that the corporate investor may obtain through alliances. I calculated this variable by counting the number of alliances in which a firm was involved prior to the investment date.

I also control for firm size and R&D expenditure of CVCs' corporate parents, by including the natural logarithm of annual firm R&D expenditures in millions of dollars, *ln(Research)*, and the natural logarithm of firm size measured as total firm assets in millions of dollars, *ln(Assets)*, in the regression model. Larger companies having more resources to devote to R&D are expected to generate more patents (Cohen and Levinthal, 1990). The internal R&D expenditures are also likely to increase patenting number (Henderson and Cockburn, 1996).

To control for differences across industries, I use the *Industry Citations* to address the technological opportunities in each industry. Following Dushnitsky and Lenox (2005), the variable is measured by the average number of citation-weighted patents from companies in a given standard industrial classification applying in a given year .

4.3.3 Statistical method

In the statistic models, I examined the negative binomial regression for all the realized pairs between the CVCs and the ventures. I adopted a negative binomial model because the variance of the dependent variable exceeds its mean, which could cause the problem of over-dispersion in the Poisson regression. Since the negative binomial model can overcome the over-dispersion problem and account for the omitted variable bias, it was used in regression to test the above hypotheses.

4.4 Results

Table 16 displays the descriptive statistics and correlations. Firm size, R&D expenditure, and alliance experience of CVCs' corporate were log transformed to reduce skewness and kurtosis. Table 2 presents the negative binomial regression results. In Table 17, Model 1 represents the baseline model that only contains control variables. The main effects of technological knowledge overlap and its square were added to Models 2 and 3, respectively. Then, the moderating effects of active- and passive- control with both the linear and squared term of technological knowledge overlap were examined in model 4 to model 7. The moderators were first tested without any interactions (Model 4) before separately tested in Model 5 and 6, and mutinously tested in Model 7. The F test and adjusted R-squared suggest model fit.

Hypothesis 1 predicted an non-linear relationship between knowledge overlap and CVC parents' innovation. A significantly negative quadratic term, but not necessarily a significant linear term, is required for proving an inverted U-shaped relationship (Aiken and West, 1991). Therefore, hypothesis 1 is supported by Models 2 to Model 7 where the squared term of knowledge overlap is all significantly negative.

Hypothesis 2 predicted that a CVC's control over its portfolio ventures would moderate the relationship between knowledge overlap and investor innovation. In Models 5 and 7, the interaction between technological knowledge overlap and both active and passive control rights is negative and significant. Greater control rights mitigate the deleterious effect of excessive portfolio diversity. I hence find support for hypothesis 2.

Hypothesis 3 predicted that different types of control rights would moderate the relationship between technological knowledge overlap and investor innovation differently under high knowledge similarity. In Models 7, the interaction between knowledge overlap squared and active control is positive and significant, and same to the interaction between knowledge overlap

squared and passive control. However, the coefficient for the active control interaction is higher than the coefficient for the passive control interaction. Thus, at higher levels of knowledge similarity, active control rights held by CVCs appear to mitigate the deleterious effect of knowledge overlap on corporate investors' innovation more than passive control rights do. Therefore, I find support for hypothesis 3 (a): the moderating effect on amplitude of innovation performance is higher by active controls when knowledge similar is high.

Table 16. Descriptive Statistics

	Mean	SD	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Innovation performance	62.32	31.53		1								
(2) Tech knowledge overlap	0.23	0.41	7.00	0.05	1							
(3) Active control	1.01	4.26	4.29	0.12	0.09	1						
(4) Passive control	0.49	1.06	3.82	0.06	0.24	0.13	1					
(5) Tech knowledge overlap x Active control	5.31	4.27	6.97	0.02	0.75**	0.59**	0.04	1				
(6) Tech knowledge overlap x Passive control	2.19	1.83	5.06	0.02	0.64**	0.02	0.63**	0.56**	1			
(7) Patent Stock	713.02	1063.6	4.26	0.75***	0.04	-0.05	0.69*	-0.01	0.04	1		
(8) ln(Assets)	8.17	2.5	1.69	0.60***	0.22***	0.09+	0.86**	0.02**	0.20	0.61	1	
(9) ln(Research)	0.1	0.13	1.57	-0.12	-0.02	0.02	-0.35	-0.01	-0.01*	-0.19***	-0.39	1
(10) Investor age	44.99	40.02	4.43	0.55***	0.06	0.03	0.66*	0.00	0.03	0.63***	0.58	-0.16
(11) Investor M&A	7.5	10.25	2.09	0.24	0.16	0.07	0.13	0.01	0.02	0.43	0.42	-0.08
(12) ln(Investor alliances)	33.6	38.52	1.49	0.66	0.15	0.15	0.12	0.02	0.02	0.71	0.60	-0.11
(13) Industry Citations	0.09	0.26	3.6	0.04	0.40*	0.33	0.04	0.15**	0.01	-0.07	0.06	0.01
(14) Portfolio size	12.17	15.6	3.54	-0.02	0.79	0.06	0.15	0.04	0.13	0.06	0.17	-0.02
(15) Investor CVC experience	11.91	5.1	1.17	0.12	-0.15**	-0.01	0.14**	-0.00	-0.13*	0.11*	0.25	-0.09

N=238.

Table 16. continued

	(10)	(11)	(12)	(13)	(14)	(15)
(1) Innovation performance						
(2) Tech knowledge overlap						
(3) Active control						
(4) Passive control						
(5) Tech knowledge overlap x Active control						
(6) Tech knowledge overlap x Passive control						
(7) Patent Stock						
(8) ln(Assets)						
(9) ln(Research)						
(10) Investor age	1					
(11) Investor M&A	0.56	1				
(12) ln(Investor alliances)	0.54	0.57	1			
(13) Industry Citations	-0.00	0.29	0.10	1		
(14) Portfolio size	0.08	0.18	0.12	0.07	1	
(15) Investor CVC experience	0.20	0.24	0.10	0.29	0.33	1

Table 17. Negative Binomial Regression Estimation Results

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-3.684***	-2.393***	-3.473***	-3.615***	-3.828***	-3.639***	-3.883***
	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)
Technological knowledge overlap		0.138*	0.435**	0.234**	0.594**	0.284**	0.675**
		(0.083)	(0.016)	(0.031)	(0.014)	(0.026)	(0.011)
Technological knowledge overlap squared			-0.547**	-0.366**	-0.715**	-0.421**	-0.802**
			(0.013)	(0.017)	(0.012)	(0.015)	(0.011)
Active control				0.068*	0.193**	0.063*	0.200**
				(0.058)	(0.033)	(0.062)	(0.034)
Passive control				0.047*	0.017***	0.061*	0.044*
				(0.076)	(0.009)	(0.084)	(0.081)
Tech knowledge overlap x Active control					-0.096**		-0.106**
					(0.040)		(0.045)
Tech knowledge overlap^2 x Active control					2.388**		2.818*
					(0.048)		(0.059)
Tech knowledge overlap x Passive control						-0.651*	-0.710*
						(0.077)	(0.075)
Tech knowledge overlap^2 x Passive control						0.807*	0.622*
						(0.074)	(0.082)
Patent Stock	0.334***	3.238***	3.375***	3.382***	3.413***	3.388***	3.425***
	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)
ln(Assets)	0.458***	0.351**	0.415**	0.572**	0.356**	0.216	0.225*
	(0.004)	(0.023)	(0.024)	(0.027)	(0.028)	(0.114)	(0.071)
ln(Research)	5.936***	7.128***	6.248***	13.161***	6.108***	5.184***	4.393***
	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)
Investor age	0.110**	0.109**	0.095**	0.049**	0.055**	0.051**	0.047**
	(0.023)	(0.024)	(0.024)	(0.025)	(0.026)	(0.025)	(0.025)
Investor M&A	-0.443	-0.347	0.483	-0.359	-0.355	-0.040	-0.090
	(1.792)	(2.990)	(2.387)	(3.389)	(2.078)	(2.267	(4.042)
Ln(Investor alliances)	0.030**	0.014***	0.223***	0.007***	0.011***	0.007***	0.012***
	(0.045)	(0.002)	(0.002)	(0.005)	(0.009)	(0.001)	(0.010)
Industry Citations	0.067**	0.718**	0.650*	0.964**	0.643*	0.589***	0.401
	(0.014)	(0.049)	(0.083)	(0.045)	(0.076)	(0.049)	(0.193)
Portfolio size	-5.540	-7.160	-6.440	-6.120	-5.890	-5.720	-5.760
	(0.514)	(0.372)	(0.567)	(0.613)	(0.670)	(0.632)	(0.701)
Investor CVC experience	0.023***	0.025***	0.022***	0.021***	0.022***	0.021***	0.022***
	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)	(<.000)
F Value	186.87***	124.76***	92.59***	60.75***	45.02***	44.65***	35.27***
Adj R-Sq	0.756	0.791	0.789	0.785	0.782	0.781	0.778

Note: N=238 (CVC corporate parents between 1998-2010).

*** p<0.001, ** p<0.01, * p<0.05, † p<0.1.

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VITA

Hsin-Ju (Crystal) Bien

EDUCATION

Ph.D. in Strategic Management – Krannert School of Management, Purdue University, USA	2018
MSc in Applied Biomolecular Technology – University of Nottingham, UK	2006
BS in Agricultural Economics – National Taiwan University, Taiwan	2005

PUBLICATION & WORKING PAPERS

Bien, Hsin-Ju (2016) "Protective covenants as a safeguard in interfirm relationships", *Academy of Management Proceedings*

Bien, Hsin-Ju, Ben, Tai-Ming, Wang, Kuan-Fei (2014) "Trust relationships within R&D networks: A case study from the biotechnological industry", *Innovation – Organization & Management*, 16 (3): 354-373

Ben, Tai-Ming, Su, Hsiao-Jui, **Bien, Hsin-Ju** (2018) "The Study of Creative Class Residential Location Choice: The Effects of Government Public Housing and Entrepreneurial Space", *International Regional Science Review* (Revised and Resubmitted)

Bien, Hsin-Ju, Makadok, Richard (2018) "Governance Design and Innovation Performance of Corporate Venture Capital-Backed Firms" (Undergoing revision. Plan to submit to *Strategic Management Journal*)

Bien, Hsin-Ju, Makadok, Richard, Ozmel, Umit (2018) "Portfolio management strategy and Innovation Performance of Investing Incumbents" (Undergoing revision. Plan to submit to *Strategic Management Journal*)

Bien, Hsin-Ju (2018) "How do incumbents learn from corporate venture capital investment? Control right allocation and investing firm innovation rates" (working paper)

RESEARCH EXPERIENCE

Research Assistant – Krannert Business School, Purdue University, IN, USA 08/2012 to 08/2018

- Design allocation of control rights in competitive cooperation between firms with imbalanced power. Results validated by 700 venture capital contracts with factor analysis and regression models.
- Conceptualized competitive cooperation strategy with decision tree models.
- Identified factors of successful cooperation by scrutinizing 2,200 M&A and alliance deals.

Research Assistant – Department of International Business, National Taiwan University 04/2011 to 07/2012

- Performed Time Series Analysis.
- Conducted Benefit and Cost Analysis for a cooperating company.

Research Assistant – Department of Land Economics, National Chengchi University 10/2006 to 04/2008

- Conducted survey research and qualitative data analysis.
- Wrote a research report for the National Science Council.

TEACHING EXPERIENCE

Teaching assistant of MGMT 484 –Management of Entrepreneurial Ventures, Krannert School of Management, Purdue University, Fall 2018

Instructor of MGMT 352 – Strategic Management (Undergraduate-Core), Krannert School of Management, Purdue University, Spring 2017

Instructor of MGMT 451 – Strategic Management (Undergraduate-Core), Krannert School of Management, Purdue University, Fall 2014

Teaching assistant of MGMT 650 – Strategic Management (MBA-Core), Krannert School of Management, Purdue University, Spring 2017

Teaching assistant of Strategic Management of Multinational Corporations (Undergraduate-Core), Department of International Business, College of Management, National Taiwan University, Spring 2011

INDUSTRY EXPERIENCE

Board Service

Board Director or Board Observer in five bioscience or high-tech firms 2009 to 2011

- Board Director – AeroVision Avionics Inc., Taipei, Taiwan
- Board Director – TaiAn Asset Management Co., Ltd., Taipei, Taiwan
- Board Observer – Adimmune Corporation, Taipei, Taiwan
- Board Observer – TaiMed Biologics Inc., Taipei, Taiwan
- Board Observer – Taiwan Flower Biotechnology Co., Ltd., Taipei, Taiwan

Work Experience

Business Consultant – Freelance, West Lafayette, IN, USA 01/2017 to 08/2018

- Conducted strategies to help local companies develop, grow, or reposition.
- Established marketing strategy and channels for a supermarket, resulting in 25% sales growth.
- Grew operations by planning and negotiating deals with distributors and vendors.

Project Manager – National Development Fund, Taipei, Taiwan 08/2008 to 04/2011

- Initiated a restructuring process for a horticulture firm, resulting in 20% revenue growth.
- Led a biotech company to pass clinical trials, and took it to an IPO.
- Developed a market entry strategy that took a Taiwanese vaccine company into European markets.
- Managed portfolio firms by working closely with senior managers.
- Executed due diligence; negotiate cooperation with VC partners in US, Germany, and Japan.

Business Consultant Intern – IBM Global Business Services, Taipei, Taiwan 05/2008 to 08/2008

- Led a team of 5 interns to win the internal Business Plan Competition, ranked 1st out of 18 teams.
- Led a team of 6 to collect data, accelerating the process by 15%.
- Collected and compiled data from stakeholders; participate in client interviews.

Business Consultant Intern – UNIEI lab. Nottingham, UK 06/2006 to 10/2006

- Researched market and product to develop a Business Plan at the University's Enterprise Lab.
- The recommendation was implemented by a start-up.

AWARDS

- Taiwanese Ministry of Education Scholarship (top 8% among 1200 applicants for Ph.D. programs)
- Department Valedictorian, Junior Student Representative (National Taiwan University)
- Graduated 2nd in the class, GPA: 3.9/4.00 (National Taiwan University)
- Presidential Awards (top 5 %) of junior and senior class (National Taiwan University)
- Certified by Biotechnology Program