# Essays on
# International Venture Capital

by

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# Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

# Abstract

Venture Capital firms (VCs), compared with other sources of financing, are known to be a value-adding source of finance for high-growth entrepreneurial firms. Venture capital has transitioned from a local to an international subject in recent years. In this thesis , I address three important aspects of the international venture capital research area.

In the first essay, I answer these questions: do venture capital firms decide to invest in a cross-border company based solely on their own international experience, or do they also decide based on other venture capital firms' behavior in investing in that country? I address these questions by investigating vicarious and experiential learning in the venture capital context, focusing on US cross-border venture capital investment data from 2000 to 2013. The analysis indicates that, on average, venture capital firms use both experiential and vicarious learning strategies in making their cross-border investment decisions. Moreover, the effect of experiential learning is greater than that of vicarious learning, and a venture capital firm's size moderates this effect.

In the second essay, I answer this question: do government venture capital funds crowd-in or crowd-out international private venture capital investment? The crowding-in effect arises when international private venture capital benefits from government subsidies through the enhancement of an entrepreneurial ecosystem and investment syndication. The crowding-out effect arises when government venture capital competes with private venture capital, bidding up deal prices and lowering returns, thereby spurring local private venture capitalists to invest internationally. I examine data from 26 countries from 1998 to 2013. The analysis indicates that, on average, more mixed-structured government venture capital investments than pure-structured government investments in a country crowds-in domestic and foreign private venture capitalists internationally. Moreover, the effect of both structures is greater on domestic private venture capitalists than on foreign ones.

In the third essay, I investigate whether government venture capital practices in Canada promote a robust entrepreneurial ecosystem, by analyzing the effect of these practices on domestic and cross-border venture capital investments by private venture capital firms separately. I research the following two questions in parallel: a) Does Canadian government venture capital investment attract private venture capital firms to invest in the domestic market? b) Does Canadian government venture capital investment lead to, or prevent, domestic private venture capital firms from investing in other countries? I find that Canadian government venture capital investment has no measurable impact on private venture capital firms' decisions to invest in the domestic market. I also find that certain of the Canadian government's venture capital programs have displaced private venture capital, although with negligible impact, towards cross-border VC markets, primarily to the United States.

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# Dedication

To

My wife, ***Dr. Elahe Jabari***

&

My daughter, ***Rose***

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# Chapter 1

# Introduction

Venture Capital firms (VCs), compared with other sources of financing, are known to be a value-adding source of finance for high-growth entrepreneurial firms, mainly because venture capitalists play a value adding role, such as by giving administrative advice, providing human capital, networking, etc., on top of providing financial resources to their investee companies (Cumming and Knill, 2012; Gompers and Lerner, 2004). Venture capital has transitioned from being a local to an international concept in recent years, with internationalization of VC investments on the rise (Dai et al., 2012) since the late 1990s (Schertler and Tykvová, 2011), significantly impacting growth-oriented technology companies in various markets that have limited domestic VCs (Mäkelä and Maula, 2008). The three core essays of this thesis address important aspects of international venture capital research. In the first essay, I analyze venture capital firms' cross-border investment decisions in connection with organizational learning theories. In the second essay, I investigate the effect of different types of government venture capital investment structures on private venture capital internationalization. In the third essay, I address the Canadian government's venture capital efforts in regards to private venture capital localization and internationalization.

## 1.1 Organizational Learning and Venture Capital Internationalization

Research on cross-border venture capital (VC) has attracted many scholars in recent years and has suggested that international experience is critical for VC firms' subsequent cross-border investments (Dai and Nahata, 2016; Dimov and Milanov, 2010; Li et al., 2014; Liu and Maula, 2016; Tykvová and Schertler, 2014). VC firms' previous international experience in entrepreneurial firms in culturally distinct countries has been found to explain the propensity of VC firms to partner with local venture capital firms, and to predict the success of VC firms in their exit from investee companies (Dai and Nahata, 2016; Liu and Maula, 2016; Meuleman and Wright, 2011). Although these studies provide useful insight, they do not address whether the possession of such experience in a specific country impacts VC firms' decision to invest again in that country. Also, the studies do not examine whether VC firms will follow other VC firms in deciding to invest in foreign companies. Therefore, a major research gap exists in relation to whether VC firms rely only on their own recent experience, or whether they imitate the cross-border VC investment behaviour of others, and if they do, to what extent, and how.

In the first essay, I extend prior work on cross-border VC research by proposing that VC firms' international investment decisions can be explained by considering both experiential learning, which is generated by reactions to historical activities that relate to the firm's previous actions, and vicarious learning, which is an observational method that entails imitation of other businesses (Bingham and Davis, 2012; Levitt and March, 1988). Previous research has established the relationship between experiential and vicarious learning by suggesting that firms under certain conditions imitate the strategies of first movers or larger competitors in other fields of study, for example in international mergers and acquisitions (Malhotra et al., 2015; Oehme and Bort, 2015; Yeniyurt et al., 2009), or in chain acquisitions (Baum et al., 2000). In the VC context, Baum and Silverman (2004) considered venture capitalists to be, to some degree, "scouts" when they vicariously select investee firms in biotechnology. Keil et al. (2008) showed that corporate VC firms adopt disembodied experimentation learning, which is a combination of

vicarious and active participation learning. However, to the best of my knowledge, the essay presented in Chapter 2 of this thesis is the first to investigate the effect of both vicarious and experiential learning in VC cross-border investment.

## 1.2 Government Venture Capital and Venture Capital Internationalization

Many government bodies around the world spend over a billion dollars per year subsidizing venture capital (VC) funds (Alhorr et al., 2008; Alperovych et al., 2016, 2015, Bruton et al., 2009, 2005, Keuschnigg and Nielsen, 2001, 2003; Lerner, 2009; Li and Zahra, 2012; Luo and Junkunc, 2008; Megginson, 2004). The rationale for such support typically includes the potential for substantial innovation amongst small firms, the creation of positive externalities from innovation, and the creation of a VC ecosystem with experienced VC managers, who provide administrative, financial, strategic, and human resource advice, as well as a network of contacts to suppliers, investment bankers, accountants, lawyers, and other strategic investors(Ahlstrom and Bruton, 2006; Peng, 2012). Furthermore, government intervention attenuates the excess risk aversion of many entrepreneurs and their private investors that would otherwise result in insufficient private investment in entrepreneurship and innovation. It also promotes employment creation and attracts foreign private investment capital. While prior work has offered substantial insights into many aspects of government venture capital (GVC), there has been a comparative dearth of work on the relationship between GVC and private venture capital (PVC) investment internationally. In the second essay, I describe the possible theoretical arguments that may point to various results pertaining to why GVC may crowd-in or crowd-out PVC internationally, and I then conduct empirical tests. To the best of my knowledge, this study is the first attempt to investigate the effect of GVC on international PVC investment.

GVC may crowd-in domestic and international PVC through the creation of a domestic VC ecosystem, through encouraging greater institutional investment in PVC funds, and through

investment syndication. Conversely, GVC may displace domestic and international PVC if GVC competes with PVC, bids up deal prices, and lowers investment returns, thereby causing an outflow of domestic VC to other countries and a reduction in the inflow of foreign PVC. In theory, either or both effects are possible, and it is, therefore, worthwhile to carry out empirical analysis. Recent studies have found that GVCs have successful outcomes in a mixed-structured investment (i.e., when they syndicate with PVC funds), and unsuccessful outcomes in a pure-structured investment (i.e., when they are the sole investor) (Bertoni and Tykvová, 2015; Grilli and Murtinu, 2014). The aforementioned studies do not include the international perspective of GVC investments. In the second essay, I investigate the effect of mixed- and pure- GVC investment on international PVC investments.

## 1.3 Canadian Government Venture Capital and localization versus internationalization of private VCs

Since 1980, Labour Sponsored Venture Capital Corporations (LSVCCs) and the Business Development Bank of Canada (BDC) have been Canada's major programs supporting entrepreneurial ecosystem, but they have been criticized for inefficient investments. Besides being inefficient, government VC in Canada has engendered academic interest in whether government VC funds in Canada are performing as intended to promote an entrepreneurial ecosystem?

The literature offers two competing explanations. The first suggests that adverse practice of government VC may 'crowd out' domestic private VCs. Crowding out, in this instance, means pushing private funding away, yet it is a vital source of development; that is, too much government VC would deny other venture capitalists opportunities to invest or compete favorably (Cumming et al., 2016; Cumming and MacIntosh, 2007, 2006). In the third study, the focus is? on whether the aggregate pool of domestic VC investments and cross-border venture capital investments is disregarded (Cumming and Johan, 2013; Cumming and MacIntosh, 2006).

The competing explanation suggests that adverse practice of government venture capital may displace domestic private VC instead of crowding-out private VC; i.e., bad government VC practices may force domestic private VCs to transfer their efforts to other countries. The main motivation behind this reasoning comes from Lerner's (2009, p. 122) unproven claim that adverse government venture capital practices may compel non-GVCs to invest internationally, but further exploration of this claim is necessary.

Although, there is no doubt that either explanation conveys the idea of harmful effects of government VC programs in Canada, the latter is less damning than the former explanation. The third essay adds to the limited extant empirical studies on the existence of a link between inefficient government VC practices and international private VC investment flows. In the third study, I will analyze the effect of government VC on domestic and cross-border private VC investments in parallel to each other.

This thesis is organized as follows. Chapter 2, the first essay, explores organizational learning and VC internationalization; Chapter 3, the second essay, examines government VC and cross-border investment; Section 2.3, the third essay, discusses Canadian government VC and the internationalization or localization of Canadian private VCs.

# Chapter 2

# How Experiential and Vicarious Learning Shape Venture Capital firms' Cross-Border Investment Decisions: The Case of the US Venture Capital Industry

## 2.1 Introduction

Research on cross-border venture capital (VC) has attracted many scholars to investigate international experience in VC firms' cross-border investment decisions (Dai and Nahata, 2016; Dimov and Milanov, 2010; Li et al., 2014; Liu and Maula, 2016; Tykvová and Schertler, 2014). Mostly, these scholars have focused on how VC firms' previous international experience in entrepreneurial firms in culturally distinct countries affect the propensity of VC firms to partner with local venture capital firms (Dai and Nahata, 2016; Liu and Maula, 2016; Meuleman and Wright, 2011). I will address a major research gap in relation to whether VC firms rely on their own recent experience, or imitate the cross-border VC investment behaviour of others, and if they do, to what extent, and how. I extend prior work on cross-border VC research by proposing that VC firms' international investment decisions can be explained by considering both experiential learning, which is generated by reactions to historical activities that relate to the firm's previous actions, and vicarious learning, which is an observational method that entails imitation of other businesses (Bingham and Davis, 2012; Levitt and March, 1988).

This essay explores experiential and vicarious learning on the market-selection decisions of VC firms in their cross-border investments. Theorist in organizational learning highlight that when firms internationalize, they tend to overestimate the appropriateness of their recent action,

and therefore, they are more likely to increase their international participation in that market (Levinthal and March, 1993; March, 1991; Miller and Friesen, 1980). Other researchers have also noted that imitation occurs when the frequency of specific routines' incidence by certain firms increases the chance that the same routine will be adopted by similar firms in uncertain settings (Baum et al., 2000; Fernhaber and Li, 2010; Haunschild and Miner, 1997; Huber, 1991; Levitt and March, 1988). Drawing on these theories, I predict that VC firms with recent international investment experience in a country are more likely to reinvest in that focal country. Moreover, VC firms are also more likely to invest in that focal country if there are other VC firms investing in that country. Likewise, I argue that VC firms with recent international experience, who also face such patterns of investments by others, tend to over-weigh their recent investment, in deciding to reinvest in that country. In addition, I find that smaller VC firms tend to be influenced more by investment pattern of others rather than their own recent experience. To test these conjectures, I use cross-border investments by U.S venture capital firms between 2000 and 2013. I analyze the data using event history analysis based on annual observations of a unique unit of observation: the combination of US VC firms, investee companies' countries, and the industry SIC codes of investee companies. The data indicate that both experiential and vicarious learning affect cross-border venture capital investment decisions. The evidence shows that, in general, the effect of experiential learning is greater than the effect of vicarious learning.

My study contributes to the literature in two main areas. First, it sheds light on the effect of vicarious learning and experiential learning plus their interplay on international market-selection decisions of VC firms. Prior research on these topics has examined only the effect of venture capitalists' past international experience on their subsequent performance and local partner selection (Dai and Nahata, 2016; Dimov and Milanov, 2010; Liu and Maula, 2016; Tykvová and Schertler, 2014). Second, my study uses a unique ordered triplet of 'VC firm-country-industry' as the unit of analysis, which enables a more-deliberate analysis and the ability to track more details compared with previous studies. Using this unit of analysis enables me to show that industry-related international experience has a greater effect than solo? international experience,

and that vicarious learning from geographically closer resources has a greater effect than farther-off resources on cross-border VC investment decisions.

This essay is organized as follows. Section 2.2 discusses related studies and articulates hypotheses development; Section 2.3 introduces the methodology of the study; Section 2.4 covers results; and Section 2.5 provides concluding remarks.

## 2.2 Literature Review, Theory, and Hypotheses

In this section, I first review previous studies on cross-border venture capital investments. Then, I develop a theoretical framework pertaining into my hypotheses on experiential learning, vicarious learning, and their interplay.

### 2.2.1 Cross-border Venture Capital Investments

Considerable research describes why VCs internationalize through investing in foreign ventures, and these studies of cross-border VC investments can be categorized into macro-level studies, in which the focus is towards the fact that aggregated cross-border VC investment activities are greater in countries with suitable macroeconomic factors, and micro-level studies, in which the focus is on investigating the instrumentalities that can explain the why and the how of cross-border VC investment practices (Wright et al., 2005). The aggregate VC investment flows between different countries have been described by factors such as positive GDP growth, research, and development activities, stock market capitalization (Schertler and Tykvová, 2011), size and dynamism of market legal factors, and government policies (Guler and Guillén, 2010a). Micro-level studies, on the other hand, analyze the factors that influence internationalization strategies by the VCs including: Geographical and cultural differences, relational and institutional trust between the VC and the entrepreneurial firm, previous experience in either or both domestic and international VC investment, the role of local VC partners in host countries, and the social capital or network advantage of the VCs (Dai and Nahata, 2016; Hain et al., 2015; Liu and Maula, 2016; Mäkelä and Maula, 2008; Tykvová and Schertler, 2014). The remaining of this section will review these factors in more details.

Geographical, institutional (cognitive, normative, and regulative) (Tykvová and Schertler, 2014) and cultural distances are some of the hurdles faced by cross-border VC investors (Hain et al., 2015). While convergence in culture enhances negotiations (Dai and Nahata, 2016), differences in culture discourage the formation of partnerships between local VCs and foreign ones. However, such differences have beneficial effects such as producing synergies to alleviate the effects of geographical distance. The lower confidence levels, due to such distances, between VCs and investee companies, affect the nature of financial contracting, increase the severity of potential conflicts and diminish the overall performance of the investment (Dai and Nahata, 2016). Schertler and Tykvová (2014) suggest that geographical distance has a larger effect on the relationship between the foreign VC and the venture than that of the foreign and a local VC because to some degree, VCs follow almost similar business models and network advantages.

VC investment in a venture is staged in rounds that progress as the company progresses from a start-up to later stages wherein the firm can self-sustain (Mäkelä and Maula, 2008). The investment rounds may attract multiple investors to share investment rounds, a process called syndication. Syndication seeks to reduce risk by diversifying and exchanging information in selection, resource pooling, and reciprocation of deal flow (Mäkelä and Maula, 2008). During syndication, one VC acts as the lead investor, having more monitoring roles while the others play lesser but significant roles; the foreign VC may choose to involve local VCs in the syndicate. Syndication with local VCs helps overcome the effects of geographical distance, obtain deal access more efficiently, improve the distribution of risk, and reduce costs of information (Meuleman and Wright, 2011; Tykvová and Schertler, 2014). Uncertainty at the firm level increases the need for local VC involvement, but uncertainty at a country level discourages it (Liu and Maula, 2016). Meuleman and Wright (2011) examined the role of institutional learning and institutional context in private equity[1], syndications. The results of their study indicated that institutional context and organizational learning have significant relevance with the use of cross-border syndicates, and that private equity firms use learning to reduce institutional barriers.

[1] Private equity investments is a general categorization of private investments and Venture Capital (VC) investments is a subset of it. VC financing targets early stage companies.

Cross-border VC investments' behaviour can also be enlightened by institutional trust, which refers to trust in the firm structure and sincere behavior of the people of a country where a new venture exists, and relational trust, which is the gradual improvement of confidence between parties through frequent communications (Hain et al., 2015). Institutional trust encourages cross-border VC from developed to emerging economies and helps overcome the reputation factor that prevents VCs from developed economies from investing in emerging economy ventures so as not to diminish their reputational capital. Relational trust, on the other hand, mitigates the risks that come with the lack of proximity through the frequent, persistent and transparent exchange of information and over time reduces the perception of uncertainty by improving information symmetry. Their effects, however, depend on whether the investment is foreign only, or both international and local and also on whether the host economy is emerging or developing. Likewise, social capital or network advantage is another factor that affects the investment process. Social capital refers to potential resources that come with the network of relationships that an entrepreneur or a firm has, and international social capital relates to the cross- border manifestations of social capital (Mäkelä and Maula, 2008). Global networks provide exposure to opportunities, complementary skills (Hain et al., 2015), connections, learning, and advice, assistance in foreign negotiations, new markets, and resource gathering. Iriyama et al. (2010) found that these networks not only positively affect VC investment but also the flow of ideas, formation of the enterprise and flow of investments. Those advantages acquired by VCs in their home country help reduce the risk associated with foreign investments, but the same may not be said for brokerage benefits (Guler and Guillén, 2010b).

### 2.2.2 Experiential Learning and Cross-border VC

Over the years, research has continuously supported the significance and prevalence of direct and indirect learning processes in organizations (Baum and Dahlin, 2007; Huber, 1991; Levitt and March, 1988; Miner et al., 2001). Experiential learning is a direct learning process and is defined to be the repetition and/or the modification of subsequent actions by organizations, based on the recognition of historical patterns and/or the conception of previous performance (Bingham and Davis, 2012). It is in essence the knowledge that is obtained through reflections on

undertaking the organizational routines and strategies (Levitt and March, 1988), and helps the learner to acquire awareness from outcomes of those routines and strategies (Miner et al., 2001).

Theorists highlighted the prevalence of organizational search processes within experiential learning framework; that is, the routines that helps organizations to survive in their external environment (March, 1991). Specifically, in the search processes, organizations typically make a balance between two major actions: exploitation, which is the process of adopting current routines through local searches, versus exploration, which is the process of exploring new routines (Levinthal and March, 1993; March, 1991). Conversely, putting more weight on exploitation can cause the selection of unsound procedures, whereas focusing more on exploration is associated with an increase in pertinent expenditures (Levinthal and March, 1993; March, 1991). Theorist highlight that there exists a bias towards exploitation rather than exploration, since organizations tend to emphasize on the reasonability of their recent choices in their subsequent decisions and the level of such self-reinforcing bias tend to be spoiled by growing experience and confidence of decision-makers (Miller and Friesen, 1980). They consequently, tend to place more trust in the success of their previous strategies rather than take the risk of failure without searching for new and untested routines (Levitt and March, 1988). In effect, utilizing one pattern in organizational processes can quickly become routinized, and prevent organizations from exploiting newer frontiers (March, 1991).

VC firms investing in foreign ventures have always been faced with the challenge of the information gap, which is, in part, a result of the cultural and institutional differences between the information they possess and the one they require to operate successfully in the foreign environment (Liu and Maula, 2016; Meuleman and Wright, 2011; Tykvová and Schertler, 2014). Empirical evidence supports that experience does allow VC firms to fill such gaps by improving their abilities and capabilities through forms of repetition. According to one study, VCs that have previous experience in domestic and international investment are more open to cross-border VC (Tykvová and Schertler, 2011). Having international experience has been found to increase chances of US VCs investing in other countries because these firms have better access to social capital, and are more familiar with the hurdles of institutional and legal differences (Guler and

Guillén, 2010b). Also, VC firms international experience helps them in adjusting their strategies, calculations and assessments for their subsequent international investments (Dai et al., 2012). International experience of VCs has been showed to affect the partner-selection decisions (Liu and Maula, 2016; Meuleman and Wright, 2011), the investment amount and number of stages, and the likelihood of successful exits (Dai and Nahata, 2016). However, these studies do not address whether the possession of recent international experience in a specific country impacts VC firms' decision to invest again in that country.

Once a VC firm invests in a cross-border company, insights from the experiential learning framework suggest that VC firms gain knowledge about the regulations, institutions, and cultural aspects related to the host country (Dai and Nahata, 2016). The reported bias towards the exploitation processes of organizational search (March, 1991) suggests that VC firms tend to exploit their host-country-related knowledge gained through previous investment, rather than, explore new opportunities in other countries with new cultural and institutional settings. I argue that VC firms with past international experience in a country are able to develop the capability of entry, and can also deal with constraints and obstacles that they may encounter only in that host country. Under these settings, I hypothesize the effect of a VC firms' recent experience on its subsequent cross-border VC investment decisions as follows:

**Hypothesis 1a**: A focal VC firm's recent experience in a host country positively influences its propensity to further invest in that country.

A VC firm's international investment, on top of providing specific knowledge gained related to country-level settings, will also acquire knowledge about the industry of the investee company. As discussed earlier, due to the exploration bias discussed above, this experience can similarly act as a bias for venture capitalists that have already realized the potential of the country and the industry through previous international investments. I argue that the recent international experience of a VC firm in a specific country and specific industry, will affect the VC firm's subsequent decision to invest again. Under these settings,

**Hypothesis 1b:** A focal VC firm's recent experience in a host country and an industry positively influences its propensity to further invest in that country-industry.

Although prior county-related knowledge does influence the VC firms' decision to invest in a country, the bias towards exploitation rather than exploration suggests a VC firm will not tend to search for new investment opportunities in a different industry within the same country, as it may face higher more exploration costs. Consequently, the combination of recent industry-level knowledge and country-level knowledge is more important than country-level knowledge alone in deciding to invest again in that focal industry-country.

**Hypothesis 2:** Overall, a focal VC firm's propensity to invest in a country-industry is influenced more by its international experience in the host country-industry than its international experience in the host country.

### 2.2.3 Vicarious Learning and Cross-border VC

With vicarious learning, a common indirect learning process, One learns from others' experience (Baum et al., 2000; Huber, 1991; Levitt and March, 1988). In an organizational learning framework, vicarious learning can be defined as an organization's behavioral change in response to certain strategies employed by certain competitors (Kim and Miner, 2007). Imitation of what others have done in similar situations is a form of vicarious learning, in which learners observe what others do and mimic their course of actions (Cyert and March, 1963).

Inter-organizational imitation, as a form of vicarious learning, has been visited by theorists from different angles. It mostly occurs when the practices of one or more firms tempt other organizations to adopt them (Fernhaber and Li, 2010; Haunschild and Miner, 1997). The concept is supported by neoinstitutional theory, in which it is assumed that organizational strategies reflect not only technicalities and resources, but also the social norms of organizations' environments (Meyer and Rowan, 1977). Neoinstitutional theory, by highlighting the influence of social environment on organizations, provides grounds for frequency-based imitation, in which it is assumed that common practices of organizations in an environment can become a source of knowledge for others, as well as for trait-based imitation, in which it is assumed that

practices of organizations with specific characterizations can become a source of knowledge for other firms (Fernhaber and Li, 2010). Moreover, organizational learning theories provide grounds for outcome-based imitation; that is, the fact that certain actions resulted from certain performance levels motivates other firms to adopt them (Cyert and March, 1963). Furthermore, institutional isomorphism theory can support mimetic isomorphism, which is imitation due to behavioral similarity, and assumes that firms deliberately imitate other firms , 1) if they believe that the strategy of the original player is legitimate, and 2) if they believe that the original player is similar, either logically or socially, to themselves (DiMaggio and Powell, 1991; Haunschild and Miner, 1997). Finally, rivalry theories can also support inter-organizational imitation, by assuming that firms imitate their rivals to sustain their relative competitive advantage in their market (Lieberman and Asaba, 2006).

Some research suggests that vicarious learning may be an important initial learning process for organizations faced with insufficient information; that is, organizations rely on others' experiences to cover their understanding deficiency (Baum et al., 2000; Henisz and Delios, 2001). Research also shows that vicarious learning is particularly valuable in new industries and when uncertainty is high; for example, vicarious learning may take place as firms introduce new products in nascent markets (Srinivasan et al., 2007). International business literature shows that mimetic behavior, on top of an existing alliance experience, has a substantial role in reducing the impacts of uncertainties associated with cross-border operations (Yeniyurt et al., 2009). Moreover, small and medium enterprises (SMEs) have been found to use network-enabled learning approaches to imitate the internationalization modes of their peers in their network (Oehme and Bort, 2015). Also, the maturity and density of the location of firms have been found to influences internationalization of new ventures, by providing access to rich, imitable patterns for new ventures (Fernhaber et al., 2007). In contrast, other research suggests that vicarious learning may not be a good initial learning process because inexperienced firms are not able to internalize the knowledge gained through imitation (Henisz and Delios, 2001; Zahra and Dess, 2001).

In the VC context, it is shown that, to some extent, VCs decide to invest in entrepreneurial firms based on vicarious learning; that is, VCs are shown to have a combination of picking and building abilities in their selection and management of promising entrepreneurial companies respectively (Baum and Silverman, 2004). Baum and Silverman (2004) show that VCs vicariously decide, to some degree, on selecting promising entrepreneurs in the biotechnology sector. Moreover, Keil et al. (2008) show that corporate VC firms adopt "disembodied experimentation learning", which is a combination of vicarious and active participation learning in making their investment decisions. However, there is a gap in exploring whether VC firms imitate the cross-border market selection behaviour of other VC firms. Because VC firms face different types of uncertainties when making a cross-border VC investments, due to many cultural and institutional differences (Liu and Maula, 2016), imitation could be a standard response. VC firms' imitation of others' investment behaviour can be a tempting strategy for overcoming such uncertainties.

Frequency-based imitation (Fernhaber and Li, 2010) supports the fact that a known pattern of cross-border investments by VC firms in a specific country and industry can be a source of knowledge for a focal VC firm considering the same country-industry. Additionally, rivalry theory supports the idea that focal VC firms following the investment pattern established by VC firms located in the same home country, generally find themselves in a weaker competitive position than their competitors (i.e. those VC firms that established such patterns of investment) (Lieberman and Asaba, 2006). This position is partly because of the accessibility of international investment data through informal sources and private institutions such as Thomson Reuters, all of which can be obtained with a subscription. Consequently, a focal VC firm gain more confidence when they see a flow of initial VC firms to a specific country and industry. They are thus inspired to follow others in investing in the same country-industry, even though the potential opportunity in the country-industry may not be promising. They are more likely to imitate this pattern of investment to retain their competitive position, consequently, I hypothesize:

**Hypothesis 3a:** The number of VC firms located in one country and recently investing in a cross-border investment in a specific country-industry positively influences the propensity of a focal VC firm located in that same country to invest in the same country-industry.

Moreover, following a similar argument, the pattern of cross-border investments in a country-industry by VC firms located in one state/province is also trackable by VC firms in that state/province. Therefore, I expect that increase in such patterns of investments by home state/province firms, will also increase the probability that this pattern will be imitated by other VC firms.

**Hypothesis 3b:** The number of VC firms located in one state/province and recently investing a cross-border investment in a specific country-industry positively influences the propensity of a focal VC firm located in that same state/province to invest in the same country-industry.

Based on organizational learning theories, organizational search processes are typically conducted on nearer organizational routines (Ingram and Baum, 1997), since closer choices and actions, tend to be given more credence than distant untested choices and actions. Familiar searches of recognized contexts and locations also take precedence (Cyert and March, 1963; Levitt and March, 1988). A VC firm can assess the home state/province patterns of VC firms' international investments in a host country-industry more easily than such patterns by home country competitors. Therefore, it is more likely that a focal VC firm will imitate VC firms that are located in its closer vicinity, which - in my case - is the province/state of the focal VC firm.

**Hypothesis 4:** Overall, a focal VC firm's propensity to invest in a country-industry is influenced more by imitating other VC firms located in the same state/province than by imitating other VC firms located in the same country, and recently investing in that same country-industry.

### 2.2.4 The interplay of vicarious and experiential learning

Vicarious learning, as an indirect form of learning, is taking advantage of the behaviors of others by concentrating on their experiences (Baum et al., 2000; Haunschild and Miner, 1997) In contrast, experiential learning, which is a direct form of learning, is more costly and time-

consuming than imitation (Cyert and March, 1963). The distinctions for organizations regarding these types of learning depend on their resources, time, and commitment. Firms having adequate time and resources to explore the market environment are more likely to select experiential learning, whereas those in an uncertain environment will adopt imitation.

Empirical research shows that firms have the choice of adopting either of the experiential and vicarious learning processes, but mostly, a combination of both suffices. For instance, in the international business area, Guillén (Guillen, 2002; Guillén, 2003) shows that both experiential and imitation learning methods shape joint venture practices in the expansion of South Korean companies into China. His research indicates that experience and imitation in a business group from the same home country positively impacts foreign expansion (Guillen, 2002; Guillén, 2003).

As I discussed above, there exists a self-reinforcing bias towards exploitation rather than exploration in organizations, because they tend to emphasize on their recent actions' validity in their current behavior (March, 1991; Miller and Friesen, 1980). In my context, when the existence of a VC firm's recent experience in investing in a cross-border country-industry coincides and matches with other VC firms' investment flow to the same country-industry, the focal VC firm is more compelled to reinvest in that country-industry. The effect of such a self-reinforcing bias from the focal VC firm's recent experience is greater than that pertaining to competitive advantage, due to imitation effect. I hypothesise the effect of international experience in the country-industry versus imitation effect of other VC firms' investment in the same country-industry as follows:

**Hypothesis 5:** Overall, the VC firm's propensity to invest in a country-industry is affected more by its recent international experience in that country-industry than imitating other VC firms located in the same state/province and investing in that same country-industry.

Evidence from previous studies shows that small organizations imitate their larger counterparts, mainly because of the visibility of the latter's' actions (Haunschild and Miner, 1997). Baum et al. (2000) show that, in the chain acquisition context, large organizations are

imitated by other organizations. Moreover, empirical research in international business highlights that when smaller companies gain awareness of how to penetrate new countries through viewing the pattern of strategies and performance results of large firms or first movers in an industry, they may mimic steps employed by their competitors as a common response to approach the uncertainty on how the global market runs (Fernhaber and Li, 2010). In fact, it is quite possible that small VC firms' likelihood of investing in a certain country-industry is less affected by their recent experiential learning that it is by larger VC firms' investment patterns to that country-industry. Smaller VC firms are reported to employ more rigid assessments and decide more cautiously when considering the soundness of an investment opportunity, as they tend to gain the trust of their institutional investors for future fund raising by managing to have more successful exits from their investee ventures (Gompers and Lerner, 2001). Therefore, in my context, the self-reinforcing effect of a recent experience of a small VC firm is weaker than imitation effect, and the existence of a pattern of investment in a specific country-industry has more influence in investing again in that country-industry.

**Hypothesis 6:** A focal VC firm's propensity to invest in a country-industry is affected more by imitating other VC firms located in the same state/province and investing in that country-industry than by its recent experience in that country-industry, if that focal VC firm is smaller than the average size of other VC firms located in the same state/province and investing in that same country-industry in the previous years.

Figure 2-1 summarizes all of six hypotheses introduced in the section 2.2.

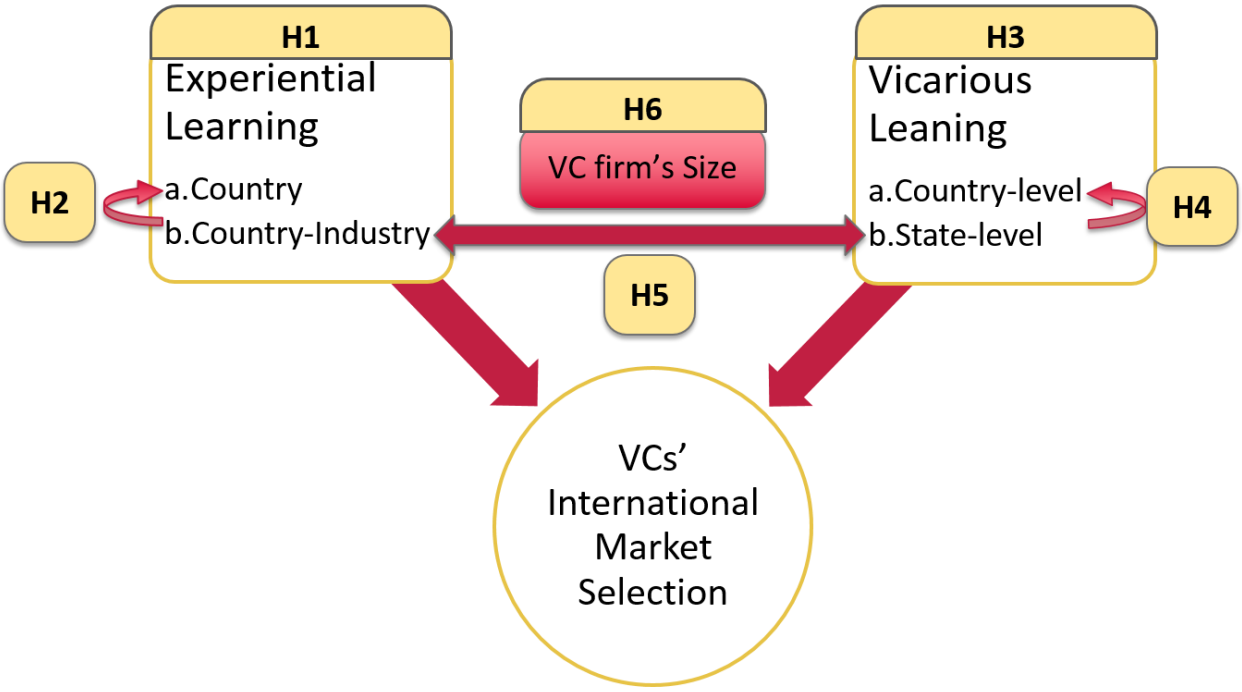


Figure 2-1 Theoretical model and summary of hypotheses

## 2.3 Methodology

In this section I develop my methodological framework, which are the process of downloading and generating database for analysis and analytical methodology.

### 2.3.1 Data

The data are from Thomson ONE Private Equity database. The database includes private equity investments, buyouts, mergers, and acquisitions for more than 100 countries from 1971 to the present. The data is the most comprehensive source of worldwide VC investment and has been extensively used in VC cross-border investment research (Dai and Nahata, 2016; Guler and Guillén, 2010a, 2010b; Liu and Maula, 2016). My empirical setting is venture capital firms in the United States, which engage in VC cross-border investment. From the database, I retrieved all cross-border investments by U.S VC firms between 2000 and 2013. I focused only on U.S VC

firms because the U.S is the largest market and supplier for VC capital investments (Oehme and Bort, 2015; Yeniyurt et al., 2009). I excluded investment observations in which the VC firm's name, venture's name and/or venture's country was not disclosed. I used independent venture capital funds and corporate venture capital funds as two major types of VC investor types in the Thomson database. I also limited the database only to "Venture Capital" deals (i.e. I excluded "Buyouts", "Real Estate" and "Other" as types private equity investments). Since VC investments are usually staged and main decision of a VC firm occurs at the first stage (later stages are conditional on performance of ventures), I limited my sample to the first round of investments, to avoid bias due to emphasizing later rounds of investment.

To test the effect of vicarious versus experiential learning on cross-border VC cross-border investment, I use ordered triplet of 'VC firm-venture's country-venture's SIC code, as the unit of analysis in my study; that is, all possible combinations of VC firms, countries of investee companies, and SIC codes in the data. Between 2000-2010, 1,141 VC firms invested in total of 4,787 cross-border VC investment in 79 different countries and 380 different SIC codes. I set up an event history for the ordered triplet unit of analysis, which is 'VC firm-venture's country-venture's SIC code' (I will use VC-Country-industry to address my unit of analysis), starting with the date of its first international cross-border investment. Then I arrange the data into yearly observations of the unit of analysis. Obviously, there is not an observation for all of my ordered triplet unit of analysis in all times; i.e., not all VC firms invest in all countries and all industries every year between 2000-2010. Consequently, I need to track the effects of vicarious and experiential learning on cross-border investments for those times that there are missing observations in my dataset (i.e. when there is no cross-border investment). I track changes on VC firms experience for experiential learning, other VC firms aggregate experience for vicarious learning, and macroeconomic metrics on the unit of analysis when there are missing observations. This method enable us to truly identify the effect of my independent on dependent variables. My final sample includes 60,164 observations.

### 2.3.2 Analytical Method

I use event history analysis (survival analysis) as a suitable analytical method, since, I am analyzing the effect of experiential and vicarious learning on VC firms' propensity to invest in a country and industry. Similar studies analyzing the effect of experiential and vicarious learning in international measures and acquisitions (Oehme and Bort, 2015; Yeniyurt et al., 2009) and in venture capital context (Bertoni and Groh, 2014; Guerini and Quas, 2016) used event history analysis. I assume an event occurs when a VC firm invests in a venture in a specific country and industry. Each company is considered at risk (i.e. is likely to invest in a cross-border venture in the country-industry) the year after its last event (the year a cross-border investment occurs) and until the next event. If the VC firm does not have a new cross-border VC investment in a country and industry that it had before, until 31 December 2013, then that unit of analysis is considered right-censored.

I analyze my dependent variable, i.e. the propensity of a VC firm investing in a foreign venture in a specific country and industry, by the hazard rate model (Allison, 2010; Tuma and Hannan, 1984) . The hazard function is defined by:

$$h(t|t_n) = \lim_{t \to t_n} \frac{P(t_n \leq T < t_n + t | T \geq t_n)}{t - t_n},$$

which determines the instantaneous rate at which the international investment occurs at time t, given that the VC firm's previous investment in that country and industry was at time $t_n$ (Allison, 2010). *P* denotes the discrete probability of a VC firm chooses an international investee company in that country-industry. I then employ the Cox model to identify the effects of my independent variable on the hazard rate:

$$h(t|t_n) = h_0(t) \exp(X(t)'\beta), \quad t > t_n$$

where $X(t)$ is the vector of covariates. The Cox model is a semi-parametric method in event history analysis. Semi-parametric methods make few restrictions on the probability distribution function of hazard rate (in my study the probability of engaging in a cross-border investment by a U.S VC firm) (Blossfeld, 2001).

### 2.3.3 Variables

#### 2.3.3.1 Dependent Variable: Whether to Invest in a cross-border Venture

To test my hypotheses, I set my dependent variable to be the VC firm's decision on whether to invest in a country and industry.

#### 2.3.3.2 VC firm's experiential learning

For a focal U.S VC firm, in a specific country, and, in a specific industry I define two variables to track the experiential learning effect. First, I use the cumulative number of first round investments of that VC firm in a foreign country within the past two years, to be the experience of the VC firm in that specific country. Second, I use the cumulative number of first round investments of a VC firm in that foreign country and industry within the past two years, to be the experience of the VC firm in a specific country-industry. I focus on the past two years' data since I am willing to investigate the recent experience and imitation effect. Using 1-year time window may result in an under-estimation the effect of my independent variables, as the circulation of information in the market may take more than one year. Although my results are stable by generating variables with one-year time window.

#### 2.3.3.3 VC firm's vicarious learning

Regarding vicarious learning for a focal U.S VC firm, in a specific country, and industry I define two variables. First, I count investments by other U.S VC firms investing in a foreign venture in a country and industry within the past two years. Second, I count US VC firms headquartered in the same state as the focal VC firm, investing in a specific country and industry.

#### 2.3.3.4 VC Firm Size

I define the VC firm's size to be the sum of the all of VC funds' size under its management. In limited partnership structure, a VC firm is the general partner and the institutional investors are the limited partners of a VC fund. VC firms act as the advisory role of a VC fund and can

provide professional management resources to the VC funds. A VC firm can have multiple VC funds under management. Thomson Private Equity database reports VC funds size, rather than VC firm size. VC funds size is defined to be the equity under management of VC funds that invest in the investee companies.

#### 2.3.3.5 Control variables

I need to control for macroeconomic factors that influence the VC firms' decision to invest abroad. VCs internationalize to either complement or upgrade their capabilities, so it makes sense that they would choose ventures in countries/markets with highly developed innovation systems and advanced technology. They are also attracted to a developed stock market, high capitalization and low corruption levels. Investors will also go for countries with legal protection of investors, favorable government policies, converging business ethics and practices and political stability and similar institutional settings. (Guler and Guillén, 2010a, 2010b; Schertler and Tykvová, 2011; Tykvová and Schertler, 2011). Based on the above discussion, I use macroeconomic metrics of the destination country of VC investment to control for a VC firms' decision to invest in a cross-border venture. I use GDP per capita in 2014 U.S dollars, stock market capitalization, research and development expenditures, number of patent granted to residents, venture capital legal score, cultural distance, and institutional distance as control variables the detailed explanation and source of these control variables can be found in Table 2-1.

Institutional distance is based on a longitudinal database of worldwide governance indicators on the six dimensions of governance quality. The six dimensions in the database are: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption (Kaufmann et al., 2009). Each dimension has a score between −2.5 and 2.5 for each dimension, with higher values representing higher quality. These dimensions are commonly used to measure country-level institutional quality and bilateral country level institutional distance (e.g., see Dai et al., 2012; Malhotra et al., 2015; Tykvová and Schertler, 2014). I will measure the institutional distance between country pairs as follows:

$$\text{Institutional Distance } = \sum_{j=1}^{6} \frac{\left(K_{US,j} - K_{D,j}\right)^2}{6 \times V_j}$$

Where $K_{US,j}$ and $K_{D,j}$ are the Kaufmann et al.'s dimension j for US and the destination country of investee firm respectively.

Cultural distance is measured using Hofstede's (1984) culture dimensions. This framework has been broadly used in many studies (e.g., see Dai et al., 2012; Dai and Nahata, 2016; Liu and Maula, 2016). I measure the cultural distance between the US and the investee's country by using the Cartesian distance of Hofstede's four cultural dimensions (i.e. individualism, uncertainty avoidance, power distance, and masculinity) [2]

$$\text{Cultural Distance } = \sum_{j=1}^{4} \frac{\left(H_{US,j} - H_{D,j}\right)^2}{4}$$

Where $H_{US,j}$ and $H_{T,j}$ are the Hofstede's cultural dimension j for the US and the destination country of investee firm respectively.

I measure the geographical distance between the VC firm and investee company by using the latitude and longitude points provided in the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) portal [3] (Mayer and Zignago, 2011). The detailed explanation and source of all variables can be found in Table 2-1.

[2] I obtain the data from http://geerthofstede.com/

[3] I get the data from the CEPII website. Please see http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

Table 2-1--Variable descriptions.

All the variables with subscript t are yearly basis and for each year between 1994-2013.

♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| Variable name | Description | Source |
|---|---|---|
| | Main Variables | |
| Cross-border VC investment event $(F_i,C_j,SIC_k)_t$ | A dummy variable equals one for each VC investment by the US VC firm $F_i$ in a foreign venture in country $C_j$ and the industry $SIC_k$ | Thomson ONE |
| Foreign Experience $(C_j)_t$ ♣ | Foreign Experience of VC firm in the country $C_j$. It is cumulative number of venture capital investment in the country $C_j$ during 2 years before year t | Thomson ONE |
| Foreign Experience $(C_j, SIC_k)_t$ ♣ | Foreign Experience of VC firm in the country $C_j$ and industry $SIC_k$. It is cumulative number of venture capital investment in the country $C_j$ and industry $SIC_k$ during 2 years before year t. | Thomson ONE |
| Country-level Imitation $(C_j, SIC_k)_t$ ♣ | Number of US venture capital firms other than focal venture capital firm that invested in the country $C_j$ and industry $SIC_k$ during 2 years before year t | Thomson ONE |
| State-level Imitation $(C_j, SIC_k)_t$ ♣ | Number of US venture capital firms other than focal venture capital firm and located in the same state as the focal venture capital firm that invested in the country $C_j$ and industry $SIC_k$ during 2 years before year t. | Thomson ONE |
| Small VC firm $(C_j, SIC_k)_t$ | A dummy variable equals one, when the size of the focal VC firm investing in country $C_j$ and industry $SIC_k$ is smaller than the average size of other VC firm that are located in the same state and investing in country $C_i$ and industry $SIC_k$ during 2 years before year t. | Thomson ONE |
| | Control Variables | |
| GDP $(C_j)_t$ ♣ | GDP per capita investee companies' country $(C_j)$ in the 2014 U.S. dollar (lagged one period of time). | World Bank |
| Market Capitalization $(C_j)_t$ ♣ | Stock Market capitalization of listed companies as percentage of GDP investee companies' country $(C_j)$. (lagged one period of time). | World Bank |

| Variable name | Description | Source |
|---|---|---|
| | Main Variables | |
| R&D Expenditures $(C_j)_t$ ♣ | Business Research and development expenditure (% of GDP) for investee companies' country ($C_j$). (lagged one period of time). | World Bank |
| Patents$(C_j)_t$ ♣ | Number of patent granted to residents relative to countries' GDP per capita in the 2014 U.S. dollar for investee companies' country ($C_j$) (lagged one period of time). | World Bank |
| VC legal score$(C_j)_t$ ♣ | Venture capital legal score (Venture capital is easily available for business) for investee companies' country ($C_j$) (lagged one period of time). | IMD World Competitiveness |
| Cultural Distance$(C_j)$ ♣ | Cultural distances between the capitals of venture capital's country (US) and investee companies' country ($C_j$)(time invariant) | (Hofstede, 1984) |
| Institutional Distance$(C_j)_t$ ♣ | Institutional distances between the capitals of venture capital's country (US) and investee companies' country ($C_j$). | WGI |
| Geographical Distance$(C_j)$ ♣ | Geographical distances between the capitals of venture capital's country (US) and investee companies' country ($C_j$). | CEPII |

## 2.4 Results

Table 2-2 covers the descriptive statistics and correlations. All correlation coefficients of variables that used in my regression analysis were less than 0.5.

Table 2-2—Correlation Matrix.
All the variables with subscript t are yearly basis and for each year between 1994-2013.
♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| ID | Variables | mean | SD/ ID | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Cross-border VC investment event $(F_i, C_j, SIC_k)_t$ | 0.080 | 0.271 | 1.00 | | | | | |
| 2 | Foreign Experience $(C_j)_t$ ♣ | 0.186 | 0.538 | 0.14*** | 1.00 | | | | |
| 3 | Foreign Experience $(C_j, SIC_k)_t$ ♣ | 0.004 | 0.061 | 0.22*** | 0.18*** | 1.00 | | | |
| 4 | Country-level Imitation $(C_j, SIC_k)_t$ ♣ | 0.596 | 1.036 | 0.09*** | 0.02*** | 0.11*** | 1.00 | | |
| 5 | State-level Imitation $(C_j, SIC_k)_t$ ♣ | 0.224 | 0.640 | 0.11*** | 0.08*** | 0.17*** | 0.68*** | 1.00 | |
| 6 | Small VC fund $(C_j, SIC_k)_t$ | 0.004 | 0.060 | 0.21*** | 0.02*** | 0.08*** | 0.09*** | 0.08*** | 1.00 |
| 9 | GDP $(C_j)_t$ ♣ | 9.557 | 1.470 | -0.00 | -0.20*** | -0.02*** | 0.10*** | 0.00 | 0.02*** |
| 10 | Market Capitalization $(C_j)_t$ ♣ | 4.319 | 0.630 | 0.04*** | 0.01 | 0.01 | 0.15*** | 0.08*** | 0.02*** |
| 11 | R&D Expenditures $(C_j)_t$ ♣ | 1.945 | 0.981 | 0.01 | -0.08*** | 0.01 | 0.09*** | 0.01** | 0.02*** |
| 12 | Patents$(C_j)_t$ ♣ | 8.122 | 18.804 | 0.02*** | 0.33*** | 0.04*** | 0.07*** | 0.13*** | -0.00 |
| 13 | VC legal score$(C_j)_t$ ♣ | 5.520 | 1.108 | 0.05*** | -0.03*** | 0.01 | 0.20*** | 0.10*** | 0.03*** |
| 14 | Cultural Distance$(C_j)$ ♣ | 2.239 | 0.765 | -0.00 | -0.16*** | -0.02*** | 0.19*** | 0.06*** | 0.02*** |
| 15 | Institutional Distance$(C_j)_t$ ♣ | 0.712 | 1.703 | -0.03** | -0.25*** | -0.03*** | 0.04*** | -0.05*** | 0.01*** |
| 16 | Geographical Distance$(C_j)$ ♣ | 8.527 | 1.062 | -0.01 | -0.17*** | -0.02*** | 0.24*** | 0.10*** | 0.02*** |

Correlation Matrix (continued)
All the variables with subscript t are yearly basis and for each year between 1994-2013.
♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| ID | | mean | SD/ ID | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Cross-border VC investment event $(F_i,C_j,SIC_k)_t$ | 0.08 | 0.271 | | | | | | | | |
| 2 | Foreign Experience $(C_j)_t$ ♣ | 0.186 | 0.538 | | | | | | | | |
| 3 | Foreign Experience $(C_j, SIC_k)_t$ ♣ | 0.004 | 0.061 | | | | | | | | |
| 4 | Country-level Imitation $(C_j, SIC_k)_t$ ♣ | 3.022 | 7.595 | | | | | | | | |
| 5 | State-level Imitation $(C_j, SIC_k)_t$ ♣ | 0.88 | 3.547 | | | | | | | | |
| 6 | Small VC fund $(C_j, SIC_k)_t$ | 0.596 | 1.036 | | | | | | | | |
| 7 | GDP $(C_j)_t$ ♣ | 9.557 | 1.47 | 1.00 | | | | | | | |
| 8 | Market Capitalization $(C_j)_t$ ♣ | 4.319 | 0.63 | 0.42*** | 1.00 | | | | | | |
| 9 | R&D Expenditures $(C_j)_t$ ♣ | 1.945 | 0.981 | 0.54*** | 0.14*** | 1.00 | | | | | |
| 10 | Patents$(C_j)_t$ ♣ | 8.122 | 18.804 | -0.47*** | -0.17*** | -0.19*** | 1.00 | | | | |
| 11 | VC legal score$(C_j)_t$ ♣ | 5.52 | 1.108 | 0.31*** | 0.42*** | 0.37*** | -0.3*** | 1.00 | | | |
| 12 | Cultural Distance$(C_j)$ ♣ | 2.239 | 0.765 | 0.55*** | 0.41*** | 0.00 | -0.4*** | 0.30*** | 1.00 | | |
| 13 | Institutional Distance$(C_j)_t$ ♣ | 0.712 | 1.703 | 0.82*** | 0.35*** | 0.29*** | -0.6*** | 0.21*** | 0.69*** | 1.00 | |
| 14 | Geographical Distance$(C_j)$ ♣ | 8.527 | 1.062 | 0.48*** | 0.33*** | 0.03*** | -0.3*** | 0.25*** | 0.62*** | 0.44*** | 1.00 |

Table 2-3 presents the regression analysis for the effect of experiential learning on venture capital firms' market selection decision. The experience variable has a stable effect over different models. Both recent foreign experience in the focal country, and experience in focal country-industry of investee company determine the propensity of the VC firms to invest in a cross-border company, and the coefficients are statistically significant. I will transfer the linear effects in all of regression results tables to marginal results for a 10% increase in the independent variables on my dependent variable. Model (1-a) shows that, on average, 10% increase in country-specific experience of a VC firm is equivalent to 4.7% increase in the hazard rate of a VC firm to invest again in that focal country. The corresponding figure in model 1_b shows that, on average, 10% increase in country-industry specific foreign experience of a VC firm is associated with 58% increase in that VC firm's propensity to reinvest in that focal country-industry. These inferences provide grounds to support Hypothesis 1a and 1b.

To do the analysis for both of experience variables, I remove the country-industry portion from country specific foreign experience in model 2 in Table 3. The results show the effect of experience in country-industry is greater than country specific experience and these effects are statistically significant ($p<0.001$). Consistently I can infer that 10% increase in country and country-industry experience is associated with 3.86% versus 21.2 % increase in the probability of the focal VC firm invest again Therefore, hypothesis 2 is strongly supported by the results from model (2) in Table 2-3.

Table 2-4 shows the regression results for vicarious learning of US VC firms. The results from models (3-a) and (3-b) show both country-level and state-level imitation separately affect the VC firm's propensity to invest in a country-industry and these effects are statistically significant at 1% level. W. model (3-a) and (3-b) show that 10% increase in the imitation variable at country-level and state-level separately, is associated with 1.4% and 1.6% increase in the VC firm's propensity to invest in the focal country-industry.

Table 2-3— The Experiential learning effect.

Partial likelihood estimates of covariate effects on the propensity of VC firm invests in country Ci and SICj.

Dependent variable is the dummy variable equals one when a VC firm invests in country Ci and SICj. .

***, **, * denote significance at the 1, 5, and 10% level, respectively.

All the variables with subscript t are yearly basis and for each year between 1994-2013.

♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| Dependent Variable: | Cross-border VC investment event $(F_i,C_j,SIC_k)_t$ | | |
|---|---|---|---|
| Model: | **(1_a)** | **(1_b)** | **(2)** |
| Covariates | | | |
| Foreign Experience $(C_i)_t$ ♣ | 2.2745*** | | 2.0426*** |
| | *(0.124)* | | *(0.110)* |
| Foreign Experience $(C_i, SIC_j)_t$ ♣ | | 16.7336*** | 6.7384*** |
| | | *(2.254)* | *(0.999)* |
| GDP $(C_j)_t$ ♣ | 1.2221*** | 1.1676*** | 1.2207*** |
| | *(0.050)* | *(0.040)* | *(0.048)* |
| Market Capitalization $(C_j)_t$ ♣ | 1.1283*** | 1.2102*** | 1.1288*** |
| | *(0.045)* | *(0.054)* | *(0.045)* |
| R&D Expenditures $(C_j)_t$ ♣ | 0.8558*** | 0.8221*** | 0.8451*** |
| | *(0.043)* | *(0.040)* | *(0.040)* |
| Patents$(C_j)_t$ ♣ | 1.1165** | 1.2155*** | 1.1214*** |
| | *(0.048)* | *(0.039)* | *(0.046)* |
| VC legal score$(C_j)_t$ ♣ | 1.5115*** | 1.8068*** | 1.5081*** |
| | *(0.165)* | *(0.246)* | *(0.161)* |
| Cultural Distance$(C_j)$ ♣ | 0.9321 | 0.9180*** | 0.9348 |
| | *(0.040)* | *(0.025)* | *(0.040)* |
| Institutional Distance$(C_j)_t$ ♣ | 0.9294** | 0.9412*** | 0.9317** |
| | *(0.028)* | *(0.021)* | *(0.027)* |
| Geographical Distance$(C_j)$ ♣ | 1.0022 | 0.9773** | 0.9989 |
| | *(0.015)* | *(0.011)* | *(0.014)* |
| Number of observations | 40,186 | 40,186 | 40,186 |
| Number of Clusters | *1,046* | *1,046* | *1,046* |
| Number of Events | 3,067 | 3,067 | 3,067 |
| $\chi^2$ | *259.183* | *744.688* | *711.761* |
| Degree of Freedom | 9 | 9 | 10 |
| Adjusted R2 | 0.013 | 0.010 | 0.018 |

Table 2-4— The Vicarious learning effect.

Partial likelihood estimates of covariate effects on the propensity of VC firm invests in country Ci and SICj.

Dependent variable is the dummy variable equals one when a VC firm invests in country Ci and SICj. .

***, **, * denote significance at the 1, 5, and 10% level, respectively.

All the variables with subscript t are yearly basis and for each year between 1994-2013.

♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| Dependent Variable: | Cross-border VC investment event $(F_i,C_j,SIC_k)_t$ | | |
|---|---|---|---|
| Model: | **(3_a)** | **(3_b)** | **(4)** |
| Covariates | | | |
| Country-level Imitation $(C_i, SIC_j)_t$ ♣ | 1.3689*** | | 1.1938*** |
| | *(0.025)* | | *(0.026)* |
| State-level Imitation $(C_i, SIC_j)_t$ ♣ | | 1.6085*** | 1.3467*** |
| | | *(0.041)* | *(0.042)* |
| GDP $(C_j)_t$ ♣ | 1.2238*** | 1.1992*** | 1.2211*** |
| | *(0.044)* | *(0.043)* | *(0.044)* |
| Market Capitalization $(C_j)_t$ ♣ | 1.1997*** | 1.1983*** | 1.1924*** |
| | *(0.055)* | *(0.055)* | *(0.055)* |
| R&D Expenditures $(C_j)_t$ ♣ | 0.7411*** | 0.7889*** | 0.7563*** |
| | *(0.040)* | *(0.041)* | *(0.040)* |
| Patents$(C_j)_t$ ♣ | 1.2440*** | 1.2196*** | 1.2296*** |
| | *(0.044)* | *(0.042)* | *(0.043)* |
| VC legal score$(C_j)_t$ ♣ | 1.6699*** | 1.7163*** | 1.6547*** |
| | *(0.240)* | *(0.245)* | *(0.236)* |
| Cultural Distance$(C_j)$ ♣ | 0.8506*** | 0.8771*** | 0.8560*** |
| | *(0.025)* | *(0.024)* | *(0.025)* |
| Institutional Distance$(C_j)_t$ ♣ | 0.9435*** | 0.9450*** | 0.9450*** |
| | *(0.020)* | *(0.020)* | *(0.020)* |
| Geographical Distance$(C_j)$ ♣ | 0.9055*** | 0.9275*** | 0.9063*** |
| | *(0.014)* | *(0.014)* | *(0.014)* |
| Number of observations | 40,186 | 40,186 | 40,186 |
| Number of Clusters | *1,046* | *1,046* | *1,046* |
| Number of Events | *3,067* | *3,067* | *3,067* |
| $\chi^2$ | *412.162* | *519.120* | *562.052* |
| Degree of Freedom | 9 | 9 | 10 |
| Adjusted R2 | 0.007 | 0.008 | 0.009 |

Table 2-5— The Experiential and Vicarious learning effects.

Partial likelihood estimates of covariate effects on the propensity of VC firm invests in country Ci and SICj. Dependent variable is the dummy variable equals one when a VC firm invests in country Ci and SICj. . ***, **, * denote significance at the 1, 5, and 10% level, respectively.

All the variables with subscript t are yearly basis and for each year between 1994-2013.

♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| Dependent Variable: | Cross-border VC investment event $(F_i, C_j, SIC_k)_t$ | |
|---|---|---|
| Model: | **(5)** | **(6)** |
| Covariates | | |
| Foreign Experience $(C_i, SIC_j)_t$ ♣ | 9.8320*** | |
| | *(1.377)* | |
| State-level Imitation $(C_i, SIC_j)_t$ ♣ | 1.4731*** | |
| | *(0.033)* | |
| Foreign Experience $(C_i, SIC_j)_t$ ♣× Small VC fund (Ci, SICj) | | 1.6817** |
| | | *(0.394)* |
| State-level Imitation $(C_i, SIC_j)_t$ ♣ × Small VC fund (Ci, SICj) | | 3.6906*** |
| | | *(0.193)* |
| GDP $(C_j)_t$ ♣ | 1.2014*** | 1.1581*** |
| | *(0.042)* | *(0.042)* |
| Market Capitalization $(C_j)_t$ ♣ | 1.1883*** | 1.2212*** |
| | *(0.053)* | *(0.054)* |
| R&D Expenditures $(C_j)_t$ ♣ | 0.7914*** | 0.8257*** |
| | *(0.039)* | *(0.043)* |
| Patents$(C_j)_t$ ♣ | 1.2088*** | 1.2279*** |
| | *(0.039)* | *(0.043)* |
| VC legal score$(C_j)_t$ ♣ | 1.6776*** | 1.8805*** |
| | *(0.229)* | *(0.275)* |
| Cultural Distance$(C_j)$ ♣ | 0.8906*** | 0.9115*** |
| | *(0.024)* | *(0.024)* |
| Institutional Distance$(C_j)_t$ ♣ | 0.9432*** | 0.9402*** |
| | *(0.020)* | *(0.020)* |
| Geographical Distance$(C_j)$ ♣ | 0.9408*** | 0.9626*** |
| | *(0.012)* | *(0.012)* |
| Number of observations | 40,186 | 40,186 |
| Number of Clusters | *1,046* | *1,046* |
| Number of Events | *3,067* | *3,067* |
| $\chi^2$ | *1,002.844* | *908.646* |
| Degree of Freedom | 10 | 10 |
| Adjusted R2 | 0.013 | 0.007 |

Moreover, from model 4, I control for both of imitation effects at the same time by subtracting the state-level imitation portion from the country-level imitation. The results from model (4) shows that the state-level imitation has greater impact on the hazard rate, considering the fact that the 99% confidence intervals for my competing variables do not overlap. 10% increase in the state-level and country-level imitation variables is associated with 1.81% versus 0.47% increase in the hazard rate respectively. Therefore, hypothesis 4 is supported by the results from model (2) in Table 2-4.

Table 2-5 shows the results for the analysis of experiential and vicarious learning effects together. Overall, the results show that foreign experience in a country and industry is more important than the state-level imitation effect. In unrestricted model (model 5), 10% increase in country-industry experience is associated with 32% increase in the hazard rate, while 10% increase in state-level imitation is associated with 1.47% in the hazard rate. Therefore, hypothesis 5 is supported based on the results. Moreover, the results support the moderating effect of VC firm size. The results show, when the size of a VC firm investing in a country-industry is smaller than average size of other VC firms investing in the same country and industry, then the effect of vicarious learning is greater than experiential learning. These results are significant in 1% level. Consequently, these results offer grounds to support my hypotheses 5 and 6.

### 2.4.1 Robustness Tests

I test for robustness by using different structures in generating the variables for experiential and vicarious learning. The original variable arrangement is based on the past two years' activity of the focal VC firm or other VC firms' activities. The foreign experience of VC firm in a country and in a country-industry, will be measured by the cumulative number of venture capital investments in that unit during past four years. Moreover, imitation effects also are measured for the past four years. Table 2-6, Table 2-7, and Table 2-8 show that the results remain stable over the same specifications as discussed above for my regression results.

Table 2-6—Robustness test for the Experiential learning effect.

Partial likelihood estimates of covariate effects on the propensity of VC firm invests in country Ci and SICj.

Dependent variable is the dummy variable equals one when a VC firm invests in country $C_i$ and $SIC_j$. .

***, **, * denote significance at the 1, 5, and 10% level, respectively.

All the variables with subscript t are yearly basis and for each year between 1994-2013.

♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| Dependent Variable: | Cross-border VC investment event ($F_i$,$C_j$,$SIC_k$)$_t$ | | |
|---|---|---|---|
| Model: | **(1_a)** | **(1_b)** | **(2)** |
| Covariates | | | |
| Foreign Experience ($C_i$)$_t$ ♣ | 1.8589*** | | 1.7071*** |
| | *(0.080)* | | *(0.073)* |
| Foreign Experience ($C_i$, $SIC_j$)$_t$ ♣ | | 13.2104*** | 6.4944*** |
| | | *(1.594)* | *(0.776)* |
| GDP ($C_j$)$_t$ ♣ | 1.1495*** | 1.1079** | 1.1490*** |
| | *(0.048)* | *(0.046)* | *(0.045)* |
| Market Capitalization ($C_j$)$_t$ ♣ | 1.0690 | 1.1247*** | 1.0634 |
| | *(0.048)* | *(0.050)* | *(0.047)* |
| R&D Expenditures ($C_j$)$_t$ ♣ | 0.9351 | 0.9056* | 0.9179* |
| | *(0.048)* | *(0.046)* | *(0.045)* |
| Patents($C_j$)$_t$ ♣ | 1.0418 | 1.1428*** | 1.0478 |
| | *(0.043)* | *(0.038)* | *(0.039)* |
| VC legal score($C_j$)$_t$ ♣ | 1.4150*** | 1.7065*** | 1.4179*** |
| | *(0.172)* | *(0.257)* | *(0.168)* |
| Cultural Distance($C_j$) ♣ | 0.9588 | 0.9444** | 0.9606 |
| | *(0.040)* | *(0.024)* | *(0.041)* |
| Institutional Distance($C_j$)$_t$ ♣ | 0.9585 | 0.9749 | 0.9610 |
| | *(0.027)* | *(0.021)* | *(0.025)* |
| Geographical Distance($C_j$) ♣ | 1.0263* | 0.9927 | 1.0225 |
| | *(0.015)* | *(0.011)* | *(0.014)* |
| Number of observations | 28,166 | 28,166 | 28,166 |
| Number of Clusters | *826* | *826* | *826* |
| Number of Events | *2,483* | *2,483* | *2,483* |
| $\chi^2$ | *258.847* | *732.688* | *619.982* |
| Degree of Freedom | 9 | 9 | 10 |
| Adjusted R2 | 0.013 | 0.010 | 0.018 |

Table 2-7— Robustness test for the Vicarious learning effect.

Partial likelihood estimates of covariate effects on the propensity of VC firm invests in country Ci and SICj.

Dependent variable is the dummy variable equals one when a VC firm invests in country $C_i$ and $SIC_j$. .

***, **, * denote significance at the 1, 5, and 10% level, respectively.

All the variables with subscript t are yearly basis and for each year between 1994-2013.

♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| Dependent Variable: | Cross-border VC investment event $(F_i,C_j,SIC_k)_t$ | | |
|---|---|---|---|
| Model: | **(3_a)** | **(3_b)** | **(4)** |
| Covariates | | | |
| Country-level Imitation $(C_i, SIC_j)_t$ ♣ | 1.3097*** | | 1.1660*** |
| | *(0.021)* | | *(0.020)* |
| State-level Imitation $(C_i, SIC_j)_t$ ♣ | | 1.4608*** | 1.2626*** |
| | | *(0.031)* | *(0.031)* |
| GDP $(C_j)_t$ ♣ | 1.1921*** | 1.1521*** | 1.1839*** |
| | *(0.053)* | *(0.051)* | *(0.053)* |
| Market Capitalization $(C_j)_t$ ♣ | 1.1116** | 1.1174** | 1.1086** |
| | *(0.052)* | *(0.052)* | *(0.052)* |
| R&D Expenditures $(C_j)_t$ ♣ | 0.8011*** | 0.8572*** | 0.8162*** |
| | *(0.045)* | *(0.046)* | *(0.045)* |
| Patents$(C_j)_t$ ♣ | 1.1896*** | 1.1533*** | 1.1704*** |
| | *(0.044)* | *(0.043)* | *(0.044)* |
| VC legal score$(C_j)_t$ ♣ | 1.5061*** | 1.5779*** | 1.4981*** |
| | *(0.230)* | *(0.245)* | *(0.229)* |
| Cultural Distance$(C_j)$ ♣ | 0.8718*** | 0.8932*** | 0.8729*** |
| | *(0.026)* | *(0.025)* | *(0.025)* |
| Institutional Distance$(C_j)_t$ ♣ | 0.9679 | 0.9776 | 0.9729 |
| | *(0.023)* | *(0.022)* | *(0.022)* |
| Geographical Distance$(C_j)$ ♣ | 0.9025*** | 0.9345*** | 0.9069*** |
| | *(0.017)* | *(0.016)* | *(0.016)* |
| Number of observations | 28,166 | 28,166 | 28,166 |
| Number of Clusters | *826* | *826* | *826* |
| Number of Events | *2,483* | *2,483* | *2,483* |
| $\chi^2$ | *414.847* | *449.169* | *536.810* |
| Degree of Freedom | 9 | 9 | 10 |
| Adjusted R2 | 0.007 | 0.007 | 0.008 |

Table 2-8— Robustness test for the Experiential and Vicarious learning effects.

Partial likelihood estimates of covariate effects on the propensity of VC firm invests in country Ci and SICj.

Dependent variable is the dummy variable equals one when a VC firm invests in country Ci and SICj. .

***, **, * denote significance at the 1, 5, and 10% level, respectively.

All the variables with subscript t are yearly basis and for each year between 1994-2013.

♣ shows the variables that are transformed by a natural logarithm one plus the original variable value.

| Dependent Variable: | Cross-border VC investment event $(F_i, C_j, SIC_k)_t$ | |
|---|---|---|
| Model: | **(5)** | **(6)** |
| Covariates | | |
| Foreign Experience $(C_i, SIC_j)_t$ ♣ | 8.4011*** | |
| | (1.107) | |
| State-level Imitation $(C_i, SIC_j)_t$ ♣ | 1.3609*** | |
| | (0.024) | |
| Foreign Experience $(C_i, SIC_j)_t$ ♣ × Small VC fund (Ci, SICj) | | 2.0773*** |
| | | (0.539) |
| State-level Imitation $(C_i, SIC_j)_t$ ♣× Small VC fund (Ci, SICj) | | 2.6855*** |
| | | (0.099) |
| GDP $(C_j)_t$ ♣ | 1.1482*** | 1.1054** |
| | (0.048) | (0.048) |
| Market Capitalization $(C_j)_t$ ♣ | 1.1061** | 1.1323*** |
| | (0.050) | (0.050) |
| R&D Expenditures $(C_j)_t$ ♣ | 0.8597*** | 0.9126* |
| | (0.044) | (0.049) |
| Patents$(C_j)_t$ ♣ | 1.1385*** | 1.1552*** |
| | (0.038) | (0.043) |
| VC legal score$(C_j)_t$ ♣ | 1.5442*** | 1.7754*** |
| | (0.230) | (0.284) |
| Cultural Distance$(C_j)$ ♣ | 0.9078*** | 0.9385** |
| | (0.024) | (0.025) |
| Institutional Distance$(C_j)_t$ ♣ | 0.9764 | 0.9704 |
| | (0.021) | (0.022) |
| Geographical Distance$(C_j)$ ♣ | 0.9499*** | 0.9789* |
| | (0.013) | (0.013) |
| Number of observations | 28,166 | 28,166 |
| Number of Clusters | 826.000 | 826.000 |
| Number of Events | 2,483.000 | 2,483.000 |
| $\chi^2$ | 874.511 | 1,015.719 |
| Degree of Freedom | 10 | 10 |
| Adjusted R2 | 0.014 | 0.006 |

## 2.5 Discussion

In this, I focused on two components of organizational learning theory, namely experiential learning and vicarious learning, to explain how venture capital (VC) firms make international investment decisions. I showed that the recent history of international VC and the recent international investment patterns of other VC firms are knowledge sources that can be used for future decision to invest in that country-industry.

This study makes several contributions to the application of learning theories in the VC context, and is the first attempt to investee vicarious and experiential learning in the cross-border VC research stream. I show that VC firms, tend to rely on their recent investment experiences in their cross-border investment decision makings. Liu and Maula (2016) and Dai and Nahata (2016) showed that the experience of the lead VC in a syndication team, or experience of other VC members in the syndication team, increases the propensity of VC firms to partner with local VC firms in that same country in a cross-border investment, whereas Meuleman and Wright (2011) provide an opposite result based on private equity data. Moreover, such experience increases the aggregate amount of investment and he probability of a successful exit from cross-border VC investments (Dai and Nahata, 2016; Liu and Maula, 2016). These results are based on the rational effect of experience on subsequent decisions. Learning theories show that dominant organizational routines resulting from continuous strategies often cause mistaken decisions in searching for new opportunities and threats (Levitt and March, 1988). Building on the phenomena of exploration and exploitation processes in organizational learning (March, 1991), I show that the reported bias towards the exploitation process, arising from the experience of firms, tempts VC firms to reinvest in ventures in the same country, and also the same country-industry that matches their recent experience.

Moreover, my study adds to extant literature on the role of heuristics in the VC context. VC firms are reported to decide vicariously in their selection of entrepreneurial firms to target (Baum and Silverman, 2004). By performing a case study, Keil et al. (2008) showed that corporate VC firms adopt a combination of vicarious and active participation learning. This study verifies the insights from the case study presented by Keil et al. (2008), by uncovering the role imitative

behaviour in the cross-border VC investments. The results also restate the role of imitative behaviour in international business literature; mimetic behavior has a considerable effect in reducing the impacts of uncertainties associated with cross-border operations (Fernhaber and Li, 2010; Oehme and Bort, 2015; Yeniyurt et al., 2009). I showed the pattern of cross-border investment in a country-industry, signals a potential opportunity in that country and industry, and compels that other VC to follow that pattern. Moreover, VC firms rely more on information spill-over from VC firms that are located in the closer vicinity.

# Chapter 3

# Government Venture Capital and Cross-Border Investment

## 3.1 Introduction

Governments around the globe have shown a pronounced interest in VCs ability to finance innovation (Brander et al., 2015; Cumming et al., 2014; Cumming, 2007). Traditionally, market failures occur (Hall, (2002) because investors, as agents, are often not competent to deal effectively with entrepreneurs, who know the business better than the investors. This reasoning provides the motivation for government intervention in venture capital to address market failures. These interventions are categorized in Cumming and Li (2013) as direct and indirect public expenditure programs and institutional settings. Government venture capital (GVC) is one direct method of intervening to address market failure, and governments worldwide have allocated a relatively large amount of funds towards venture capital. Moreover, the latest statistics by the European Venture Capital Association show that, in 2013, about 40% of all funds raised by venture capital investors (VCs) in Europe came from government (EVCA, 2014).

While prior work has offered substantial insights into many aspects of government venture capital (GVC), there has been a comparative dearth of work on the relationship between GVC and private venture capital (PVC) investment internationally. In this essay, I describe the possible theoretical arguments that may point to various results pertaining to why GVC may crowd-in or crowd-out PVC internationally. Recent studies found that GVCs have successful outcomes in a mixed structured investment (i.e., when they syndicate with PVC funds), and unsuccessful outcomes in a pure structured investment (i.e., when they are sole investors)

(Bertoni and Tykvová, 2015; Grilli and Murtinu, 2014). In this study, I investigate the effect of mixed- and pure- GVC investment on international PVC investments.

To test these conjectures, I use worldwide VC investment data from 1998 to 2013 from 26 countries. I address endogeneity by using an extensive set of macroeconomic controls, a unique set of fixed effects, and dynamic panel data analysis. The data indicate that the presence of GVC in a country is a determinant of both incoming and outgoing cross-border VC investment. The data further indicate that domestic mixed-GVC investment crowds-in cross-border PVC and pure-GVC investments crowds-out cross-border PVC. The evidence shows that the crowding-in effect is stronger than the crowing-out effect.

This study contributes to the literature in two main areas. First, it highlights the intersection between GVC, cross-border VC investment, and the effects of institutions on VC industry research streams, as in the extensive work by Alperovych et al. (2015); Leleux and Surlemount (2003); Vanacker et al. (2014); Colombo et al. (2014), who highlight GVC, Liu and Maula (Liu and Maula, 2016); Dai and Nahata (2016); Guler and Guillén (2010a, 2010b); Hurry et al. (1992) and Iriyama et al. (2010), who highlight cross-border venture capitalists, and Bruton et al. (2004); Bruton et al. (2009); Cumming and Knill (2012); Guler and Guillén (2010a), who highlight the effect of institutions on the VC industry. Second, I contribute to the literature on the crowding-out and crowding-in of different structures of GVC investments. Prior evidence on this topic has examined crowding-in or crowding-out without distinguishing between domestic and international investment flows (Armour and Cumming, 2006; Cumming and Johan, 2013). Lerner (2009, p. 122) argues that GVC may be linked to international PVC investment flows, but suggests that further evidence is warranted.

This essay is organized as follows. Section 3.2 discusses related studies and hypotheses development; Section 3.3 introduces the data, variables, and methodology of the study; Section 3.4 covers results; and Section 3.5 contains concluding remarks

## 3.2 Literature Review and Hypotheses

### 3.2.1 Government Venture Capital

Recently, Government venture capital as a type of public intervention has resulted in a substantial academic discussion. The initiatives of GVCs entail the generation of venture capital finances that are funded and controlled through government-linked agencies. GVCs focus on promoting commercial start-ups by injecting financial resources. The principal rationale for such a policy intervention is the equity gap. New entrepreneurial ventures often face challenges in obtaining the required funds to advance their companies. However, according to Kortum and Lerner (2000), private venture capital finances are the most suitable to offer seed and growth funding for entrepreneurial projects. Private venture capital funds are private financial organizations that obtain funds from investors (private institutional investors, pension funds, etc.) that they then channel to new entrepreneurial ventures linked with high risks. While PVCs invest in new ventures, there are some characteristics of a business that may be unappealing, such as a very early stage venture.(Bertoni et al., 2015). Dealing with this market failure is a distinct approach that government authorities take. There are two key mechanisms available to government authorities (Guerini and Quas, 2016). First, the government could indirectly intervene in the entrepreneurial funding market by tinkering with the legal and fiscal settings that impact PVCs (Armour and Cumming, 2006; Cumming and Knill, 2012). Second, the government could directly invest in the VC industry. In this study I define GVC fund as government-affiliated agencies that aim to provide funding to start-ups and companies because of their unappealing characteristics. GVCs attempt to close the gap in the supply of equity for innovation and new business growth by directing these funds to high-risk companies, or companies at a very early stage of development that may be overlooked by PVCs.

Nevertheless, such interventions by the government raise concerns since it would be counterproductive if government intervention substitutes for private investment (Leleux and Surlemont, 2003). This concern resulted in various studies that attempted to gauge whether government interventions in the VC industry bear a negative or positive impact on the volume of VC finances obtained from a macro perspective. GVC is a complex phenomenon because such

programs possess varying geographical scope, objectives and structures (Bertoni and Tykvová, 2015; Buzzacchi et al., 2013; Munari and Toschi, 2015). Studies have found mixed evidence for the impact of GVC on portfolio companies. For instance, Cumming and Macintosh (2006) and Armour and Cumming (2006) found negative impacts in Canada and Europe respectively. On the other hand, Guerini and Quas (2016), have discovered a positive impact of government investments in the VC industry development.

Prior studies utilize various performance measures to show that GVC has no positive impact especially if they participate alone (Grilli and Murtinu, 2014).The study focused on GVC performance in countries within Europe by analyzing negative and positive exit outcomes. According to Grilli and Murtinu (2014), individual investments by GVC finances have no substantial effect on portfolio firms concerning employee and sales growth. This is also evident in patenting activities (Bertoni and Tykvová, 2015). Furthermore, solo GVC funds negatively impact efficiency and result in underperformance in PVC activities with regards to the possibility of an efficient exit through Trade Sale or IPO (Alperovych et al., 2015).

Nonetheless, other studies imply that GVCs can have positive effects. First, PVCs and GVCs syndication is beneficial to the businesses' exit performance, sales growth, innovation and patenting activity (Bertoni and Tykvová, 2015; Grilli and Murtinu, 2014). Brander and his colleagues(2015) , makes a distinction between VCs that are government owned and VCs that are supported by the government. Results from such differences reflect that VCs supported by the government performed better as compared to the government-owned ones. This was with regards to the total funding of a portfolio company and also its successful exit. Besides, GVC could just add value through supporting companies until the next financing phase by increasing the investee's possibility to obtain private venture capital due to a certification outcome (Guerini and Quas, 2016; Lerner, 2002).

### 3.2.2 Cross-Border Venture Capital

Hain, Johan, and Wang define venture capitalists as emissaries who blend their technological and financial skills to support new ventures (Hain et al., 2015). Venture Capital investment was found to be more localized, with most venture capitalists having a preference for investment in

new ventures within their home countries. Equity traders in the U.S. grant almost 94% of their funds to domestic companies, despite the fact that their equity market is only 48% of the global total (Cumming and Johan, 2013). Some VCs decide on their investments based on a "20-minute rule," which discourages funding of start-up companies seeking venture capital that are more than a 20-minute drive away from the offices of the VC (Cumming and Johan, 2013). This is because internationalization and cross-border VC investment are regularly associated with uncertainty, due to opaqueness and increased information asymmetry between the VC and the venture and monitoring costs (Dai et al., 2012; Hain et al., 2015; Tykvová and Schertler, 2011).

With the increasing trend of internationalization studies show that VCs are attracted to new ventures in countries or markets that are suitable for doing business (Cumming et al., 2009). Therefore, the factors are mainly macroeconomic, and they affect both whether and how the cross-border venture capital investment will take place. The factors include GDP growth, research and development activities, stock market capitalization (Schertler and Tykvová, 2012, 2011), size and dynamism of the market, legal factors, and government policies (Guler and Guillén, 2010a). VC firms go international to complement or better their capabilities with new knowledge so institutions in environments with highly developed innovation systems and advanced technology will attract cross-border venture capital investment.

A developed stock market combined with high capitalization and low corruption levels also encourage cross-border venture capital investments (Hain et al., 2015; Schertler and Tykvová, 2012). Schertler and Tykvová argue that these factors affect cross-border venture capital from three perspectives; the country pair, the VC perspective, and portfolio company perspective. The first claims that expected growth differences between the VC's state and the firm's country positively relate to the number of cross-border venture capital deals that can take place between them. The second, which is expected GDP growth in the VC's home country, discourages cross-border venture capital due to increased localization; and high market capitalization positively affects both domestic and international investments; and the third, that cross-border venture capital deals increased when their GDP and market capitalization are expected to increase (Schertler & Tykvová, 2012).

As for legal factors, markets or countries with legal protection of investors and government policies that enforce it are critical for cross-border venture capital investors (Guler and Guillén, 2010b). Underdeveloped investor and property protection is a challenge VCs looking to internationalize experience (Cumming and Knill, 2012; Hain et al., 2015). So are diverging business ethics and perceived corruption and/or political instability in certain areas(Hain et al., 2015). Guler and Guillén (2010a) suggest the introduction of improvements across such regions, in scientific, political and financial sectors, to benefit all and not just a few firms and entrepreneurs. The institutions themselves, too, affect the choice and strategy of the VCs; their effects will be discussed later.

The micro analysis of the literature on cross-border VC, shows the factors that influence VC internationalization strategies. These include geographical and cultural differences, relational and institutional trust between the VC and the venture, previous experience in domestic and/or international VC investment, the role of domestic VCs in host countries, and social capital or network advantage of the VCs. Convergence in culture enhances negotiations (Dai and Nahata, 2016), but divergence discourages the formation of partnerships between domestic and foreign VCs even though such collaborations produce synergies, alleviating the effects of geographical distance. The effects of geographic distance are more greatly felt between international VCs and the firms than between the foreign and domestic VCs (Tykvová and Schertler, 2014). The analysis also showed that syndication affects the decision to internationalize; this is where investors share investment rounds with either one strictly as the leader or in reciprocation, where they alternate the lead position. Syndication distributes risk, reduces information costs and allows more efficient access (Liu and Maula, 2016). However, the differences in corporate management strategies of various institutions do not permit syndication to solve the issue of institutional distance. VCs with previous experience in domestic and foreign investment are more open to cross-border venture capital since they are more networked and more familiar with geographical distance (Liu and Maula, 2016; Schertler and Tykvová, 2011). Institutional and relational trusts affect cross-border venture capital depending on whether there is a domestic-foreign VC partnership involved and whether the firm's economy is developing or emerging. Confidence in the company's structure (institutional), encourages cross-border venture capital

from developed to developing countries while relationship trust reduces information asymmetry (Hain et al., 2015). Social capital or network advantage, which are the resources that come with the network of relationships that an entrepreneur or firm has, provide exposure to opportunities, complementary skills, connections, learning, resource gathering and access to new markets (Hain et al., 2015; Iriyama et al., 2010). They also influence the exit strategies of the firms (Jääskeläinen and Maula, 2014).

### 3.2.3 Hypothesis Development

In this section, we provide the grounds to hypothesize that the structure of government VC investments can be a factor that can affect the flow of investments by both domestic and international private VC funds to make a cross-border VC investment.

First, we will argue that the structure of government VC investments can influence the international activity of domestic private VCs. We address the study by Cumming and MacIntosh (2006), who investigated Canadian government VC practices. Cumming and Johan (2013) analyze Canada's government VC--called 'Labour-Sponsored Venture Capital Corporations' and report that they outbid other funds in the market by weakening the expected returns, as the they receive inexpensive tax subsidies, and consequently, institutional investors in the market reduced their fund commitment. Because of bidding-up of private VCs' rate of returns, it is possible that private VCs will be forced in lower investments, as they can not compete with government VCs who have access to cheap tax funds. As suggested by Lerner (2009, p. 122) private VCs who face competition with government VCs may look for investment opportunities in cross-border destinations. Consequently, international activity of domestic private VC funds is tied up into the activities of government VC practices.

Second, regarding the relation between the structure of government VC investments and foreign private VC attraction/ discouragement, we address the arguments by Guler and Guillén (2010a) and Makela and Maula (2008). According to Guler and Guillén (2010a), the choice made by a VC firm to invest in an environment greatly depends on the quality and nature of its institutions. Therefore, the presence of institutions plays a vital role in influencing cross-border VC investments. According to Guler and Guillen (2010a), legal systems can have an impact on a

country's attractiveness to venture capital firms. Legal institutions can thus be used to estimate the possibility of a foreign company from a country bearing substantial investor protections will finance an investment in a nation that lacks a legal regime offering such protections. Moreover, the study conducted Makela and Maula (2008) further established that domestic venture capital investors impact cross-border VC , as the presence of prominent domestic venture capitalists is a good sign to potential cross-border VC investors (Mäkelä and Maula, 2008). Consequently, we claim that the structure of government venture capital, as the public institutions mostly related to the VC market, and as one of the significant domestic investors in any country, can be a determinant of both domestic and foreign private VC investment flows.

We then claim that the direction of such effects depends on the structure of government VC investments, building on recent literature that shows government VCs have successful outcomes in mixed structured investments and unsuccessful outcomes in pure structured investments (Bertoni and Tykvová, 2015; Brander et al., 2015; Cumming et al., 2014; Grilli and Murtinu, 2014). In mixed structures, government VC funds leverage the available funds of private VCs to a ratio greater than or equal to one, and will provide promotional benefits for private investors in case of profitable investments. For example, the IIF program in Australia divides profits in a nine to one ratio between the government and private VCs (Cumming, 2007). Consequently, mixed-structured investment by government VCs can be a vehicle that promotes the domestic private VC ecosystem and attracts both domestic and foreign private VC for more investments. We also argue that pure-government VC investments crowd-out private VC internationally, by forcing outgoing and preventing incoming cross-border private VC investments. Destructive pure-government VC may compete with private VC, bidding up deal prices, and lowering investment returns, thereby making the domestic VC market unattractive for international private VCs, and forcing domestic private VC funds to go international.

We argue that more mixed structured government VC investment in a country inhibits domestic private VCs from investing in cross-border destinations, and attracts foreign private VC funds to invest in that country, by making that focal country's VC market more attractive. On the other hand, we expect more pure-structured government VC investment in a country discourage domestic and foreign VC funds from investing in that country. We hypothesize the effects of

mixed- and pure-government VC investments on incoming and outgoing private VC investment flows as follows:

**Hypothesis 1a**: more mixed-government VC structured investment in a country will crowd-in outgoing private VC investments.

**Hypothesis 1b**: more mixed-government VC structured investment in a country will crowd-in incoming private VC investments.

**Hypothesis 2a**: more pure-government VC structured investment in a country will crowd-out outgoing private VC investments.

**Hypothesis 2b**: more pure-government VC investment in a country will crowd-out incoming private VC investments.

Furthermore, in a country that has multiple government VC programs with a combination of mixed and pure we expect that more mixed-government VC investment compared to pure-government VC investment will crowd-in (both incoming and outgoing) private VC investors. Conversely, increasing number of pure-structured VC investments will crowd-out private VC investors. Under these settings, we hypothesize the effect of mixed and pure-government VC investments on cross-border private VC investment flows in the hypothesis 3, as follows:

**Hypothesis 3a**: more mixed-government VC structured compared with pure-government VC structured investments in a country will crowd-in outgoing private VC.

**Hypothesis 3b**: more mixed-government VC structured compared with pure-government VC structured investments in a country will crowd-in incoming private VC.

**Hypothesis 4a**: more pure-government VC structured compared with mixed-government VC structured investments in a country will crowd-out outgoing private VC.

**Hypothesis 4b**: more pure-government VC structured compared with mixed-government VC structured investments in a country will crowd-out incoming private VC.

## 3.3 Data and Empirical Methodology

### 3.3.1 Data

The data are from Thomson Reuters, specifically Thomson ONE Private Equity. The database includes private equity investments, buyouts, mergers, and acquisitions for 106 countries from 1971 to the present. From the database, I use all VC investments between 1998 and 2013. I exclude outlier data at the lowest fifth percentile of sample countries in the global VC investment data for which there is, at least, one domestic VC fund that has, at least, one investment. This action is identical to include countries in the sample that have more than 200 new investment rounds over 1998-2013 period. In my study, a GVC fund refers to government funding and Retail venture capital funds in the Thomson database, and a PVC fund refers to independent venture capital funds and corporate venture capital funds. I focus on source countries whose VC funds create investments as well as the destination countries, mainly because my aim is to test the GVC effect on the investment location of PVC funds at the source and destination of VC flows. I also solve the problem of subsidiary VC funds, which are reported to be a domestic VC fund in a country, but they are a subsidiary fund of other VC firms in another country. After matching and cleaning, the data contains 125,310 new VC investment rounds originated by 13,034 VC funds and 7,213 VC firms worldwide, located in 26 countries. Overall, 84% of all new investment rounds are domestic; i.e., they originated from domestic VC funds into domestic companies.

I use a bilateral country-level as my analytical framework, in which I focus on VC investment flows between different countries, i.e. on the overall investment activity for each country pair in each year. The advantage of this analysis, relative to a country-level perspective, is that I can control for both destination and source country VC investment, which leads to a superior analysis of cross-border investment. In this case, I have a panel of 10,400 observations (26 countries as source and destination of VC flows, and 16 years).

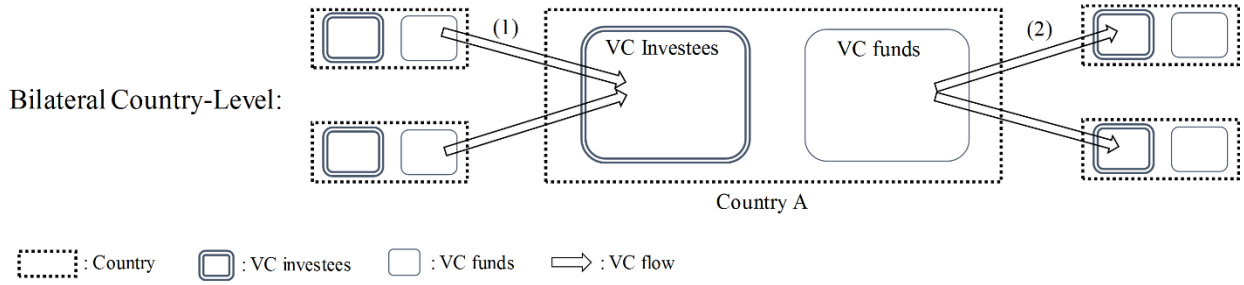


Figure 3-1— Bilateral country-level framework

(1) represents cross-border VC flows from VC funds of VC funds in a source country to VC investees in country A as a destination country, and (2) represents cross-border VC flows from VC funds in country A as a source country into VC investee companies in a destination country (both arrows (1) and (2) represent variables 1-3 in Table 2).

### 3.3.2 Variables

The main dependent variable in the analysis is the number of new investment rounds annually. VC investments usually take place in multiple rounds. As the main decision of VC funds occurs in the first round, I focus on the first round of investment to remove possible bias in counting VC investment flows in multiple round investments. In particular, I focus on the number of new cross-border investment rounds by PVC as the main dependent variable. The independent variables are the number of mixed or pure domestic new investment rounds by GVC. As shown in Figure 3-1, a cross-border new investment round can be counted multiple times based on the number of countries that at least one VC fund invests. Another aspect that might influence the analysis is the size of the domestic VC market. Countries are extremely different in terms their VC markets. For example, the US is by far the best and largest VC market for both domestic and international VC funds. Consequently, large cross-border deals might lead to biased analysis without correcting for the size of the domestic VC market. We, therefore, standardize cross-border PVC investment by dividing by the average of domestic new investment rounds in the source and destination countries.

In order to limit biased estimation, for example, due to an idiosyncratic investment, or a special interest of a fund in a country, I test the effect of GVC on two other groups of dependent variables in the robustness tests section: the number of new enterprises, and the number of funds.

Regarding different dependent variables, I use count variables of new enterprises, and VC funds as dependent variables to test if the results are sensitive to counting the number of new investment rounds as the dependent variable.

A country can also experience growth in both mixed- and pure-GVC investments, and this might lead to biased results. In order to avoid such bias, I use the percentage of mixed and percentage of pure investments to total GVC new investment rounds for each country-year, and I track if the change of mixed-GVC investments over pure-GVC investments affects the pool of domestic and cross-border PVC investments. Combining groups of variables and the above classification of cross-border investments yield three dependent variables in the bilateral country-level framework.

To control for country-level factors that might affect domestic, outgoing cross-border and incoming cross-border VC investments, I include several control variables based on the literature regarding macroeconomic conditions. Base on the major studies in the field of cross-border VC (e.g. Guler and Guillén, 2010a; Schertler and Tykvová, 2012, 2011), I control for GDP per capita, stock market capitalization, research and development expenditures, corporate tax rate, patents, and VC legal score. The variable descriptions and summary statistics can be found in Table 3-1.

Table 3-1--Variable descriptions and summary statistics.
S and D are one of 26 countries in the sample as the source country and destination country, respectively.
All of the variables in the main variables section are yearly basis and for each year between 1998-2013.
All of the variables are transformed by a natural logarithm one plus the original variable value.

| | Variable Code | Description | Source | N | Mean | SD | Min | max |
|---|---|---|---|---|---|---|---|---|
| | | Main Variables | | | | | | |
| 1 | $PVC_{SD}$ NNIR | The percentage of number of bilateral cross-border new investment rounds participated by PVCs in country S into country D, to average of domestic number of new investment rounds by PVC in country S and D. | Thomson ONE | 10,400 | 0.257 | 0.545 | 0 | 3.948 |
| 2 | $PVC_{SD}$ NE | The percentage of number of new enterprises in country D funded by PVCs from country S, to average of domestic number of distinct domestic enterprises funded by PVC in country S and D. | Thomson ONE | 10,400 | 0.223 | 0.494 | 0 | 3.645 |
| 3 | $PVC_{SD}$ NF | The percentage of number of PVC funds in country S which has done at least one investment in the country D, to average of domestic number of distinct domestic PVC funds making at least one investments in country S and D. | Thomson ONE | 10,400 | 0.238 | 0.508 | 0 | 3.730 |
| 4 | GVC mixed-NNIR | The percentage of number of domestic mixed-new investment rounds participated by GVC funds in the source or destination country to total number of domestic new investment rounds by PVC. | Thomson ONE | 10,400 | 0.916 | 1.233 | 0 | 5.762 |
| 5 | GVC pure-NNIR | The percentage of number of domestic pure-new investment rounds participated by GVC funds in the source or destination country to total number of domestic new investment rounds by PVC. | Thomson ONE | 10,400 | 1.188 | 1.345 | 0 | 5.429 |
| 6 | GVC mixed-PCT | The percentage of number of new investment rounds of mixed-GVC investment to domestic new investment rounds that were funded by GVCs. | Thomson ONE | 10,400 | 0.202 | 0.238 | 0 | 0.693 |
| 7 | GVC pure-PCT | The percentage of number of new investment rounds of pure-GVC investment to domestic new investment rounds that were funded by GVCs. | Thomson ONE | 10,400 | 0.311 | 0.281 | 0 | 0.693 |
| 8 | Successful-GVC-Exits | The percentage of number of domestic successful exits participated by GVC funds in the source or destination country | Thomson ONE | 10,400 | 0.591 | 1.163 | 0 | 4.845 |

| | Variable Code | Description | Source | N | Mean | SD | Min | max |
|---|---|---|---|---|---|---|---|---|
| | | to total number of domestic new investment rounds by PVC. | | | | | | |
| 9 | Unsuccessful-GVC-Exits | The percentage of number of domestic unsuccessful exits participated by GVC funds in the source or destination to total number of domestic new investment rounds by PVC. | Thomson ONE | 10,400 | 0.187 | 0.579 | 0 | 3.611 |
| | | Control Variables | | | | | | |
| 1 | GDP | GDP per capita in the 2014 U.S. dollar. | World Bank | 10,400 | 9.934 | 1.134 | 6.055 | 11.50 |
| 2 | Market Capitalization | Stock Market capitalization of listed companies (% of GDP) (lagged one period of time). | World Bank | 10,400 | 4.232 | 0.628 | 2.152 | 5.679 |
| 3 | R&D Expenditures | Business Research and development expenditure (% of GDP) (lagged one period of time). | World Bank | 10,400 | 1.065 | 0.310 | 0.451 | 1.709 |
| 4 | Taxes | Tax rates based on net income, corporate profits and capital gain (lagged one period of time). | World Bank | 10,400 | 3.378 | 0.523 | 0.865 | 4.215 |
| 5 | Patents | Number of patent granted to residents relative to countries' GDP per capita in the 2014 U.S. dollar (lagged one period of time). | World Bank | 10,400 | 0.648 | 0.975 | 0 | 4.487 |
| 6 | VC legal score | Venture capital legal score (Venture capital is easily available for business) (lagged one period of time). | IMD World Competitiveness | 10,400 | 1.791 | 0.242 | 1.069 | 2.260 |

To control for country-level factors that might affect domestic, outgoing cross-border and incoming cross-border VC investments, I include several control variables based on the literature regarding macroeconomic conditions. Base on the major studies in the field of cross-border VC (e.g. Guler and Guillén, 2010a; Schertler and Tykvová, 2012, 2011), I control for GDP per capita, stock market capitalization, research and development expenditures, corporate tax rate, patents, and VC legal score. The variable descriptions and summary statistics can be found in Table 3-1.

### 3.3.3 Empirical Methodology

I focus on whether GVC funds drive domestic PVC funds to invest in foreign markets. I also focus on the impact of GVC funds on incoming PVC investment. I transform the raw VC investment data from Thomson ONE into a bilateral country-level framework. The analysis uses the following equation:

$$Y_{SDt} = \rho . Y_{SDt-1} + \beta_1 . \text{GVC\_Mixed}_{St-1} + \beta_2 . \text{GVC\_Pure}_{St-1} + \beta_3 . \text{GVC\_Mixed}_{Dt-1} + \beta_4 . \text{GVC\_Pure}_{Dt-1} + \sum \alpha_i . \text{CONTROL}_{St-1} + \sum \alpha_j . \text{CONTROL}_{Dt-1} + \varepsilon_{SDt} \quad (1)$$

Where $Y_{SDt}$ is for variables 1-3 in the bilateral country-level framework in Table 2. S and D represent one of 26 countries as the source and destination countries of VC flows, respectively. In my model, the panel identifier is the ordered pair of 'source country-destination country' in the bilateral country-level framework. I also use country-fixed effects as well as year-fixed effects to control for time-varying heterogeneity. Moreover, I control within a country for macroeconomic changes that may affect international VC deal flows. Variables GVC_Mixed and GVC_Pure in equation 1 are for variables 4-5, or 6-7.

Dealing with unobserved heterogeneity is the main issue in panel data analysis. One way of addressing this issue, in the context of my study, is to apply the within (demeaning) transformation or fixed effects panel data analysis (Greene, 2003). Dynamic panel data models contain one or more lagged dependent variables, allowing for the modeling of a partial adjustment mechanism (Anderson and Hsiao, 1981). Dynamic panel data models have been extensively used in the area of country-level and cross-border VC investment to address possible heterogeneities (Schertler & Tykvová, 2012). I use Arellano and Bover (1995) / Blundell and Bond (1998) (hereafter called an ABBB method) dynamic panel data estimators for my regressions. ABBB is an AR(1) model with $\rho < 1$, in which a system of Generalized Method of

Moments instrumental variables is used. Instruments in this model can be a combination of a lagged dependent variable, independent variables, and optional external instruments. In the regression specifications, I assume that the number of cross-border VC investments in a country is correlated with the previous year's number (amount) of investments. The idea behind this argument is that the number (amount) of cross-border VC flows from country S to country D depends on the experience that VC funds in country S have gained while investing in the previous year (Liu & Maula, 2015).

I follow the rules by Roodman (2006), who has provided detailed instructions on how to implement ABBB dynamic panel data in Stata. In the ABBB dynamic panel data, every regressor in the instrument matrix Z is one of three forms: 1) single column (IV-style), if the regressor is strictly exogenous or an instrument of an explanatory variable; 2) lags one and deeper in a matrix form, if a regressor is predetermined but not strictly exogenous, and 3) lags two and deeper in a matrix form, if the regressor is endogenous. From this study, one can claim that there can be an unobserved factor to drive both domestic GVC and cross-border PVC; i.e., it is likely that domestic GVC can be endogenous to cross-border PVC. Based on the above reasoning, I include domestic GVC and cross-border PVC in category 3, control variables, and dummy variables in category 1. I correct the lag structure of dependent variables based on the Arellano-Bond test for serial correlation of the error term for each regression separately. I use the lag structure of order three if the 2nd order autocorrelation is significant at the 5% level, and a lag structure of order 2 in all other models.

Table 3-2--VC fund activities by country for 1998-2013.

| | Total Domestic[1] | Total GVC[2] | Pure-GVC (%) | Mixed-GVC (%) | Outgoing cross-border | Incoming cross-border |
|---|---|---|---|---|---|---|
| United States | 81,874 | 3,631 | 55 | 45 | 8,988 | 7,862 |
| Canada | 6,364 | 2,057 | 64 | 36 | 1,354 | 1,547 |
| China | 5,239 | 187 | 48 | 52 | 289 | 1,402 |
| United Kingdom | 5,008 | 189 | 37 | 63 | 1,909 | 2,305 |
| France | 4,864 | 56 | 39 | 61 | 872 | 1,120 |
| South Korea | 4,261 | 339 | 76 | 24 | 273 | 490 |
| Germany | 3,760 | 352 | 46 | 54 | 1,432 | 1,165 |
| India | 1,779 | 65 | 88 | 12 | 283 | 1,074 |
| Sweden | 1,442 | 130 | 55 | 45 | 339 | 608 |
| Spain | 1,205 | 128 | 87 | 13 | 105 | 236 |
| Japan | 1,156 | 11 | 45 | 55 | 1,031 | 308 |
| Israel | 1,140 | 7 | 0 | 100 | 830 | 1,050 |
| Australia | 955 | 80 | 85 | 15 | 352 | 302 |
| Finland | 861 | 68 | 87 | 13 | 174 | 254 |
| Denmark | 683 | 130 | 72 | 28 | 339 | 230 |
| Ireland | 640 | 148 | 22 | 78 | 163 | 352 |
| Belgium | 628 | 113 | 65 | 35 | 402 | 232 |
| Norway | 534 | 63 | 63 | 37 | 349 | 124 |
| Netherlands | 526 | 67 | 84 | 16 | 522 | 405 |
| Switzerland | 473 | 1 | 0 | 100 | 1,146 | 426 |
| Italy | 367 | 3 | 67 | 33 | 128 | 168 |
| Portugal | 340 | 58 | 71 | 29 | 58 | 23 |
| Brazil | 337 | 2 | 100 | 0 | 19 | 193 |
| Singapore | 326 | 234 | 38 | 62 | 843 | 285 |
| Russia | 287 | 52 | 75 | 25 | 183 | 148 |
| Austria | 261 | 15 | 67 | 33 | 71 | 145 |
| Total | 125,310 | 8,186 | 59 | 41 | 22,454 | 22,454 |

1- Number of domestic new investment rounds that were funded by domestic VCs.
2- Number of domestic new investment rounds that were funded by government VCs.
3- The percentage of pure-GVC new investment rounds to total new investment rounds by GVCs
4- The percentage of mixed-GVC new investment rounds to total new investment rounds by GVCs
5- Number of outgoing cross-border new investment rounds that were funded by domestic VCs.
6- Number of incoming cross-border new investment rounds that were funded by foreign VCs.

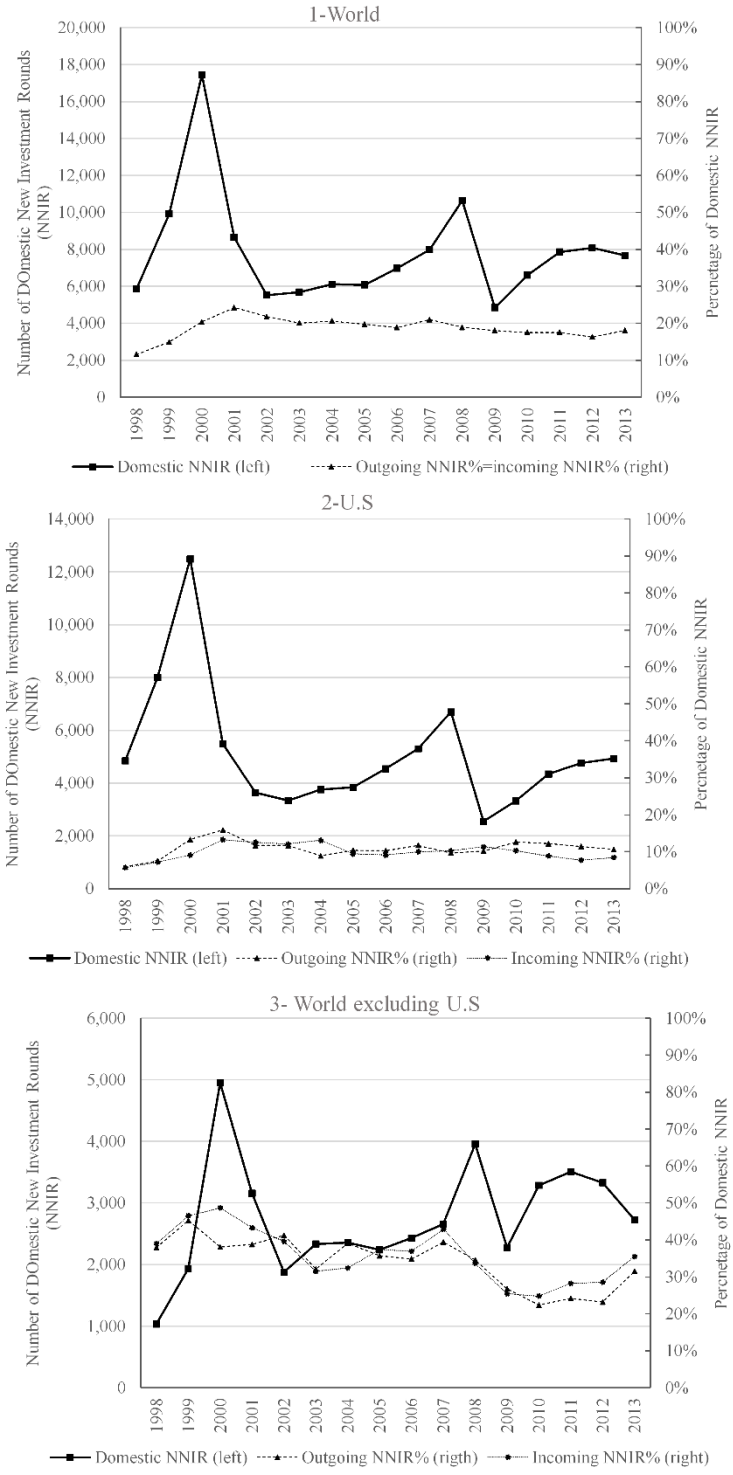


Figure 3-2--The trend of New Investment Rounds (NIR) participated by VC funds based on 1--the world, 2--the U.S. only, and 3-theworld, excluding the U.S. data for the period of 1998-2013.

## 3.4 Results

### 3.4.1 Descriptive Statistics

Table 3-2 contains information on the number of new investment rounds and the number of new enterprises that were VC funded in 26 countries. It can be inferred from Table 6 that U.S. VC funds have the highest rank regarding new investment rounds. On average, 5% of new investment rounds are funded by GVCs. Overall, VC funds make up 16% of total new investment rounds in cross-border destinations.

Figure 3-2 shows the annual trend of new investment rounds by VC funds over the sample period and the percentage of domestic versus foreign investments. I can readily see the 2000-2001 Internet bubble and the 2007-2008 financial crisis. Focusing on U.S. data, I find that both U.S. VC funds and cross-border VC funds invested in the U.S. seem to have a fixed proportion of cross-border investments over time, as the proportion of outgoing and incoming cross-border new investment rounds by VCs remained stable, even during the 2007-2008 stock market crash, other than slight growth in 2000.

### 3.4.2 Regression Analysis

The main independent variables are the yearly number of government VC investments standardized by domestic private VC size, which we used in Table 3, and are standardized by the total size of government VC investments (the percentage of each group of government VC investments), which we use in Table 3-4. So, by the results from Table 3-3, we can investigate hypotheses 1 and 2. Also, Table 3-4, investigates hypotheses 3 and 4. Our main dependent variables ( i.e., the VC flow between countries) are standardized by the average of domestic private VC in the source and destination countries, but for simplicity in explaining the results we only use the terms ‘inflow’ and ‘outflow’ of private VC. Also, for the following reasoning, we assume that domestic private VC is fixed.

Table 3-3--Bilateral country-level regression analysis using macroeconomic factors as controls.

Main independent variables are logarithmic transformed count variables of GVC which are standardized by the size of local PVC (variables 4 and 5 from Table 3-1). In models 1-3 dependent variable is the number of new investment rounds PVCSD NNIR (variable 1 in Table 3-1); in models 4-6 dependent variable is the number of new enterprises PVCSD NNE (variable 2 in Table 3-1). In models 7-9 dependent variable is the number of new Funds PVCSD NF (variable 2 in Table 3-1). All regressions use the Arellano and Bover/Blundell and Bond (ABBB) dynamic panel data regression model. The panel identifier is the ordered pair of 'source country-destination country'. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| **Dependent variable:** | Number of new Investment Rounds $PVC_{SD}$ NNIR | | | Number of new enterprises $PVC_{SD}$ NNE | | | Number of new Funds $PVC_{SD}$ NF | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** |
| GVC mixed-$NNIR_S$ | -0.0446* | | -0.1307*** | -0.0440** | | -0.1098*** | -0.0514** | | -0.1165*** |
| | *(0.026)* | | *(0.043)* | *(0.021)* | | *(0.037)* | *(0.022)* | | *(0.032)* |
| GVC mixed-$NNIR_D$ | 0.0314 | | 0.0750* | 0.0139 | | 0.0425 | 0.0150 | | 0.0574* |
| | *(0.029)* | | *(0.041)* | *(0.021)* | | *(0.032)* | *(0.021)* | | *(0.034)* |
| GVC pure-$NNIR_S$ | | 0.0423 | 0.1022** | | 0.0143 | 0.0764* | | 0.0087 | 0.0918*** |
| | | *(0.071)* | *(0.045)* | | *(0.057)* | *(0.041)* | | *(0.062)* | *(0.035)* |
| GVC pure-$NNIR_D$ | | -0.0508 | -0.0547* | | -0.0587 | -0.0388 | | -0.0777* | -0.0733** |
| | | *(0.048)* | *(0.037)* | | *(0.044)* | *(0.033)* | | *(0.043)* | *(0.032)* |
| Lagged dependent variable | 0.5656*** | 0.5684*** | 0.3149*** | 0.5806*** | 0.5886*** | 0.2770*** | 0.5738*** | 0.5646*** | 0.3169*** |
| | *(0.100)* | *(0.095)* | *(0.107)* | *(0.086)* | *(0.080)* | *(0.089)* | *(0.107)* | *(0.105)* | *(0.112)* |
| $GDP_S$ | 0.0808*** | 0.0197 | 0.1369*** | 0.0571** | 0.0246 | 0.1096*** | 0.0506** | 0.0151 | 0.1007*** |
| | *(0.027)* | *(0.028)* | *(0.036)* | *(0.024)* | *(0.025)* | *(0.028)* | *(0.022)* | *(0.024)* | *(0.028)* |
| Market $Capitalization_S$ | 0.0197 | 0.0176 | 0.0464 | 0.0334 | 0.0067 | 0.0436 | 0.0202 | 0.0125 | 0.0413 |
| | *(0.031)* | *(0.032)* | *(0.041)* | *(0.024)* | *(0.026)* | *(0.033)* | *(0.025)* | *(0.028)* | *(0.035)* |
| R&D $Expenditures_S$ | -0.0423 | 0.0851 | -0.0433 | -0.0479 | 0.0340 | -0.0706 | 0.0016 | 0.0777 | 0.0157 |
| | *(0.094)* | *(0.102)* | *(0.128)* | *(0.069)* | *(0.078)* | *(0.097)* | *(0.076)* | *(0.089)* | *(0.107)* |
| $Taxes_S$ | -0.1556*** | -0.1299*** | -0.3107*** | -0.1333*** | -0.1057*** | -0.2750*** | -0.1339*** | -0.1210*** | -0.2561*** |
| | *(0.048)* | *(0.049)* | *(0.072)* | *(0.034)* | *(0.038)* | *(0.058)* | *(0.040)* | *(0.044)* | *(0.056)* |
| $Patent_S$ | 0.0557** | -0.0038 | 0.1134*** | 0.0430** | 0.0124 | 0.0858*** | 0.0358* | 0.0056 | 0.0828** |
| | *(0.028)* | *(0.041)* | *(0.042)* | *(0.021)* | *(0.036)* | *(0.033)* | *(0.022)* | *(0.037)* | *(0.035)* |
| VC legal $score_S$ | 0.1799** | 0.0556 | 0.2673** | 0.1690** | 0.1142 | 0.2238*** | 0.1530** | 0.0916 | 0.1763** |
| | *(0.091)* | *(0.096)* | *(0.107)* | *(0.066)* | *(0.093)* | *(0.081)* | *(0.069)* | *(0.096)* | *(0.081)* |
| $GDP_D$ | -0.0109 | -0.0028 | -0.0508 | -0.0159 | 0.0092 | -0.0372 | -0.0227 | 0.0022 | -0.0394 |
| | *(0.032)* | *(0.031)* | *(0.044)* | *(0.026)* | *(0.028)* | *(0.038)* | *(0.027)* | *(0.027)* | *(0.035)* |

| **Dependent variable:** | Number of new Investment Rounds $PVC_{SD}$ NNIR | | | Number of new enterprises $PVC_{SD}$ NNE | | | Number of new Funds $PVC_{SD}$ NF | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** |
| Market Capitalization$_D$ | -0.0807** | -0.1156*** | -0.0990*** | -0.0771*** | -0.0866*** | -0.0823*** | -0.0429 | -0.0738** | -0.0731** |
| | *(0.033)* | *(0.032)* | *(0.036)* | *(0.028)* | *(0.029)* | *(0.030)* | *(0.029)* | *(0.029)* | *(0.031)* |
| R&D Expenditures$_D$ | 0.1086 | 0.1553 | 0.2787* | 0.0571 | 0.0400 | 0.1545 | 0.0857 | 0.0794 | 0.1711 |
| | *(0.105)* | *(0.103)* | *(0.158)* | *(0.076)* | *(0.081)* | *(0.126)* | *(0.082)* | *(0.081)* | *(0.127)* |
| Taxes$_D$ | -0.0520 | -0.0447 | -0.0972* | -0.0406 | -0.0331 | -0.0837** | -0.0316 | -0.0207 | -0.0790* |
| | *(0.041)* | *(0.039)* | *(0.053)* | *(0.031)* | *(0.031)* | *(0.039)* | *(0.029)* | *(0.029)* | *(0.041)* |
| Patent$_D$ | 0.0267 | 0.0462 | 0.0277 | 0.0243 | 0.0512* | 0.0281 | 0.0142 | 0.0463 | 0.0225 |
| | *(0.036)* | *(0.037)* | *(0.056)* | *(0.024)* | *(0.029)* | *(0.041)* | *(0.028)* | *(0.028)* | *(0.042)* |
| VC legal score$_D$ | 0.2394*** | 0.3131*** | 0.3389*** | 0.2119*** | 0.2487*** | 0.3126*** | 0.2025*** | 0.2779*** | 0.3681*** |
| | *(0.087)* | *(0.085)* | *(0.100)* | *(0.073)* | *(0.082)* | *(0.081)* | *(0.072)* | *(0.082)* | *(0.082)* |
| _cons | -0.4113 | 0.0792 | -0.3636 | -0.2048 | -0.1084 | -0.1780 | -0.1962 | -0.0654 | -0.2778 |
| | *(0.390)* | *(0.434)* | *(0.628)* | *(0.293)* | *(0.369)* | *(0.474)* | *(0.317)* | *(0.336)* | *(0.497)* |
| Number of observations | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 |
| Hansen test of joint validity of instruments (p-value) | *0.039* | *0.092* | *0.002* | *0.063* | *0.042* | *0.003* | *0.069* | *0.032* | *0.001* |
| Arellano-Bond test for AR(2) in differences (p-value) | *0.013* | *0.012* | *0.137* | *0.007* | *0.007* | *0.191* | *0.006* | *0.006* | *0.082* |
| Arellano-Bond test for AR(3) in differences (p-value) | *0.341* | *0.325* | *0.327* | *0.426* | *0.412* | *0.438* | *0.086* | *0.083* | *0.089* |

Table 3-4--Bilateral country-level regression analysis using macroeconomic factors as controls.

Main independent variables are logarithmic transformed count variables of GVC which are standardized by the size of local GVC (variables 6 and 7 from Table 3-1). In models 1-3 dependent variable is the number of new investment rounds $PVC_{SD}$ NNIR (variable 1 in Table 3-1); in models 4-6 dependent variable is the number of new enterprises $PVC_{SD}$ NNE (variable 2 in Table 3-1). In models 7-9 dependent variable is the number of new Funds $PVC_{SD}$ NF (variable 2 in Table 3-1). All regressions use the Arellano and Bover/Blundell and Bond (ABBB) dynamic panel data regression model. The panel identifier is the ordered pair of 'source country-destination country'. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| **Dependent variable:** | Number of new Investment Rounds $PVC_{SD}$ NNIR | | Number of new enterprises $PVC_{SD}$ NNE | | Number of new Funds $PVC_{SD}$ NF | |
|---|---|---|---|---|---|---|
| Model | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| GVC mixed-$PCT_S$ | -0.2255** | | -0.1911** | | -0.1649** | |
| | *(0.112)* | | *(0.084)* | | *(0.082)* | |
| GVC mixed-$PCT_D$ | 0.1439 | | 0.1020 | | 0.1013 | |
| | *(0.102)* | | *(0.083)* | | *(0.082)* | |
| GVC pure-$PCT_S$ | | 0.0207 | | -0.0166 | | -0.0057 |
| | | *(0.120)* | | *(0.088)* | | *(0.093)* |
| GVC pure-$PCT_D$ | | -0.2502*** | | -0.1571* | | -0.1867** |
| | | *(0.095)* | | *(0.082)* | | *(0.081)* |
| Lagged dependent variable | 0.5739*** | 0.5612*** | 0.6192*** | 0.6103*** | 0.6084*** | 0.5930*** |
| | *(0.077)* | *(0.095)* | *(0.059)* | *(0.067)* | *(0.064)* | *(0.089)* |
| $GDP_S$ | 0.0597** | 0.0489* | 0.0467** | 0.0273 | 0.0464** | 0.0402** |
| | *(0.025)* | *(0.025)* | *(0.020)* | *(0.018)* | *(0.019)* | *(0.019)* |
| Market $Capitalization_S$ | -0.0003 | 0.0050 | 0.0090 | 0.0158 | -0.0046 | 0.0161 |
| | *(0.032)* | *(0.033)* | *(0.025)* | *(0.026)* | *(0.026)* | *(0.027)* |
| R&D $Expenditures_S$ | 0.0305 | 0.0716 | -0.0403 | 0.0582 | -0.0128 | 0.0418 |
| | *(0.088)* | *(0.101)* | *(0.070)* | *(0.071)* | *(0.070)* | *(0.078)* |
| $Taxes_S$ | -0.1269*** | -0.1520*** | -0.1200*** | -0.1141*** | -0.1024*** | -0.1305*** |
| | *(0.043)* | *(0.048)* | *(0.033)* | *(0.032)* | *(0.033)* | *(0.038)* |
| $Patent_S$ | 0.0549** | 0.0366 | 0.0458** | 0.0171 | 0.0379** | 0.0261 |
| | *(0.027)* | *(0.026)* | *(0.018)* | *(0.018)* | *(0.018)* | *(0.019)* |
| VC legal $score_S$ | 0.1396* | 0.1570* | 0.1686** | 0.1079 | 0.1366** | 0.1122 |
| | *(0.079)* | *(0.082)* | *(0.070)* | *(0.068)* | *(0.066)* | *(0.071)* |
| $GDP_D$ | -0.0153 | -0.0335 | -0.0108 | -0.0261 | -0.0182 | -0.0299 |
| | *(0.030)* | *(0.030)* | *(0.024)* | *(0.025)* | *(0.024)* | *(0.024)* |
| Market $Capitalization_D$ | -0.1051*** | -0.0811*** | -0.0920*** | -0.0638** | -0.0980*** | -0.0687*** |

| **Dependent variable:** | Number of new Investment Rounds $PVC_{SD}$ NNIR | | Number of new enterprises $PVC_{SD}$ NNE | | Number of new Funds $PVC_{SD}$ NF | |
|---|---|---|---|---|---|---|
| Model | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| | *(0.034)* | *(0.031)* | *(0.029)* | *(0.025)* | *(0.030)* | *(0.026)* |
| $R\&D\ Expenditures_D$ | 0.0751 | 0.1732* | 0.0278 | 0.0899 | 0.0600 | 0.1126 |
| | *(0.094)* | *(0.105)* | *(0.069)* | *(0.074)* | *(0.075)* | *(0.083)* |
| $Taxes_D$ | -0.0240 | -0.0754* | -0.0178 | -0.0565** | -0.0163 | -0.0517* |
| | *(0.038)* | *(0.040)* | *(0.028)* | *(0.025)* | *(0.027)* | *(0.027)* |
| $Patent_D$ | 0.0303 | 0.0205 | 0.0211 | 0.0099 | 0.0170 | 0.0103 |
| | *(0.030)* | *(0.032)* | *(0.021)* | *(0.020)* | *(0.024)* | *(0.023)* |
| VC legal $score_D$ | 0.2650*** | 0.3012*** | 0.2170*** | 0.2531*** | 0.2486*** | 0.2760*** |
| | *(0.093)* | *(0.088)* | *(0.077)* | *(0.066)* | *(0.076)* | *(0.071)* |
| _cons | -0.1816 | 0.0759 | -0.1146 | 0.1329 | -0.0697 | 0.0561 |
| | *(0.334)* | *(0.351)* | *(0.269)* | *(0.278)* | *(0.259)* | *(0.286)* |
| Number of observations | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 |
| Hansen test of joint validity of instruments (p-value) | *0.032* | *0.020* | *0.032* | *0.103* | *0.050* | *0.062* |
| Arellano-Bond test for AR(2) in differences (p-value) | *0.008* | *0.012* | *0.004* | *0.005* | *0.002* | *0.004* |
| Arellano-Bond test for AR(3) in differences (p-value) | *0.323* | *0.337* | *0.409* | *0.416* | *0.078* | *0.082* |

The overall results from the regression analysis listed in Table 3-3 and Table 3-4 suggest that more mixed-GVC investment compared to pure-GVC investment will decrease the outflow of PVC investments, and will increase the inflow of international PVC.

The overall results from the regression analysis listed in Tables 3-3 suggest that more mixed-government VC investment is associated with a decrease the outflow of private VC investments, and an increase the inflow of international private VC. Based on model 3 in Table 3-3, in which we control for both mixed- and pure- government VC investments at the same time, we find that a 10 percent increase in mixed-government VC will cause a 1.3 percent decrease in outflow of private VC investment, and a 0.75 percent increase in the inflow of private VC investments. Alternatively, a 10 percent increase in pure-government VC is associated with one percent increase in the outflow, 0.5 percent decrease in the inflow of private VC investments. the same conclusions can be drawn from models 1 and 2 in Table 3-3, in which we control for the effects of mixed and pure government VC investments separately. As it can be seen from Table 1, the mean and standard deviation of "$PVC_{SD}$ NNIR" are 0.26 and 0.54 after our standardization process. These changes are in the range of one standard deviation of our main dependent variable.

Moreover, overall, the results are not sensitive to the use of different dependent variables in the sample. More specifically, an increase in mixed-government VC is associated decrease in outflow and increase in the inflow of new companies funded by private VCs and private VC funds. Likewise, pure-government VC investments effects on new investment rounds hold for the number of new companies funded and the number of private VC funds to invest internationally, compared to using the main dependent variable.

The results from Table 3 supports hypothesis 1a in 1% significance level, hypothesis 2a in 5% significance level, and hypotheses 1b and 2b in 10% significance level. The result show that overall, the association between government VC investments is more with international investment by domestic private VCs, compared with foreign VCs.

Considering the percentage of mixed- and pure government VC investments as independent variables also provide same insight in Table 3-4. 10 percent increase in mixed government VC investments relative to total government VC investments in a country is associated with 2.2 percent decrease and 1.4 percent increase in outgoing and incoming private

VC investments respectively. This statement suggests that if we assume there are an equal number of mixed- and pure- government VC investments, and mixed government VC investments increase and pure government VC investment decrease by 10 percent at the same time in a country, the domestic VC market experience at least 3.6 percent increase in attracting domestic and foreign VC funds. Conversely, a 10 percent increase in pure-government VC percentage is associated 2.5 percent decrease in the inflow of private VC.

The overall results from the regression analysis listed in Tables 4 suggest that more mixed-government VC investment compared to pure-government VC investment will decrease the outgoing, and will increase the incoming private VC investments. Conversely, more pure government VC investments compared with mixed government VC investments, increases the outgoing and decreases the incoming investments. Based on the results from Table 3-4, we can conclude more mixed-government VC compared with pure-government VC in source countries, crowd-in outgoing private VC investment, while more pure- versus mixed-government VC investments crowd-out incoming private VC investment. Moreover, the magnitude of effects of both of mixed- and pure- government VC is greater on domestic than international private VC.

Considering the statistical significance, the results from Table 3-4 allow us to reject the null hypothesis for hypothesis 3a and 4b only. First, as more mixed-government VC compared to pure-government VCs in the fund country (i.e., the source country of VC flows) decrease the outgoing of private VC. This effect is significant in most of our analysis arrangements. Second, more pure-government VC compared to mixed-government VC investments, decrease the incoming private VC investment flow.

### 3.4.3 Test for Endogeneity

It is likely that GVC investments are endogenous to cross-border PVC; i.e., there would be an unobserved factor (embedded in the error term) that will affect both domestic GVC and cross-border PVC simultaneously. To address such endogeneity, so far, I have used Arellano and Bover/Blundell and Bond dynamic panel data, which is appropriate for studies that encounter endogeneity (Roodman, 2006). However, I use instrumental variable analysis as well. A good instrument for my study should be correlated with domestic GVC and not correlated with the error term from equation 1. I will use the quality of GVCs in their exits from their investee companies as the instrument for mixed or pure-GVC investment strategies. Using exits to

measure VC quality is a common practice in VC literature (Dai et al., 2012; Nahata, 2008). The justification for such operationalization is straightforward in the context of private venture capital industry, where the success of the VC firm is closely tied to the exits, which determines the survival of private VC firms. Regarding GVCs though, the successful outcomes might refer to multiple contexts, such as promoting more active entrepreneurship environment in the society, being supportive of the VC industry; or, having successful exits from their investees (Colombo et al., 2014). Here I assume the major measure of GVC quality is their exit performance from their investee companies, as used by other scholars (Cumming and MacIntosh, 2006). As Thomson does not provide the returns of VC exits, I use successful and unsuccessful exits by GVC as instruments for mixed and pure-GVC investments respectively. VC scholars have widely used successful exit, usually through IPO or a merger and acquisition as a proxy for success, and other exit outcomes as unsuccessful exit performance (Cumming and Johan, 2013). I use Thomson ONE Private Equity to access exit data of GVC investments. I count successful and unsuccessful exits by GVC for each country-year for all of the countries in my sample, and standardize them by size domestic private VC new investment rounds. Instrumental variables can be added to the main model by declaring the link between endogenous variables and instruments (Roodman, 2006). Nevertheless, I also admit the limitations of this approach and believe that further research could clarify the causal effects.

I analyze the endogeneity of domestic mixed- and pure-GVC with respect to cross-border PVC investments. The coefficients for both the number and amounts of domestic GVC as a driving source for both outgoing and incoming cross-border PVC investments remain positive in all cases and significant in most of the cases. Table 3-5 reports bilateral country-level regression using macroeconomic control variables for both the source and destination countries. I use successful and unsuccessful exits by GVC as instruments for mixed and pure-GVC investments respectively. After using instrumental variables, the effect of the domestic number of mixed- and pure- GVCs in both the source and destination countries of VC investment flows did not change in magnitude and significant. Overall, the results from table 5 are stable compared to my main results discussed earlier in regression analysis section.

Table 3-5--Bilateral country-level regression analysis using macroeconomic factors as controls and instruments for domestic GVC investments. Main independent variables are logarithmic transformed count variables of GVC which are standardized by the size of local PVC (variables 4 and 5 from Table 3-1). In models 1-3 dependent variable is the number of new investment rounds PVCSD NNIR (variable 1 in Table 3-1); in models 4-6 dependent variable is the number of new enterprises PVCSD NNE (variable 2 in Table 3-1). In models 7-9 dependent variable is the number of new Funds PVCSD NF (variable 2 in Table 3-1). All regressions use the Arellano and Bover/Blundell and Bond (ABBB) dynamic panel data regression model. The panel identifier is the ordered pair of 'source country-destination country'. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| **Dependent variable:** | Number of new Investment Rounds $PVC_{SD}$ NNIR | | | Number of new enterprises $PVC_{SD}$ NNE | | | Number of new Funds $PVC_{SD}$ NF | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** |
| GVC mixed-$NNIR_S$ | -0.0295* | | -0.1375*** | -0.0382*** | | -0.1139*** | -0.0351*** | | -0.1252*** |
| | *(0.015)* | | *(0.041)* | *(0.012)* | | *(0.036)* | *(0.013)* | | *(0.032)* |
| GVC mixed-$NNIR_D$ | 0.0100 | | 0.0617 | -0.0079 | | 0.0307 | -0.0149 | | 0.0432 |
| | *(0.019)* | | *(0.038)* | *(0.014)* | | *(0.031)* | *(0.015)* | | *(0.032)* |
| GVC pure-$NNIR_S$ | | 0.0281 | 0.1082*** | | 0.0084 | 0.0769** | | 0.0109 | 0.0926*** |
| | | *(0.024)* | *(0.041)* | | *(0.018)* | *(0.036)* | | *(0.019)* | *(0.032)* |
| GVC pure-$NNIR_D$ | | -0.0037 | -0.0651* | | -0.0086 | -0.0465* | | -0.0251 | -0.0770*** |
| | | *(0.022)* | *(0.034)* | | *(0.017)* | *(0.026)* | | *(0.018)* | *(0.029)* |
| Lagged dependent variable | 0.5668*** | 0.5743*** | 0.3141*** | 0.5814*** | 0.6000*** | 0.2760*** | 0.5751*** | 0.5742*** | 0.3163*** |
| | *(0.100)* | *(0.095)* | *(0.106)* | *(0.085)* | *(0.080)* | *(0.089)* | *(0.105)* | *(0.103)* | *(0.112)* |
| $GDP_S$ | 0.0749*** | 0.0204 | 0.1364*** | 0.0546** | 0.0196 | 0.1090*** | 0.0452** | 0.0168 | 0.1025*** |
| | *(0.027)* | *(0.024)* | *(0.036)* | *(0.022)* | *(0.020)* | *(0.028)* | *(0.022)* | *(0.020)* | *(0.029)* |
| Market $Capitalization_S$ | 0.0213 | 0.0200 | 0.0438 | 0.0309 | 0.0073 | 0.0426 | 0.0151 | 0.0143 | 0.0410 |
| | *(0.031)* | *(0.030)* | *(0.040)* | *(0.024)* | *(0.024)* | *(0.033)* | *(0.026)* | *(0.027)* | *(0.034)* |
| R&D $Expenditures_S$ | -0.0331 | 0.0708 | -0.0397 | -0.0463 | 0.0328 | -0.0672 | 0.0085 | 0.0692 | 0.0101 |
| | *(0.095)* | *(0.093)* | *(0.132)* | *(0.068)* | *(0.068)* | *(0.101)* | *(0.077)* | *(0.075)* | *(0.110)* |
| $Taxes_S$ | -0.1528*** | -0.1281*** | -0.3068*** | -0.1302*** | -0.1119*** | -0.2707*** | -0.1310*** | -0.1221*** | -0.2530*** |
| | *(0.047)* | *(0.047)* | *(0.072)* | *(0.034)* | *(0.036)* | *(0.058)* | *(0.040)* | *(0.042)* | *(0.056)* |
| $Patent_S$ | 0.0492* | 0.0015 | 0.1122*** | 0.0416** | 0.0116 | 0.0872*** | 0.0322 | 0.0046 | 0.0847** |
| | *(0.028)* | *(0.025)* | *(0.042)* | *(0.020)* | *(0.019)* | *(0.033)* | *(0.022)* | *(0.021)* | *(0.035)* |

| **Dependent variable:** | Number of new Investment Rounds $PVC_{SD}$ NNIR | | | Number of new enterprises $PVC_{SD}$ NNE | | | Number of new Funds $PVC_{SD}$ NF | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** |
| VC legal $score_S$ | 0.1600* | 0.0870 | 0.2671** | 0.1636** | 0.1302* | 0.2296*** | 0.1379** | 0.0878 | 0.1869** |
| | *(0.090)* | *(0.080)* | *(0.106)* | *(0.067)* | *(0.070)* | *(0.081)* | *(0.070)* | *(0.073)* | *(0.083)* |
| $GDP_D$ | -0.0051 | -0.0058 | -0.0437 | -0.0099 | 0.0056 | -0.0293 | -0.0154 | 0.0019 | -0.0311 |
| | *(0.033)* | *(0.029)* | *(0.043)* | *(0.026)* | *(0.025)* | *(0.037)* | *(0.028)* | *(0.024)* | *(0.035)* |
| Market $Capitalization_D$ | -0.0805** | -0.1226*** | -0.1032*** | -0.0768*** | -0.0841*** | -0.0865*** | -0.0412 | -0.0772*** | -0.0749** |
| | *(0.034)* | *(0.030)* | *(0.037)* | *(0.028)* | *(0.028)* | *(0.030)* | *(0.029)* | *(0.027)* | *(0.031)* |
| R&D $Expenditures_D$ | 0.1012 | 0.1374 | 0.2715* | 0.0561 | 0.0226 | 0.1439 | 0.0767 | 0.0503 | 0.1622 |
| | *(0.106)* | *(0.100)* | *(0.158)* | *(0.076)* | *(0.078)* | *(0.126)* | *(0.085)* | *(0.081)* | *(0.130)* |
| $Taxes_D$ | -0.0564 | -0.0560 | -0.1023** | -0.0410 | -0.0459* | -0.0846** | -0.0359 | -0.0355 | -0.0793* |
| | *(0.041)* | *(0.034)* | *(0.051)* | *(0.031)* | *(0.027)* | *(0.038)* | *(0.030)* | *(0.027)* | *(0.041)* |
| $Patent_D$ | 0.0334 | 0.0348 | 0.0335 | 0.0323 | 0.0367 | 0.0376 | 0.0234 | 0.0330 | 0.0320 |
| | *(0.036)* | *(0.034)* | *(0.057)* | *(0.023)* | *(0.024)* | *(0.040)* | *(0.028)* | *(0.026)* | *(0.045)* |
| VC legal $score_D$ | 0.2571*** | 0.2947*** | 0.3701*** | 0.2205*** | 0.2178*** | 0.3379*** | 0.2256*** | 0.2580*** | 0.3906*** |
| | *(0.086)* | *(0.083)* | *(0.099)* | *(0.073)* | *(0.076)* | *(0.078)* | *(0.073)* | *(0.076)* | *(0.081)* |
| _cons | -0.4063 | 0.1232 | -0.4283 | -0.2341 | 0.0214 | -0.2717 | -0.1998 | 0.0001 | -0.4038 |
| | *(0.388)* | *(0.364)* | *(0.599)* | *(0.303)* | *(0.310)* | *(0.448)* | *(0.325)* | *(0.285)* | *(0.474)* |
| Number of observations | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 | 10,400 |
| Hansen test of joint validity of instruments (p-value) | *0.034* | *0.065* | *0.002* | *0.047* | *0.029* | *0.003* | *0.040* | *0.020* | *0.001* |
| Arellano-Bond test for AR(2) in differences (p-value) | *0.013* | *0.011* | *0.139* | *0.007* | *0.006* | *0.193* | *0.006* | *0.006* | *0.082* |
| Arellano-Bond test for AR(3) in differences (p-value) | *0.340* | *0.326* | *0.327* | *0.425* | *0.415* | *0.439* | *0.085* | *0.081* | *0.090* |

### 3.4.4 Robustness Tests

In this section, I show how the magnitude of the results is sensitive to the use of different structures in the regressions. I test for robustness by using different time periods and different countries in the sample.

Regarding different time periods--four different periods are selected. First, I divide 1998-2013 into two equal periods of eight years: 1998-2005 and 2006-2013. Moreover, I test for periods after the Internet bubble (2000-2007) and after the stock market crash (2008-2013). Table 3-6 shows the sensitivity of results for using different time periods. The significance of the results is not sensitive to different time periods, although the magnitude is the same in sign but different in weight for different time periods.

Regarding different countries, I first exclude the U.S. as a fund (source) or investment (destination) country, from my sample. Second, as some countries in my sample have few GVC investments, I limit the sample to countries with at least 50 new GVC investment rounds from 1998-2013 (see Table 3-2 for a list of countries in the sample). Third, I limit my sample to include all country-years, in which at least one new GVC investment round has occurred. Finally, I limit the sample to European countries with at least 50 new GVC investment rounds from 1998-2013; these countries include Germany, United Kingdom, Ireland, Sweden, Denmark, Spain, Belgium, Finland, Netherlands, Norway, Portugal, and France. Table 3-7 shows the sensitivity of results for different countries in the sample. Overall the results remain stable after including different countries in the sample. This shows that my main results are not due to the inclusion of specific countries in my main sample.

Table 3-6--Robustness test based on different time periods.
Main independent variables are logarithmic transformed count variables of GVC which are standardized by the size of local PVC (variables 4 and 5 from Table 1). In all models dependent variable is the number of new investment rounds $PVC_{SD}$ NNIR (variable 1 in Table 1). All regressions use the Arellano and Bover/Blundell and Bond (ABBB) dynamic panel data regression model. The panel identifier is the ordered pair of 'source country-destination country'. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| Time period of sample | 1998-2005 | | 2006-2013 | | 2000-2007 | | 2008-2013 | |
|---|---|---|---|---|---|---|---|---|
| Model | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| GVC mixed-$NNIR_S$ | -0.0232** | | -0.0384* | | -0.0097* | | -0.0533** | |
| | *(0.036)* | | *(0.041)* | | *(0.056)* | | *(0.050)* | |
| GVC mixed-$NNIR_D$ | 0.0071* | | 0.0164 | | 0.0706 | | 0.0618 | |
| | *(0.036)* | | *(0.044)* | | *(0.069)* | | *(0.062)* | |
| GVC pure-$NNIR_S$ | | 0.0418** | | 0.1618** | | 0.0328* | | 0.0061* |
| | | *(0.089)* | | *(0.069)* | | *(0.125)* | | *(0.100)* |
| GVC pure-$NNIR_D$ | | 0.1361 | | -0.0760 | | 0.0177 | | -0.0892 |
| | | *(0.107)* | | *(0.061)* | | *(0.081)* | | *(0.088)* |
| Lagged dependent variable | 0.7187*** | 0.7558*** | 0.2960*** | 0.2812*** | 0.5818*** | 0.6277*** | 0.6914*** | 0.6532*** |
| | *(0.089)* | *(0.083)* | *(0.069)* | *(0.071)* | *(0.125)* | *(0.100)* | *(0.125)* | *(0.143)* |
| $GDP_S$ | 0.0724* | 0.0324 | 0.0177 | -0.0095 | 0.0205 | -0.0319 | 0.0446 | 0.1030** |
| | *(0.038)* | *(0.044)* | *(0.039)* | *(0.038)* | *(0.043)* | *(0.050)* | *(0.036)* | *(0.046)* |
| Market $Capitalization_S$ | -0.0257 | -0.0091 | 0.0256 | 0.0085 | 0.0607 | -0.0003 | 0.0020 | -0.0242 |
| | *(0.057)* | *(0.059)* | *(0.038)* | *(0.042)* | *(0.056)* | *(0.074)* | *(0.045)* | *(0.049)* |
| R&D $Expenditures_S$ | 0.0243 | 0.0908 | 0.2073 | 0.1712 | 0.1432 | 0.2355* | -0.0578 | -0.1520 |
| | *(0.123)* | *(0.136)* | *(0.126)* | *(0.117)* | *(0.118)* | *(0.126)* | *(0.117)* | *(0.123)* |
| $Taxes_S$ | -0.0835 | -0.0263 | -0.0708 | -0.1605** | -0.1409* | -0.1014 | -0.0122 | -0.0954 |
| | *(0.074)* | *(0.077)* | *(0.069)* | *(0.067)* | *(0.084)* | *(0.083)* | *(0.065)* | *(0.076)* |
| $Patent_S$ | 0.0473 | 0.0428 | -0.0024 | -0.0980* | 0.0400 | 0.0116 | -0.0081 | 0.0413 |
| | *(0.043)* | *(0.049)* | *(0.044)* | *(0.051)* | *(0.045)* | *(0.060)* | *(0.038)* | *(0.069)* |
| VC $legal\ score_S$ | 0.2617 | 0.3344* | 0.0723 | -0.1207 | 0.2028 | 0.1174 | -0.1277 | -0.0661 |
| | *(0.162)* | *(0.175)* | *(0.112)* | *(0.118)* | *(0.153)* | *(0.211)* | *(0.124)* | *(0.176)* |
| $GDP_D$ | -0.0282 | -0.0297 | -0.0247 | -0.0256 | -0.0610 | -0.0837 | 0.0264 | -0.0052 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *(0.047)* | *(0.052)* | *(0.044)* | *(0.046)* | *(0.058)* | *(0.059)* | *(0.061)* | *(0.058)* |
| Market Capitalization$_D$ | -0.1372** | -0.1782*** | -0.1488*** | -0.0564 | -0.1641*** | -0.0809 | -0.1388** | -0.0924 |
| | *(0.062)* | *(0.067)* | *(0.046)* | *(0.046)* | *(0.063)* | *(0.076)* | *(0.066)* | *(0.062)* |
| R&D Expenditures$_D$ | 0.2998** | 0.3521** | 0.2023 | 0.2221* | 0.2033 | 0.1865 | -0.1511 | -0.0714 |
| | *(0.145)* | *(0.176)* | *(0.131)* | *(0.130)* | *(0.135)* | *(0.138)* | *(0.173)* | *(0.170)* |
| Taxes$_D$ | -0.0313 | -0.1354 | -0.0728 | -0.0439 | -0.0384 | -0.0554 | -0.0400 | -0.0114 |
| | *(0.053)* | *(0.107)* | *(0.054)* | *(0.052)* | *(0.067)* | *(0.080)* | *(0.049)* | *(0.056)* |
| Patent$_D$ | 0.0096 | 0.0031 | 0.0101 | 0.0447 | -0.0016 | -0.0312 | 0.0181 | -0.0290 |
| | *(0.047)* | *(0.050)* | *(0.044)* | *(0.050)* | *(0.061)* | *(0.057)* | *(0.055)* | *(0.070)* |
| VC legal score$_D$ | 0.1646 | 0.0985 | 0.3949*** | 0.3856*** | 0.1920 | 0.2432 | 0.3123* | 0.2024 |
| | *(0.179)* | *(0.190)* | *(0.115)* | *(0.130)* | *(0.154)* | *(0.180)* | *(0.169)* | *(0.170)* |
| _cons | -0.3347 | 0.0519 | 0.1040 | 0.5862 | 0.5203 | 1.0895 | -0.1077 | -0.1049 |
| | *(0.652)* | *(0.835)* | *(0.501)* | *(0.547)* | *(0.744)* | *(1.045)* | *(0.579)* | *(0.572)* |
| Number of observations | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 3,900 | 3,900 |
| Hansen test of joint validity of instruments (p-value) | *0.078* | *0.038* | *0.083* | *0.600* | *0.255* | *0.165* | *0.683* | *0.551* |
| Arellano-Bond test for AR(2) in differences (p-value) | *0.027* | *0.024* | *0.847* | *0.782* | *0.064* | *0.044* | *0.552* | *0.553* |
| Arellano-Bond test for AR(3) in differences (p-value) | *0.117* | *0.116* | *0.836* | *0.899* | *0.803* | *0.822* | *0.722* | *0.736* |

Table 3-7-- Robustness test based on different sample of countries.
Main independent variables are logarithmic transformed count variables of GVC which are standardized by the size of local PVC (variables 4 and 5 from Table 1). In all models dependent variable is the number of new investment rounds $PVC_{SD}$ NNIR (variable 1 in Table 1). All regressions use the Arellano and Bover/Blundell and Bond (ABBB) dynamic panel data regression model. The panel identifier is the ordered pair of 'source country-destination country'. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| Sample of countries: | Without U.S. | | More than 50 GVC NNIR over 1998-2013 | | European countries with more than 50 GVC NNIR over 1998-2013 | | At least 1 obs of GVC NNIR per country-year | |
|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| GVC mixed-$NNIR_S$ | -0.0558** | | -0.0404** | | -0.3347*** | | -0.0586** | |
| | *(0.027)* | | *(0.031)* | | *(0.091)* | | *(0.057)* | |
| GVC mixed-$NNIR_D$ | 0.0406 | | 0.0040* | | 0.0762* | | 0.0314 | |
| | *(0.034)* | | *(0.044)* | | *(0.088)* | | *(0.052)* | |
| GVC pure-$NNIR_S$ | | 0.0263** | | 0.0148** | | -0.2963* | | -0.0452* |
| | | *(0.060)* | | *(0.114)* | | *(0.234)* | | *(0.089)* |
| GVC pure-$NNIR_D$ | | -0.0723 | | -0.2320** | | -0.1597** | | -0.1029 |
| | | *(0.048)* | | *(0.115)* | | *(0.205)* | | *(0.092)* |
| Lagged dependent variable | 0.5499*** | 0.5563*** | 0.5729*** | 0.5740*** | 0.4547*** | 0.4739*** | 0.5086*** | 0.5145*** |
| | *(0.101)* | *(0.096)* | *(0.094)* | *(0.092)* | *(0.074)* | *(0.073)* | *(0.131)* | *(0.129)* |
| $GDP_S$ | 0.0757** | 0.0328 | 0.1015** | 0.0045 | 0.2016 | 0.1191 | 0.0861 | 0.0480 |
| | *(0.030)* | *(0.025)* | *(0.045)* | *(0.049)* | *(0.153)* | *(0.135)* | *(0.059)* | *(0.041)* |
| Market $Capitalization_S$ | 0.0225 | 0.0320 | 0.0548 | 0.0426 | -0.0472 | -0.1126 | 0.0053 | 0.0211 |
| | *(0.035)* | *(0.034)* | *(0.047)* | *(0.055)* | *(0.154)* | *(0.173)* | *(0.049)* | *(0.041)* |
| R&D $Expenditures_S$ | -0.0467 | 0.0444 | -0.1079 | -0.0280 | 0.3286 | 0.4062 | -0.0507 | 0.0462 |
| | *(0.108)* | *(0.102)* | *(0.169)* | *(0.184)* | *(0.479)* | *(0.390)* | *(0.189)* | *(0.160)* |
| $Taxes_S$ | -0.1959*** | -0.1495*** | -0.2701*** | -0.2490** | 0.1815 | 0.1158 | -0.1738** | -0.1142 |
| | *(0.053)* | *(0.048)* | *(0.072)* | *(0.108)* | *(0.226)* | *(0.248)* | *(0.076)* | *(0.092)* |
| $Patent_S$ | 0.0340 | -0.0018 | 0.0718 | -0.0219 | 0.5200** | 0.3212 | 0.0704 | 0.0208 |
| | *(0.028)* | *(0.029)* | *(0.050)* | *(0.059)* | *(0.246)* | *(0.275)* | *(0.065)* | *(0.037)* |
| VC $legal\ score_S$ | 0.1794* | 0.0576 | 0.3894*** | 0.2710** | 0.7462** | 0.6588* | 0.3855*** | 0.1689 |
| | *(0.102)* | *(0.092)* | *(0.111)* | *(0.117)* | *(0.365)* | *(0.368)* | *(0.133)* | *(0.127)* |
| $GDP_D$ | -0.0104 | -0.0090 | -0.0649 | 0.0027 | -0.1693 | -0.1139 | -0.0907 | -0.0464 |
| | *(0.037)* | *(0.033)* | *(0.051)* | *(0.058)* | *(0.157)* | *(0.181)* | *(0.084)* | *(0.057)* |
| Market $Capitalization_D$ | -0.0836** | -0.1050*** | -0.0695 | -0.0533 | -0.0337 | 0.0230 | -0.0799 | -0.0876* |
| | *(0.038)* | *(0.034)* | *(0.051)* | *(0.042)* | *(0.164)* | *(0.160)* | *(0.052)* | *(0.048)* |

| Sample of countries: | Without U.S. | | More than 50 GVC NNIR over 1998-2013 | | European countries with more than 50 GVC NNIR over 1998-2013 | | At least 1 obs of GVC NNIR per country-year | |
|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| R&D Expenditures$_D$ | 0.1244 | 0.1464 | 0.3018* | 0.5224*** | 0.9777** | 1.0560*** | 0.2518 | 0.1937 |
| | *(0.123)* | *(0.115)* | *(0.160)* | *(0.184)* | *(0.386)* | *(0.406)* | *(0.185)* | *(0.150)* |
| Taxes$_D$ | -0.0753 | -0.0717* | -0.0849 | 0.0821 | -0.0523 | -0.0586 | -0.0588 | 0.0083 |
| | *(0.046)* | *(0.040)* | *(0.060)* | *(0.096)* | *(0.386)* | *(0.320)* | *(0.060)* | *(0.076)* |
| Patent$_D$ | 0.0138 | 0.0102 | -0.0099 | 0.1319 | -0.2018 | 0.0814 | -0.0189 | 0.0065 |
| | *(0.043)* | *(0.038)* | *(0.064)* | *(0.092)* | *(0.395)* | *(0.341)* | *(0.066)* | *(0.053)* |
| VC legal score$_D$ | 0.2904*** | 0.2768*** | 0.2980*** | 0.2243** | 0.3575 | 0.3584 | 0.3238** | 0.3713*** |
| | *(0.100)* | *(0.093)* | *(0.103)* | *(0.110)* | *(0.304)* | *(0.287)* | *(0.142)* | *(0.126)* |
| _cons | -0.2219 | 0.2326 | -0.2941 | -0.4050 | -3.0987 | -2.2923 | -0.1193 | -0.1688 |
| | *(0.437)* | *(0.398)* | *(0.634)* | *(0.591)* | *(2.099)* | *(2.041)* | *(0.662)* | *(0.598)* |
| Number of observations | 9,600 | 9,600 | 5,662 | 5,662 | 1,980 | 1,980 | 3,464 | 3,464 |
| Hansen test of joint validity of instruments (p-value) | *0.026* | *0.105* | *0.001* | *0.004* | *0.998* | *0.156* | *0.267* | *0.282* |
| Arellano-Bond test for AR(2) in differences (p-value) | *0.015* | *0.013* | *0.362* | *0.356* | *0.196* | *0.169* | *0.605* | *0.604* |
| Arellano-Bond test for AR(3) in differences (p-value) | *0.347* | *0.335* | *0.788* | *0.800* | *0.387* | *0.451* | *0.947* | *0.949* |

## 3.5 Discussion

I investigated whether and how government venture capital investment structure (i.e. pure- and mixed-government VCs) affects the domestic pool of private venture capital internationally. The analysis used a bilateral country-level framework. I transformed VC investment data from Thomson ONE, which contains 125,310 new investment rounds, into standard panel data, consisting of 10,400 observations.

The contributions of the study are twofold. First, it sheds light on the intersection between government VC and international VC investment studies. Findings show that the presence of domestic GVC is a determinant of both incoming and outgoing cross-border VC investment. This area has not been empirically investigated by scholars, except for verbal arguments made by Lerner (2009). Second, I contribute to the literature on the crowding-out and crowding-in effect of different structures of GVC investments namely, mixed structured and pure structured government VC, using an international perspective.

The results of this study are in line with recent literature, which shows that government VCs have successful outcomes in mixed structured investments (i.e. when they syndicate with PVC funds), and unsuccessful outcomes in pure structured investments (i.e. when they are sole investor) (Bertoni and Tykvová, 2015; Brander et al., 2015; Cumming et al., 2014; Grilli and Murtinu, 2014). I showed that more mixed versus pure structured government VC investments in a country is associated with more incoming foreign and less outgoing cross-border VC investments by private VC funds.

# Chapter 4

# Revisiting Canadian Public Policy on Venture Capital: Crowding-out or Displacing

## 4.1 Introduction

Every country desires to have an entrepreneurial ecosystem like Silicon Valley's; however, access to risk-oriented capital for entrepreneurs is a major block in promoting such ecosystems (Alperovych et al., 2015; Bertoni and Tykvová, 2015; Cumming, 2007; Lerner, 2009). Thus, many governments have themselves been spending great amounts of money on venture capital (VC) efforts to promote such ecosystems (Cumming et al., 2016; Vanacker et al., 2014; Zacharakis et al., 2007). While the specific objectives and structure of GVC investment vehicles may vary, one of their underlying objectives is to compensate for the scarcity of private VC investments (Cumming, 2013). In this essay, I will revisit the topic of how the Canadian version of government VC practices affects private VC investments in that country.

Labour Sponsored Venture Capital Corporations (LSVCCs) and the Business Development Bank of Canada (BDC) have been Canada's major programs supporting an entrepreneurial ecosystem. As with every other government's VC program, there is an academic interest in the following question: are government VC funds in Canada performing as intended to promote an entrepreneurial ecosystem? I investigate whether government VC in Canada 'crowds-out' domestic private VCs and whether adverse practices of government venture capital may displace domestic private VC to other countries. Although there is no doubt that either explanation highlights the harmful effects of government VC programs in Canada, the latter is less damning

than the former explanation. In this study, I analyze the effect of government VC on domestic and cross-border private VC investments in parallel to each other.

To test my conjectures, I use Canadian VC investment data during 1994-2013 from the Thomson Private Equity database and event history (survival) analysis based on yearly observations. I set up two unique units of analysis to track the activities of private and government VC firms in different provinces and industries. My contribution is that I disaggregate the domestic and cross-border VC investments and study the effect of government VC on each in parallel. This approach is different from prior studies that focused on the pool of domestic VC investments and omitted the cross-border venture capital investments (Cumming and MacIntosh, 2007, 2006). Taking cross-border VC investments into consideration helps to explain whether adverse government VC practices in Canada have displaced or crowded-out private VC investments. The results show that the investments by all types of government VC firms in Canada were associated with an increased likelihood of private VC firm engaging again in domestic investment, although this effect was negligible. However, government VC practices tended to displace domestic private VC to cross-border investments, mainly to the United States.

This essay is organized as follows. Section 4.2 discusses related studies; Section 4.3 explores hypotheses development; Section 4.4 introduces the methodology of the study; Section 4.5 covers results; and Section 4.6 contains concluding remarks.

## 4.2 Literature Review

Economic theory has provided sufficient grounds for government intervention in financing research and development (R&D) and innovation. The theoretical basis for government intervention can be explained by asymmetric information. The main element of R&D undertaking is knowledge but there is a wide gap between a private investor's valuation of a start-up's knowledge capital and the entrepreneur's expectation of its value. This gap can lead to an undersupply of funds for R&D in the market. As described by Hall (2002), the more complex the new technology, the more difficult it is for an external investor to assess risk and the more difficult it is for the firm to obtain financing. Information asymmetry can cause agency problems

such as moral hazards, adverse selection, and free riding[4]. Market failures occur, as investors as agents are not willing to deal with entrepreneurs, who know the business better than investors and can easily underperform without principal knowledge. The reasoning above provides the motivation for government intervention in R&D to address market failures. In this section, I summarize studies that analyzed government VC. I categorize previous studies in government VC based on the region or countries analyzed: global studies, European Countries, the United States; and studies that analyze other countries (United Kingdom, and Australia). Finally, I provide an overview of Canadian Labour-Sponsored Venture Capital Corporations (LSVCCs).

### 4.2.1 Global Studies

Brander et al. (2015) conduct an international analysis of government VC policies and show that more government VC funding results in more overall VC funding per enterprise. They intend to answer the question of whether government VCs expand private venture capital funds and/or if government VCs increase the probability of successful exits. They claim that syndicated investments by government and private venture capital (called mixed government VC funding) are associated with higher total investment and more favorable exit outcomes. Their results show that for a mixed government VC investment (although the average investment per investor fund is lower) the number of syndicated investors and the investment amount is higher. On top of this, they also claim that mixed government VC investments increased the pool of investment funds of private VC investments. Conversely, they show that enterprises which have sole government investor funds (called pure government VC funding), have a lower investment amount. In the market level analysis, they found a positive relation between government VC funding and aggregate investment and number of enterprises. On assessing exit performance, they claim that the likelihood of successful exits increases with mixed government VC funding.

### 4.2.2 European Countries

Leleux and Surlemont (2003) studied public VC in 15 European countries to ascertain whether government VCs in Europe either had crowding-out effect (removing private VC industry) or

[4] For a complete explanation and examples see (Cumming and Johan, 2013, pp. 46–56).

seeding effect (promoting private VC industry). They showed that there was a negative association between the magnitude of government VC investments and the size of the venture capital industry, while controlling for country-specific factors. However, they showed that public involvement had increased the amount of funds increased the level of VC funding available in different industries. They have also shown that government VC help develop investments in the areas which is not attractive for private VCs (Leleux and Surlemont, 2003).

Buzzacchi et al. (2013), drawing on European Investment Fund data, found that public investment showed a preference for long-term investment. Moreover, unlike private VCs, which are concerned only with profitability and returns on investments, public investors have diverse expectations from entrepreneurs, such as knowledge spill over. their analysis of public investment patterns in connection with the lower incidences of write-offs (unsuccessful exit from investment), suggested that higher public participation in the equity of investee companies are correlated with a lower probability of write-offs, but an extended duration for the investment (Buzzacchi et al., 2013).

Cumming and his colleagues (2014) analyzed investor-side performance by comparing positive and negative exit outcomes. They focus ed on comparing the influence of government VC funds, private VC funds (Independent Venture Capitals), and their syndicated investments in positive exits. Exploring whether different exit outcome might arise with different investment syndication structures between private VC and government VC, they found that private VCs positively influence the likelihood of reaching an exit though IPO or M&A. In contrast, government VCs have a negligible impact.  Syndicated VC investments between private VCs and government VCs lead to a higher likelihood of a positive exit than do independent VC-backed investments (Cumming et al., 2014). They also showed that VC size, which is the annual number of VC investors in the year before the analysis, makes a negative exit outcome less likely. On the other hand VC diversity, which means different fund types for each investee firm in the year preceding the analysis, will make a negative exit outcome more likely (Cumming et al., 2014).

Grilli and Murtinu (2014) compared the impact of government VC and private VC on the growth of European high-tech entrepreneurial firms. In doing so, they analyzed the impact of government VC and private VC when they invest separately, co-financed (with first only one investing, followed by the other latter), and syndicated (when both invest at the same time). They also showed that young investee firms who get their financing from private VCs generate remarkable growth in sales and employees compared to firms supported by public VC financing. When government VCs are either the leader in syndicated investments or the sole investor, the growth of young companies is influenced only in the initial stages of development.

Based on the study by Bertoni & Tykvová (2015), government VC does not spur innovation and invention in public companies and other ventures where VC is directed. The study found that there were fewer innovations in government VC invested companies as compared to private VC, which was evidenced by fewer or no patents of their products and services. Besides, it was evident that the performance of government VC companies was poor with low productivity compared to private VC firms. The private VC were found to foster patents, thus encouraging inventions. It was found that government VC management follows strict guidelines, and lacks autonomy, that affects the functioning of the management and thus restricts innovativeness. They found that companies that receive funding from a combination of government and private VCs will have more inventions, when compared with sole government VC investments.

Bertoni et al. (2015) investigated different types of VCs with a sample of European VC investments between 1994 and 2004. They suggested that private venture capitals invest in low-risk businesses like telecommunication and internet services as opposed to capital-intensive ventures like engineering and R&D. Bank-oriented VCs in Europe usually invest in low-risk ventures, and do not invest in new companies and those with few employees (less than ten). On the other hand, they show that government VCs invest in capital-intensive and high-technology businesses. Besides, they also invest in small and new companies as compared to other types of VCs. They found government VCs in Europe suffer from local bias, as they usually invest in companies located closer than 10 km to their head quarter. They have shown, overall, government VCs were unsuccessful in filling the equity gap in early stage deals, and possibly crowd out private VC investments (Bertoni et al., 2015). Luukkonen et al. (2013) evaluated the

added value of government VC in comparison to the private VC. They used survey data from investee companies in seven European countries  determine the benefits of private and government investors. The findings indicated that the government VC and private VC were different on some of the value adding profiles. Private VC performance was oriented to improvements of the business such as focusing on the management team, board members and exit strategies. Another finding was that, government VC contribution to the investment was little compared to private VCs, regarding the activities of that are related to the profitability of the business. However, they could not find any differences on having adverse effects between government VC and private VCs (Luukkonen et al., 2013).

### 4.2.3 United States

Lerner (1996) suggests that in the United States, the empirical analysis has shown that government venture capital had little effectiveness. The small business innovation research (SBIR) program has shown that even in the active promotion of government VC there is little economic impact in the United States. The reason that these funds have a slight effect is that most of them are used by the government for political purposes. However, Lerner showed that firms that won SBIR awards grew faster; in sales or employment; than non-awardees firms. Yet, these positive effects of SBIR awards were restricted to firms in areas with extensive private VC activity, mainly due to a huge prevalence of spillovers in the United States, suggesting the complimentary effect of government VC to private (Lerner, 1996).

Lerner (2002) suggests that government should be involved in the provision of the finance to young firms that are using very high technology applications. The government VC would rather advance the subsidy investments to private investors rather than direct investments; the appropriateness of it is that it captures the spillover effects that are brought about by the research and development. The spillover may achieve the imitations that are brought into the market by the competitors and the enhancements of the complementary products. Lerner (Lerner, 2002) advances that the administrators of public venture capital should be very cautious in the issuance of these funds. They should be able to conduct the precommercial visibility studies and come up with a way of selecting the winners to be allocated the funds. They should also be able to remove

some bottlenecks that ensure that the companies are not afraid in the usage of their resources in venturing into risky businesses.

Audretsch (2003) aimed at identifying the role of the United States' public policy for development of the Small Business Innovation Research (SBIR) program. His objective was to clarify if SBIR program linked international competitiveness and the promotion of small firms. He has shown that the SBIR program was successful in maintaining growth and innovation in high-technology small firms.

### 4.2.4 Other Countries

Munari, and Toschi (2015) investigated the provision of venture capital in the United Kingdom. In the UK, the government has supported programs that assist in improvement of the small firms so that they can secure the requisite financing for investment in innovation. Venture capital in the UK depends on the intensities of the innovation and how these funds do compare with private VCs. In the United Kingdom, the private venture capital fares better than government VC. Regarding the exit performance, the government VC ranks poorly as compared to the private VC. In the research carried out in this article, the results indicate that, in spite of the fact that the level of public VC investments increased in the UK , government VC funds had a lower influence on the success rate, staging and syndication of their VC investments. Moreover, they were unable to provide certification signal in order to attract private VC financing for their investee companies, mainly in poorly innovative areas.

Australian government VC policies have been reported by: Cumming (2007) for the Australian Investment Innovation Fund; Cumming and Johan (2013) for the Australian Pre-Seed Fund program. Both studies show a positive effect in that government VC investment increases the level of investment from non-government VC firms in the domestic market. Australian venture fund that was introduced in the equity funds in the period during 1982-2005 (Cumming, 2007). The program in Australia usually centers on the innovation investment fund (IIF). This program is made unique as it can partner with both the government and the private sector, through investing in the staging, portfolio, and the high-tech investments.

### 4.2.5 Canadian Government VC

The venture capital industry in Canada has faced criticism due to the involvement of the government in VC investments that are considered to be inefficiently organized. Such programs include the Federal government direct VC investment programs called Business Development Bank of Canada (BDC), and the Labour Sponsored Venture Capital Corporations (LSVCCs).

The federal government of Canada operates the Business Development Bank of Canada (BDC) and other entities[5]. They invest directly in young high-potential SMEs, and, recently, indirectly by contributing to other private VC funds. The BDC is reported to be ineffective in promoting private VC ecosystems (Guerini and Quas, 2016), mainly because its funds are entirely owned and managed by government entities, and the evidence in sections 2.1 and 2.2, its investment structures tend to have unsuccessful outcomes. More scholarly work has been devoted to reviewing the practices and effectiveness of LSVCCs than of BDCs.

LSVCCs are operated by provincial and federal government bodies in Canada. LSVCCs operated like mutual funds that are subsidized from taxes to attract funds from retail investors, and to invest the funds in private entrepreneurial firms (Cumming and MacIntosh, 2006). Both the federal government and provincial governments provide tax credits to LSVCC investors, to aid in the promotion and growth of small and midsized companies.

In the late 1990s and early 2000s, Canadian LSVCCs attracted billions of dollars in capital and would have been considered as the most dominant venture capital firm in Canada (Cumming and MacIntosh, 2006). LSVCC program began in Quebec in the early 1980s. By early 1990, the federal government and other provinces had also adopted the same structure, making it the dominant venture capital program in Canada in the 1990s and the early 2000s (Cumming and MacIntosh, 2006) . It aims at increasing the amount of venture capital funds that are available and attainable to Canadian investors, and providing the opportunity that individuals can invest in high-technology companies. There is no minimum investment amount, and anyone can invest

[5] The major entity in charge of VC investments is Business Development Bank of Canada (BDC). The other entities include Export Development Bank of Canada (EDC) and other entities with very few VC investments.

regardless of their net worth and the amount they can contribute (Cumming and MacIntosh, 2006).

An LSVCC fund can be incorporated in the various provinces that have passed the legislation requisite to allow its creation. In addition, provinces that have passed the federal legislation authorizing the operation of LSVCCs can also incorporate their fund in the jurisdiction. Depending on the provincial or federal government recognizing an LSVCC, several restrictions or statutory constraints may limit certain aspects of the program. The main restrictions are that (a) LSVCCs are subject to a constraint in operating in the jurisdictions they are sponsored in, and (b) there must be an eight-years investor lock-in period.

Cumming and MacIntosh (2007, 2006) investigated whether LSVCCs have crowded-out or displaced other venture capital organizations and whether they have been successful in expanding the pool of VC investments in Canada. They showed that in almost every jurisdiction in Canada, LSVCCs have displaced 100% of other VC types, and have not had a positive effect on increasing the pool of venture capital funds (Cumming and MacIntosh, 2006). One major specification of LSVCCs' adverse impacts is that they are legislated to be created in the form of corporation administrators, which is in contrast to the limited partnership structure of ordinary VC funds (Cumming and MacIntosh, 2007). The utilization of the corporate form additionally reduces legally binding adaptability in developing the combination of agreements that underlies LSVCC operation. Hypothetically, the utilization of the corporate form forces a more demanding disciplinary structure on LSVCC administration than I see in private, restricted associations. Mandatory corporate structure of LSVCCs requires that the shareholders choose the executives of the VC funds. Due to free-riding issues, this arrangement will compel shareholders to be less motivated in screening the VC fund managers.

As a consequence of the unsuccessful experience that the government of Ontario and Canada had with LSVCCs, such as the crowding-out of the venture capital industry which led to the dollars in the venture company industry being decided by inferior investment managers, both governments staged a reduction of LSVCC tax subsidy. Thus, the government of Ontario declared on September 30, 2005, that it would slowly dispense with the tax credit for individual

speculators putting resources into LSVCCs (Cumming and MacIntosh, 2006). Taking out the tax credit decreased the engaging quality of the funding assets to retail speculators in this way affecting the inflow of capital into LSVCCs in Ontario. The government of Ontario finally eliminated the tax credits in 2011 while the government of Canada withdrew in 2012 (Cumming et al., 2016).

## 4.3 Research Question Development

In this section, I draw on neoclassical economic theory and literature on government VC to question the effect of Canadian government VC on both of domestic and cross-border private VC investment in Canada.

Here I bring a heuristic discussion based on neoclassical economic theory on the effect of public capital on private capital (Aschauer, 1989). By assuming that similar individuals live competitively over a given period and building on neoclassical economics, Aschauer (1989) suggests that increase in public investment can either crowd-out or crowd-in private investments. The ambiguity of public investment expenditure will continue to affect private investment in a neoclassical economic sense. Two possible viewpoints exist which are: public and private stocks can be substituted, but the equilibrium can be attained if higher public investments crowd-out the same amount of private capital spending. Another viewpoint is that if government provision is strong enough, there can be an increase in private capital expenditures provided that public capital gives considerable external consequences on private elements of production.

Aschauer (1989) shows when public capital substitutes private capital it is likely that crowding-out occurs. Whereas, in case public capital complement private investments mainly in the infrastructure sector, for example investment in highways, airports, water systems etc., public capital will crowd-in private investments. Crowding out of private investment occurs when the higher the rate of public investment, the higher the national rate of capital growth beyond the desired level. He further elaborates that the crowding-out effect mainly depends on the extent to which the public investments substitute private investments, whether it provides productive benefits for private sector investment, whether the change in public investments is

permanent or temporary. if public capital substitutes, does not provide productive benefits based on its intended objectives, and is temporary the crowding-out effect prevails [6]. Based on Aschauer's reasoning (1989), the prediction for the effect of government VC on private VC in Canada is ambiguous. The time span of government VC programs in Canada is permanent, which suggests crowding-in effect. Whereas, the management and investment structure of government VC, makes it a substitute for private VCs in Canada, and suggests crowding-out effect. Moreover, the weak performance of government VC investments provides grounds for crowding-out effect. Cumming and MacIntosh (2007) reported that LSVCCs has weaker assessment and screening platforms in selecting and managing entrepreneurial firms than did private VCs. The obligatory utilization of the corporate form in LSVCC conceivably brings about these adverse impacts by reducing legally binding adaptability in developing the combination of agreements that underlies LSVCC operation. Consequently, Cumming and MacIntosh (2006) reported that LSVCCs had outbid other funds in the market by weakening the expected returns, as they get cheap tax subsidies. Consequently, institutional investors in the market had reduced their fund commitment with the increasing presence of LSVCCs (Cumming and MacIntosh, 2006).

Above discussion provides ground for development of my first research question on the effect of more provincial and federal government VC investments in a specific province and industry in Canada, on domestic VC investments by private VCs:

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[6] Aschauer's model (1989) suggests that private investment in market $i = i(\phi, i^g, c^g)$ is function of $\phi$=marginal product of private capital, $i^g$ public investment, and $c^g$ government consumption.

He presents the effect one unit increase in public spending on private investment can be modeled by:

$$-\left(\left(1 - u_{gc} - f_{gc}\right)/\phi\right) * \left(mpc^f - a * mpc\right)$$

where $mpc$ is marginal propensity to consume out of wealth, and, $u_{gc}$is the marginal rate of substitution of public for private services, $f_{gc}$ is marginal product of public spending in private production, and $mpc^f$ and $mpc$ marginal propensity to consume wealth now and in the future respective. $a$ =1, if the future change in public is the same as now, and $a = 0$ if the change in public investment is temporary.

The detailed analysis is not within the scope of this study, and can be followed in studies by Arrow and Kurz (1970), Aschauer (1988), and Aschauer and Greenwood (1985).

**Research Question 1:**

Does investment by Canadian government VC firms in the forms of LSVCC and BDC in a specific province-industry in Canada, increase or decrease the propensity of domestic private VC firms investing in that focal province-industry?

Furthermore, because of bidding-up of private VCs' rate of returns, it is possible that private VCs will be forced in lower investments, as they can not compete with government VCs who have access to cheap tax funds. As suggested by Lerner (2009, p. 122) private VCs who face competition with government VCs will look for investment opportunities in cross-border destinations. This suggestion is supported by international business and cross-border VC literature, which implies that convergence in culture enhances negotiations, and differences in culture discourage the formation of partnerships between local VCs and foreign companies. The fewer differences in the culture and language improve the nature of financial contracting, and lessen the severity of potential conflicts, and increases the overall performance of the investment (Dai and Nahata, 2016; Liu and Maula, 2016). Since Canada borders on the United States, who share the same language and a similar culture, and the United Kingdom, which has traditionally had a close relationship with Canada and shares a similar culture and language, Canadian private VCs can look to both of these countries for investment opportunities with fewer uncertainties.

Consequently, the effect of more investments by Canadian government VC might displace domestic private VC investment to international markets or might attract them to invest in domestic companies. Therefore this ambiguity provides ground for the following research question:

**Research Question 2:**

Does investment by Canadian government VC firms in the forms of LSVCC and BDC in a specific province-industry in Canada, displace private VC firms located in that focal province to a cross-border VC investment in that focal industry?

## 4.4 Methodology

### 4.4.1 Data

The data are from Thomson ONE Private Equity owned by Thomson Reuters. The database includes private equity investments, buyouts, mergers, and acquisitions for more than 100 countries from 1971 to the present. The empirical setting is venture capital firms in the Canada , which engage in VC cross-border or domestic investment. To test the effect of Canadian government VC on private the VC market in Canada, I divide all VC investments by Canadian private VC firms into two groups: domestic and cross-border. For domestic private VC investment data, I use an ordered triplet of "private VC firm-venture's province-venture's industry". For cross-border private VC investment data, I use the ordered quadruplets "private VC firm-VC firm's province- venture's country -venture's industry". I use the classification by Venture Economics Industry Codes (VEIC) for the categorization of industry in my analysis. This classification includes: Biotechnology, Communications and Media, Computer Hardware, Computer Software and Services, Consumer Related, Industrial/Energy, Internet Specific, Medical/Health, Semiconductors and Other Electronics, and Other Products.

From the database, I retrieved all domestic and cross-border VC investments by Canadian VC firms between 1994 and 2013. I excluded investment observations in which the VC firm's name, venture's name and/or venture's country was not disclosed. I used independent venture capital funds and corporate venture capital funds as two major types of private VC investor types in Thomson database. I also limited the database only to "Venture Capital" deals (i.e. I excluded "buyouts", "real estate" and "other" as types private equity investments). VC investments are usually staged and main decision of a VC firms occurs in the first stage, while later stages are conditional on future performance of entrepreneurial companies, I limited my sample to the first investments round, to avoid bias from emphasizing on later investment rounds.

Between 1994-2014, 385 Canadian private VC firms invested in a total of 1,554 domestic VC investment. During the same period, 207 Canadian private VC firms invested in 619 cross-border ventures in other countries. It is notable that from the cross-border investments, 563 were in the United States and 19 were in the United Kingdom.

Table 4-1— Overview of VC investment by government and private VC firms in Canada between 1994-2013.

| VC investor type: | LSVCCs | | Federal BDC | | Domestic private VC | | Cross-Border private VC | |
|---|---|---|---|---|---|---|---|---|
| Venture Economics Industry Codes (VEIC) | Frequency | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| Biotechnology | 492 | 9.0% | 304 | 4.2% | 167 | 10.7% | 83 | 13.4% |
| Communications and Media | 384 | 7.0% | 234 | 3.2% | 143 | 9.2% | 72 | 11.6% |
| Computer Hardware | 199 | 3.6% | 186 | 2.6% | 62 | 4.0% | 22 | 3.6% |
| Computer Software and Services | 846 | 15.5% | 722 | 9.9% | 328 | 21.1% | 130 | 21.0% |
| Consumer Related | 584 | 10.7% | 2,044 | 28.2% | 102 | 6.6% | 19 | 3.1% |
| Industrial/Energy | 605 | 11.1% | 959 | 13.2% | 130 | 8.4% | 53 | 8.6% |
| Internet Specific | 344 | 6.3% | 255 | 3.5% | 221 | 14.2% | 118 | 19.1% |
| Medical/Health | 509 | 9.3% | 285 | 3.9% | 140 | 9.0% | 48 | 7.8% |
| Other Products | 1,196 | 21.9% | 1,961 | 27.0% | 124 | 8.0% | 30 | 4.8% |
| Semiconductors/Other Electronics | 305 | 5.6% | 311 | 4.3% | 137 | 8.8% | 44 | 7.1% |
| Total | 5,464 | 100 | 7,261 | 100 | 1,554 | 100 | 619 | 100 |

### 4.4.2 Empirical Methodology

For both of domestic and cross-border datasets, I set up an event history framework for each ordered triplet unit of analysis for domestic data, and for each ordered quadruplet unit of analysis for cross-border data which is "private VC firm-venture's province-venture's industry" and "private VC firm-VC firm's province- venture's country -venture's industry" respectively, starting with the date of its first domestic and international cross-border investment. Then I arrange the data into yearly observations periods. Obviously there has not been an observation each year in units of analysis, i.e. not all VC firms invest in all industries and provinces in each year. To track the effects Canadian government VC on private VC firms I add missing observations in which there has not been any domestic or cross-border investment on the unit of analysis. This action made the domestic database with 24,817, and cross-border database with 8,459 observations.

I use event history (survival) analysis based on yearly observations on my units of analysis (i.e. ordered triplet unit of analysis for domestic data, and ordered quadruplet unit of analysis for cross-border data). In my case, event history analysis is a suitable analytical method, since, I am analyzing the effect government VC investments on VC firms' propensity to invest in domestic and cross-border venture. Similar studies in the government venture capital context used event history analysis (Bertoni and Groh, 2014; Guerini and Quas, 2016). Each VC firm is considered at risk (i.e. is likely to invest in a cross-border venture in the country-industry) the year after its last event (the year a cross-border investment occurs) and until the next event. If the VC firm does not have a new investment in a province and industry that it had before for domestic model, and in country and industry that it had before for cross-border model, until 31 December 2013, then that unit of analysis is considered right-censored.

In my context the hazard rate in the domestic case is the propensity of a VC firm to invest in a venture located in a province and industry at time t, given that the VC firm's previous investment was at time $t_n$ . The hazard rate for the cross-border case is the propensity of a VC

firm located in a province to invest in a foreign venture in a specific country and industry at time t, given that the VC firm's previous investment was at time $t_n$. If I call the hazard rate function *h*, then it can be defined as:

$$h(t|t_n) = \lim_{\Delta t \to 0} \frac{P(t_n \leq T \leq t_n + \Delta t | T \geq t_n)}{\Delta t} \quad (1)$$

In event history analysis, the probability distribution function of the hazard function can be either parametric (Tuma & Hannan, 1984) or semi-parametric (Cox, 1975), In the parametric method a specific probability distribution should be assumed for the probability distribution of the hazard function. On the other hand, in semi-parametric methods few restrictions will be made on the probability distribution function of hazard function. Instead of assuming that all data fits a predetermined probability distribution, an underlying baseline hazard function is assumed for all the observation units. I employ Cox proportional hazard model to identify the effects of my independent variable on the hazard rate:

$$h(t|t_n) = h_0(t) \exp(X(t)'\beta), \quad t > t_n \quad (2)$$

, where $X(t)$ is the vector of covariates. In the Cox regression, the vector of covariates are estimated by applying a partial likelihood maximization methodology.

### 4.4.3 Variables

In this section I introduce the variables that I am going to use in the regression analysis. The detailed description of all variables can be found in Table 4-2 and Table 4-3 for domestic and cross-border data introduced above respectively.

#### 4.4.3.1 Dependent Variables

In this study, I intend to analyze cross-border and domestic private VC investments in effect of government VC investments. Regarding the cross-border venture capital investment, which is

an investment by a domestic VC fund into a foreign company, I define cross-border displacing effect to be an increase in the aggregate pool of outgoing private VC investment, and cross-border attraction effect to be a decrease in the aggregate pool of outgoing private VC investment. To test my hypotheses, I set my dependent variables to be the VC firm's propensity whether to invest in a venture in specific province and industry for domestic model, and the VC firm's propensity whether to invest in a cross-border venture in an industry for cross-border model.

#### 4.4.3.2 Main Independent Variables

The main independent variables are cumulative number of first round investment by Labour-Sponsored Venture Capital Corporations (LSVCCs) and Business Development Bank of Canada (BDC) in a province and industry during two years before any focal private VC investment.

#### 4.4.3.3 Control Variables

In the domestic case for a focal Canadian VC firm, a specific province, and, a specific industry I use the cumulative number of first round investment of that VC firm in that province and industry in the past two years, to be the domestic experience of the VC firm in the specific province-industry. In the cross-border case for a focal Canadian VC firm located in a specific province, a specific country, and, a specific industry I use the cumulative number of first round investment of a VC firm in that foreign country and industry in the past two years, to be the cross-border experience of the VC firm in the specific country-industry.

Table 4-2--Variable descriptions for Canadian domestic VC case.
All the variables with subscript t are yearly basis and for each year between 1994-2013.
* shows the variables that are transformed by a natural logarithm one plus the original variable value.

| | Variable name | Description | Source |
|---|---|---|---|
| | | Main Variables | |
| 10 | Domestic VC investment event $(F_i,P_j,S_k)_t$ | A dummy variable equals to 1 for each VC investment by Canadian VC firm $F_i$ in a Canadian venture in province $P_j$ and industry $S_k$ at year t. | Thomson ONE |
| 11 | LSVCCs $(P_j,S_k)_t$ | Number of VC investments by LSVCCs in a Canadian venture in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| 12 | Federal BDC $(P_j,S_k)_t$ | Number of VC investments by BDCs in a Canadian venture in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| 13 | Total GVC $(P_j,S_k)_t$ | Number of VC investments by LSVCCs and BDCs in a Canadian venture in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| | | Control Variables | |
| 1 | Domestic Experience $(F_i, P_j, S_k)_t$ * | The Experience of VC firm $F_i$ in investing in domestic ventures in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| 2 | GDP $(P_j)_t$ * | the lagged level of GDP in province $P_j$ in the 2014 U.S. dollar. | Statistics Canada |
| 3 | Bubble Dummy | A dummy variable equals to 1 for the Internet bubble during 1998-2000 | |
| 4 | Crisis Dummy | A dummy variable equals to 1 for the financial crisis during 2008-2010 | |

Table 4-3--Variable descriptions for Canadian cross-border VC case.
All the variables with subscript t are yearly basis and for each year between 1994-2013.
* shows the variables that are transformed by a natural logarithm one plus the original variable value.

| | Variable name | Description | Source |
|---|---|---|---|
| | | Main Variables | |
| 1 | Cross-Border VC investment event $(F_i,P_j,C_z,S_k)_t$ | A dummy variable equals to 1 for each VC investment by Canadian private VC firm $F_i$ in a Canadian venture located in province $P_j$ in country $C_z$ industry $S_k$ at year t. | Thomson ONE |
| 2 | LSVCCs $(P_j,S_k)_t$ | Number of VC investments by LSVCCs in a Canadian venture in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| 3 | Federal BDC $(P_j,S_k)_t$ | Number of VC investments by BDCs in a Canadian venture in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| 4 | Total GVC $(P_j,S_k)_t$ | Number of VC investments by LSVCCs and BDCs in a Canadian venture in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| | | Control Variables | |
| 1 | Cross-Border Experience $(F_i,P_j,C_z,S_k)_t$ * | The Experience of VC firm $F_i$ in investing in domestic ventures in province $P_j$ and industry $S_k$ during 2 years before year t. | Thomson ONE |
| 2 | GDP $(P_j)_t$ * | the lagged level of GDP in province $P_j$ at year t in the 2014 U.S. dollar. | Statistics Canada |
| 3 | Bubble Dummy | A dummy variable equals to 1 for the Internet bubble during 1998-2000 | |
| 4 | Crisis Dummy | A dummy variable equals to 1 for the financial crisis during 2008-2010 | |
| 5 | GDP $(C_z)_t$ * | the lagged level of GDP per capita of country $C_z$ in the 2014 U.S. dollar at year t. | World Bank |
| 6 | Market Capitalization $(C_z)_t$ * | the lagged level of Stock Market capitalization of listed companies as percentage of GDP at year t. | World Bank |

For the domestic model, I control for the internet bubble years (1998-2000), global financial crisis years (2008-2010), stock market capitalization, and the lagged level of GDP in all Canadian provinces in 2014 U.S. dollars. For the cross-border case I use the same controls as the domestic case. I also use GDP per capita in 2014 U.S dollars, and stock market capitalization of the foreign investee company's country in the cross-border case.

## 4.5 Results

I present the results for Canadian domestic VC case in Table 4-4 and for each industry separately in Table 4-5. I also present the result for Canadian cross-border VC case in Table 4-6, and for each industry separately in Table 4-7. In these tables the effect of LSVCCs' and BDC investments are reported in model 1, and the effect of aggregated GVC investments are reported in model 2. In Table 4-4 and Table 4-6 the marginal effects of independent variables on my dependent variable are reported at the means of those variables in a separate column. The marginal effects of independent variables for tables that analyze industries separately, are not reported to save space and ease in readability.

In Table 4-4, I test the effect of investment by LSVCCs and BDC on the Canadian private VC firm propensity to invest in domestic ventures. Results do not show any crowding-out effect of either government VCs firms in Canada and these effects are statistically significant ($p<0.001$). However, the marginal effects at the mean of these variables are not big enough for incurring crowding-in effect. The linear effects from model 1 Table 4-4 show one unit increase in number of investments by LSVCCs is associated with 0.005% increase in propensity of private VC firms to invest in domestic VC market. The corresponding figure for one unit increase in number of BDC investments is 0.001 increase in hazard rate in the same model.

The results in Table 4-4 about domestic private VC in Canada is in line from what is already known about inefficiency of Canadian government VC. For all models in Table 4-4 the coefficients for LSVCCs and federal BDC are positive and significant at 1% level, but the

magnitude is not big enough. This fact shows the investments by different types of government VC firms in Canada does not have enough force to promote a domestic private VC industry. Other studies showed that LSVCCs have crowded-out other VC types and have not had a positive effect on increasing the pool of venture capital funds (Cumming and MacIntosh, 2007, 2006). This difference can be due to my unique unit of analysis that focuses on VC firms, industry, and province level data to avoid possible biases in merely using aggregate province-level analysis. Based on the results from Table 4-4, I cannot support the crowding-out effect or crowding-in effect of government VC investments in Canada.

Moreover, other consistent result is the coefficient for the internet bubble period and provincial GDP in Table 4-4. These results show that during internet bubble period a private VC at least 20% more likely to make a domestic VC investment. The coefficients for global financial crisis model are not significant. It is interesting to point out to the provincial GDP's coefficients, which show in case of increase in provincial GDP, private VC firms were less likely to invest in the province. This fact provides ground that in the case of economic growth in provinces in Canada, and most probably the increase in available fund, the increase in number of investments for government VC firms was associated with decrease in the likelihood of a domestic VC investment by private VCs.

Overall, the Results from Table 4-5Table 4-5 are in-line with the results in Table 4-4 for all industries. Other than the computer hardware industry that the BDC investments, on average, had a crowding-in effect, government VC programs did not have a positive and reasonable effect on increasing the probability of a private VC investing in domestic market.

Table 4-4—Results for Canadian domestic VC case.
Partial likelihood estimates of covariate effects of Canadian government venture capital investment on the VC firm propensity to invest in domestic ventures
Dependent variable is the dummy variable equals to 1 for each VC investment by Canadian VC firm Fi in a Canadian venture in province Pj and industry Sk at year t.
The marginal effects in the independent variable at the means of variables are reported in a separate column for each model. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| Dependent Variable: | Domestic VC investment event | | | |
|---|---|---|---|---|
| Model: | (1) | | (2) | |
| Covariates: | Effect on hazard rate | Marginal effects | Effect on hazard rate | Marginal effects |
| LSVCCs $(P_j, S_k)_t$ | 1.0363*** | 1.0052 | | |
| | *(0.004)* | *(0.010)* | | |
| Federal BDC $(P_j, S_k)_t$ | 1.0070*** | 1.0010 | | |
| | *(0.001)* | *(0.002)* | | |
| Total GVC $(P_j, S_k)_t$ | | | 1.0142*** | 1.0034 |
| | | | *(0.001)* | *(0.006)* |
| Domestic Experience (Fi, Pj, Sk) t * | 2.2294*** | 1.1240 | 2.7726*** | 1.2775 |
| | *(0.150)* | *(0.259)* | *(0.182)* | *(0.567)* |
| GDP $(P_j)_t$ * | 0.9346 | 0.9902 | 0.9795 | 0.9950 |
| | *(0.043)* | *(0.019)* | *(0.038)* | *(0.011)* |
| Stock Market Capitalization $_t$ * | 0.7538 | 0.9596 | 0.7449 | 0.9317 |
| | *(0.308)* | *(0.029)* | *(0.276)* | *(0.045)* |
| Bubble Dummy | 3.3167*** | 1.1911 | 2.9990*** | 1.3018 |
| | *(0.744)* | *(0.426)* | *(0.556)* | *(0.637)* |
| Crisis Dummy | 0.7165 | 0.9526 | 0.7344 | 0.9286 |
| | *(0.147)* | *(0.079)* | *(0.149)* | *(0.107)* |
| Number of observations | 23,416 | | 23,416 | |
| Number of Clusters | *385* | | *385* | |
| Number of Events | *1,384* | | *1,384* | |
| $\chi^2$ | *1,857.266* | | *1,747.422* | |
| Degree of Freedom | 7 | | 6 | |
| Adjusted R2 | 0.219 | | 0.242 | |

Table 4-5—Results for Canadian domestic VC case-Sample restriction to each industry.
Partial likelihood estimates of covariate effects of Canadian government venture capital investment on the VC firm propensity to invest in domestic ventures
Dependent variable is the dummy variable equals to 1 for each VC investment by Canadian VC firm Fi in a Canadian venture in province Pj and industry Sk at year t.
The marginal effects in the independent variable associated with 10% increase in the covariates and occurrence of the dummy variables are reported in bold formatting. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| Dependent Variable: | Biotechnology | | Communications and Media | | Computer Hardware | | Computer Software and Services | | Consumer Related | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Covariates: | | | | | | | | | | |
| LSVCCs $(P_j, S_k)_t$ | 1.1291*** | | 1.1292*** | | 1.7315 | | 0.8807*** | | 1.0659*** | |
| | *(0.930)* | | *(0.012)* | | *(0.617)* | | *(0.413)* | | *(0.728)* | |
| Federal BDC $(P_j, S_k)_t$ | 0.6963** | | 1.0877*** | | 1.8472*** | | 1.1893 | | 1.0091 | |
| | *(0.124)* | | *(0.027)* | | *(4.543)* | | *(0.145)* | | *(0.405)* | |
| Total GVC $(P_j, S_k)_t$ | | 1.114*** | | 1.2880*** | | 1.75*** | | 0.8913*** | | 1.2*** |
| | | *(0.249)* | | *(0.475)* | | *(0.974)* | | *(0.165)* | | *(0.164)* |
| Domestic Experience (Fi, Pj, Sk) t * | 0.8176*** | 0.8260** | 0.8790 | 0.8647** | 1.2466 | 1.3007 | 0.8103** | 0.7773** | 2.156*** | 1.799*** |
| | *(0.055)* | *(0.069)* | *(0.074)* | *(0.061)* | *(0.300)* | *(0.277)* | *(0.080)* | *(0.079)* | *(0.277)* | *(0.190)* |
| GDP $(P_j)_t$ * | 0.6884*** | 0.7673* | 0.3818*** | 0.3488*** | 0.4134*** | 0.4037*** | 0.5293*** | 0.5038*** | 0.569*** | 0.51*** |
| | *(0.094)* | *(0.113)* | *(0.058)* | *(0.047)* | *(0.065)* | *(0.059)* | *(0.037)* | *(0.038)* | *(0.042)* | *(0.034)* |
| Stock Market Capitalization $_t$ * | 0.2040* | 0.0681*** | 0.1445** | 0.1234** | 15.62 | 24.7583*** | 0.202** | 0.1821** | 0.1906** | 0.124** |
| | *(0.183)* | *(0.065)* | *(0.141)* | *(0.126)* | *(26.557)* | *(30.136)* | *(0.160)* | *(0.152)* | *(0.158)* | *(0.104)* |
| Bubble Dummy | 2.1572 | 1.9081 | 17.87*** | 21.26*** | 17.21*** | 9.623*** | 3.09*** | 3.016*** | 1.2623 | 1.1721 |

| Dependent Variable: | Biotechnology | | Communications and Media | | Computer Hardware | | Computer Software and Services | | Consumer Related | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Covariates: | | | | | | | | | | |
| | *(1.540)* | *(1.406)* | *(11.707)* | *(13.949)* | *(10.076)* | *(7.009)* | *(1.210)* | *(1.197)* | *(0.369)* | *(0.340)* |
| Crisis Dummy | 0.3777** | 0.3290*** | 0.6609 | 0.6650 | 2.5963*** | 2.1363*** | 1.5109 | 1.8998 | 1.1795 | 1.5160 |
| | *(0.153)* | *(0.135)* | *(0.380)* | *(0.385)* | *(0.902)* | *(0.618)* | *(0.792)* | *(0.975)* | *(0.631)* | *(0.918)* |
| Number of observations | 1,828 | 1,828 | 1,970 | 1,970 | 1,128 | 1,128 | 3,532 | 3,532 | 2,408 | 2,408 |
| Number of Clusters | *87* | *87* | *102* | *102* | *64* | *64* | *158* | *158* | *113* | *113* |
| Number of Events | *152* | *152* | *131* | *131* | *55* | *55* | *279* | *279* | *87* | *87* |
| | *774.879* | *710.618* | *719.666* | *595.641* | *175.944* | *279.920* | *741.925* | *857.129* | *362.393* | *296.393* |
| Degree of Freedom | 7 | 6 | 7 | 6 | 7 | 6 | 7 | 6 | 7 | 6 |
| Adjusted R2 | 0.347 | 0.351 | 0.380 | 0.404 | 0.511 | 0.529 | 0.311 | 0.336 | 0.354 | 0.405 |

Table 4-5—Results for Canadian domestic VC case-Sample restriction to each industry.

| Dependent Variable: | Industrial/Energy | | Internet Specific | | Medical/Health | | Other Products | | Semiconductors/Other Electronics | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Covariates: | | | | | | | | | | |
| LSVCCs $(P_j, S_k)_t$ | 1.0523*** | | 1.0303 | | 1.1438*** | | 1.0214*** | | 1.0962*** | |
| | (0.013) | | (0.019) | | (0.015) | | (0.004) | | (0.014) | |
| Federal BDC $(P_j, S_k)_t$ | 1.0186*** | | 1.2689*** | | 0.8999*** | | 1.0176*** | | 1.0600*** | |
| | (0.006) | | 1.0303 | | (0.019) | | (0.003) | | (0.011) | |
| Total GVC $(P_j, S_k)_t$ | | 1.0298*** | | 1.0911*** | | 1.2994*** | | 1.0444*** | | 1.0755*** |
| | | *(0.192)* | | *(0.295)* | | *(0.199)* | | (0.004) | | *(0.006)* |
| Domestic Experience (Fi, Pj, Sk) t * | 1.8185*** | 1.5374** | 0.9436 | 0.8535 | 0.7477*** | 0.5821*** | 1.5024* | 1.3493** | 0.7665* | 0.7725* |
| | *(0.452)* | *(0.323)* | *(0.114)* | *(0.087)* | *(0.067)* | *(0.074)* | *(0.325)* | *(0.183)* | *(0.107)* | *(0.114)* |
| GDP $(P_j)_t$ * | 0.6108*** | 0.5293*** | 0.4705*** | 0.3658*** | 0.3828*** | 0.4667*** | 0.3956*** | 0.3739*** | 0.4343*** | 0.4356*** |
| | *(0.073)* | *(0.057)* | *(0.037)* | *(0.029)* | *(0.037)* | *(0.038)* | *(0.046)* | *(0.035)* | *(0.046)* | *(0.040)* |
| Stock Market Capitalization $_t$ * | 1.6770 | 1.5633 | 0.9229 | 0.1784 | 0.1357** | 0.0738** | 0.3065 | 0.1610 | 0.0646** | 0.0661** |
| | *(1.011)* | *(1.040)* | *(1.052)* | *(0.191)* | *(0.124)* | *(0.080)* | *(0.560)* | *(0.297)* | *(0.078)* | *(0.087)* |
| Bubble Dummy | 1.7727** | 2.0601** | 5.0355*** | 4.2771*** | 1.2005 | 1.8586 | 0.9010 | 0.8547 | 14.7144*** | 14.2464*** |
| | *(0.511)* | *(0.615)* | *(2.424)* | *(2.110)* | *(0.497)* | *(0.751)* | *(0.382)* | *(0.345)* | *(8.873)* | *(9.279)* |
| Crisis Dummy | 2.8789* | 3.8617** | 4.1581*** | 3.4460*** | 0.1196*** | 0.1046*** | 0.4091 | 0.2831 | 2.4585* | 3.1241** |
| | *(1.654)* | *(2.247)* | *(2.140)* | *(1.639)* | *(0.094)* | *(0.074)* | *(0.373)* | *(0.249)* | *(1.297)* | *(1.496)* |
| Number of observations | 2,845 | 2,845 | 2,784 | 2,784 | 1,689 | 1,689 | 3,401 | 3,401 | 1,831 | 1,831 |
| Number of Clusters | *128* | *128* | *137* | *137* | *86* | *86* | *154* | *154* | *95* | *95* |
| Number of Events | *117* | *117* | *198* | *198* | *130* | *130* | *109* | *109* | *126* | *126* |
| | *641.611* | *802.065* | *625.901* | *837.374* | *497.518* | *540.247* | *427.434* | *432.581* | *648.418* | *651.411* |
| Degree of Freedom | 7 | 6 | 7 | 6 | 7 | 6 | 7 | 6 | 7 | 6 |
| Adjusted R2 | 0.347 | 0.396 | 0.258 | 0.309 | 0.301 | 0.296 | 0.438 | 0.480 | 0.353 | 0.377 |

The results in Table 4-6 show that the investments by LSVCCs are associated in an increase in private VC propensity to do a cross-border investment. But, the results show investments by federal BDCs are associated with a decrease in cross-border investments. The linear effects from model 1, Table 4-6 show a unit increase in number of investments by LSVCCs is associated with 1.4% increase in the hazard rate (i.e. the propensity of a VC firm invest in a cross-border company). The corresponding figure for one unit increase in federal BDC investments is 1.3% decrease in the hazard rate in the same model.

Based on the results from Table 4-6 I can support the displacing effect LSVCC investments, but I cannot support the displacing effect for federal BDC investments. The displacing effect of LSVCC investments is consistent with the arguments from (Lerner, 2009). The coefficients of the internet bubble and financial crisis periods in Table 4-6 are consistent with general expectations from these periods. Canadian private VC firms were at least 140% more likely and 60% less likely to invest in cross-border companies during the internet bubble period and global financial crisis periods respectively (90% of these companies were in the United States).

Overall, the Results from Table 4-7 are in-line with the results in Table 4-6 for all industries. The results show that LSVCCs had displaced private VC firms, in “Computer Software and Services” and “Semiconductors/Other Electronics” industries.

Overall the results from domestic case show that both LSVCC and federal BDC investments have increased the probability of Canadian private VC firms to invest in domestic markets. However, the magnitude of such effects has been negligible. Moreover, LSVCCs investments have displaced private VC firms to invest in cross-border investments. This is notable to consider that more than 90% percent of cross-border VC investments were in the United States. Moreover, my results show that federal BDC investments attracted the VC firms’ investments toward domestic market rather than forcing them to invest abroad, again with negligible force.

Table 4-6—Results for Canadian cross-border VC case.
Partial likelihood estimates of covariate effects of Canadian government venture capital investment on the VC firm propensity to invest in cross-border ventures.
Dependent variable is the dummy variable equals to 1 for each VC investment by Canadian private VC firm $F_i$ in a Canadian venture located in province $P_j$ in country $C_z$ industry $S_k$ at year t.
The marginal effects in the independent variable at the means of variables are reported in a separate column for each model. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| Dependent Variable: | Cross-border VC investment event | | | |
|---|---|---|---|---|
| Model: | (1) | | (2) | |
| Covariates: | Effect on hazard rate | Marginal effects | Effect on hazard rate | Marginal effects |
| LSVCCs $(P_j, S_k)_t$ | 1.0049* | 1.0144 | | |
| | *(0.003)* | *(0.029)* | | |
| Federal BDC $(P_j, S_k)_t$ | 0.9958* | 0.9877 | | |
| | *(0.002)* | *(0.025)* | | |
| Total GVC $(P_j, S_k)_t$ | | | 0.9986 | 0.9955 |
| | | | *(0.001)* | *(0.010)* |
| Domestic Experience (Fi, Pj, Sk) t * | 4.1420*** | 64.2349 | 4.2052*** | 93.6981 |
| | *(0.295)* | *(529.547)* | *(0.304)* | *(794.116)* |
| GDP $(P_j)_t$ * | 0.8781 | 0.6833 | 0.9058 | 0.7314 |
| | *(0.093)* | *(0.386)* | *(0.096)* | *(0.291)* |
| GDP (Cz)t * | 1.0937 | 1.2999 | 1.0793 | 1.2729 |
| | *(0.152)* | *(1.084)* | *(0.138)* | *(0.961)* |
| Market Capitalization (Cz)t * | 1.4124* | 2.7492 | 1.3705 | 2.7079 |
| | *(0.276)* | *(5.934)* | *(0.267)* | *(5.550)* |
| Bubble Dummy | 2.4368** | 13.5819 | 2.5815** | 20.0407 |
| | *(1.003)* | *(75.409)* | *(1.064)* | *(120.237)* |
| Crisis Dummy | 0.7312* | 0.3998 | 0.7506 | 0.4038 |
| | *(0.128)* | *(0.761)* | *(0.132)* | *(0.728)* |
| Number of observations | 8,459 | | 8,459 | |
| Number of Clusters | *206.000* | | *206.000* | |
| Number of Events | *557.000* | | *557.000* | |
| | *605.344* | | *593.214* | |
| Degree of Freedom | 8 | | 7 | |
| Adjusted R2 | 0.065 | | 0.064 | |

Table 4-7—Results for Canadian cross-border VC case- Sample restriction to each industry.

Partial likelihood estimates of covariate effects of Canadian government venture capital investment on the VC firm propensity to invest in cross-border ventures.

Dependent variable is the dummy variable equals to 1 for each VC investment by Canadian private VC firm $F_i$ in a Canadian venture located in province $P_j$ in country $C_z$ industry $S_k$ at year t.

The marginal effects in the independent variable associated with 10% increase in the covariates and occurrence of the dummy variables are reported in bold formatting. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5, and 10% level, respectively.

| Dependent Variable: | Biotechnology | | Communications and Media | | Computer Hardware | | Computer Software and Services | | Consumer Related | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Covariates: | | | | | | | | | | |
| LSVCCs $(P_j, S_k)_t$ | 0.9876 | | 1.0008 | | 1.1602 | | 1.1137** | | 0.9865 | |
| | *(0.015)* | | *(0.015)* | | *(0.110)* | | *(0.011)* | | *(0.020)* | |
| Federal BDC $(P_j, S_k)_t$ | 1.0139 | | 0.9671 | | 0.8570 | | 0.9991 | | 1.0017 | |
| | *(0.017)* | | *(0.025)* | | *(0.115)* | | *(0.010)* | | *(0.006)* | |
| Total GVC $(P_j, S_k)_t$ | | 0.9989 | | 0.9890 | | 1.0707 | | 1.0061 | | 1.0004 |
| | | *(0.005)* | | *(0.011)* | | *(0.062)* | | *(0.004)* | | *(0.004)* |
| Domestic Experience (Fi, Pj, Sk) t * | 3.702*** | 3.671*** | 3.712*** | 3.711*** | 7.71*** | 8.015*** | 4.051*** | 4.003*** | 13.060** | 12.922** |
| | *(0.393)* | *(0.372)* | *(0.426)* | *(0.446)* | *(4.914)* | *(5.129)* | *(0.398)* | *(0.385)* | *(13.059)* | *(13.279)* |
| GDP $(P_j)_t$ * | 0.7679 | 0.7511* | 0.9506 | 0.9870 | 2.0428 | 1.2602 | 0.8554 | 0.9371 | 0.9480 | 0.9236 |
| | *(0.126)* | *(0.120)* | *(0.238)* | *(0.241)* | *(1.822)* | *(1.124)* | *(0.193)* | *(0.181)* | *(0.277)* | *(0.267)* |
| GDP (Cz)t * | 0.3487 | 0.3532 | 0.9954 | 0.9430 | 0.5346 | 0.5314 | 0.8123** | 0.8200** | 0.7549 | 0.7442 |
| | *(0.264)* | *(0.253)* | *(0.761)* | *(0.725)* | *(0.453)* | *(0.459)* | *(0.083)* | *(0.079)* | *(0.205)* | *(0.198)* |
| Market Capitalization (Cz)t * | 13.832** | 13.027** | 0.898 | 0.933 | 0.780 | 0.841 | 2.475** | 2.396** | 12.308 | 14.644 |
| | *(16.253)* | *(15.232)* | *(0.563)* | *(0.591)* | *(0.560)* | *(0.623)* | *(1.027)* | *(0.954)* | *(22.871)* | *(27.582)* |
| Bubble Dummy | 4.181** | 4.053** | 7.2667** | 7.8040** | 6.99*** | 6.89*** | 0.5428 | 0.5484 | 0.2100 | 0.1102 |
| | *(2.754)* | *(2.697)* | *(5.965)* | *(6.504)* | *(4.326)* | *(4.456)* | *(0.342)* | *(0.342)* | . | . |
| Crisis Dummy | 1.2826 | 1.3920 | 0.1849** | 0.1912** | 0.8256 | 0.7832 | 0.8089 | 0.8698 | 1.0729 | 0.9548 |
| | *(0.868)* | *(0.874)* | *(0.145)* | *(0.148)* | *(0.644)* | *(0.583)* | *(0.373)* | *(0.403)* | *(0.821)* | *(0.638)* |
| Number of observations | 739 | 739 | 759 | 759 | 550 | 550 | 1,316 | 1,316 | 678 | 678 |
| Number of Clusters | *47.000* | *47.000* | *49.000* | *49.000* | *33.000* | *33.000* | *78.000* | *78.000* | *41.000* | *41.000* |
| Number of Events | *72.000* | *72.000* | *68.000* | *68.000* | *20.000* | *20.000* | *116.000* | *116.000* | *18.000* | *18.000* |

| Dependent Variable: | Biotechnology | | Communications and Media | | Computer Hardware | | Computer Software and Services | | Consumer Related | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Covariates: | | | | | | | | | | |
| | *282.087* | *286.040* | *175.816* | *139.188* | *48.168* | *1,968.987* | *497.097* | *461.208* | *8.014* | *7.114* |
| Degree of Freedom | 8 | 7 | 8 | 7 | 7 | 7 | 8 | 7 | 7 | 6 |
| Adjusted R2 | 0.142 | 0.141 | 0.099 | 0.098 | 0.065 | 0.055 | 0.080 | 0.080 | 0.061 | 0.060 |

Table 4-7—Results for Canadian cross-border VC case- Sample restriction to each industry.

| Dependent Variable: | Industrial/Energy | | Internet Specific | | Medical/Health | | Other Products | | Semiconductors/Other Electronics | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model: | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Covariates: | | | | | | | | | | |
| LSVCCs $(P_j, S_k)_t$ | 0.9857 | | 0.9977 | | 0.9972 | | 0.9994 | | 1.1437** | |
| | *(0.018)* | | *(0.015)* | | *(0.028)* | | *(0.007)* | | *(0.030)* | |
| Federal BDC $(P_j, S_k)_t$ | 1.0030 | | 0.9816 | | 1.0322* | | 1.0030 | | 1.0086 | |
| | *(0.011)* | | *(0.027)* | | *(0.043)* | | *(0.006)* | | *(0.017)* | |
| Total GVC $(P_j, S_k)_t$ | | 0.9965 | | 0.9929 | | 1.0123* | | 1.0011 | | 1.1244* |
| | | *(0.004)* | | *(0.012)* | | *(0.007)* | | *(0.003)* | | *(0.013)* |
| Domestic Experience (Fi, Pj, Sk) t * | 7.0240*** | 6.6747*** | 5.28*** | 5.29*** | 5.05*** | 5.09*** | 6.02*** | 5.98*** | 7.36*** | 7.06*** |
| | *(1.301)* | *(1.076)* | *(0.706)* | *(0.711)* | *(1.074)* | *(1.117)* | *(3.340)* | *(3.304)* | *(3.312)* | *(3.044)* |
| GDP $(P_j)_t$ * | 0.8684 | 0.9153 | 0.9379 | 0.9355 | 1.0523 | 0.9146 | 0.8704 | 0.9114 | 0.3784** | 0.4141*** |
| | *(0.185)* | *(0.202)* | *(0.239)* | *(0.238)* | *(0.368)* | *(0.286)* | *(0.266)* | *(0.250)* | *(0.151)* | *(0.135)* |
| GDP (Cz)t * | 8.6281 | 8.4286 | 1.2861 | 1.2907 | 0.7111** | 0.7258* | 1.0353 | 1.0414 | 1.3978 | 1.4338 |
| | *(18.590)* | *(19.623)* | *(0.231)* | *(0.239)* | *(0.123)* | *(0.121)* | *(0.318)* | *(0.322)* | *(0.607)* | *(0.610)* |
| Market Capitalization (Cz)t * | 0.1494 | 0.1832 | 0.7897 | 0.7867 | 3.7360 | 3.4159 | 2.3500** | 2.3702** | 1.1481 | 1.1215 |
| | *(0.202)* | *(0.240)* | *(0.205)* | *(0.209)* | *(3.929)* | *(3.535)* | *(1.007)* | *(1.018)* | *(0.682)* | *(0.653)* |
| Bubble Dummy | 0.8198 | 0.0000 | 5.6180*** | 5.8704*** | 2.59E-13 | 9.20E-14 | 2.59E-13 | 9.20E-14 | 8.38E-15 | 3.29E-14 |
| | . | . | *(2.735)* | *(2.807)* | *(0.000)* | *(0.000)* | *(0.000)* | *(0.000)* | *(0.000)* | *(0.000)* |
| Crisis Dummy | 0.8208 | 0.7834 | 1.1317 | 1.1218 | 1.4946 | 1.1726 | 0.0000 | 0.0000 | 1.6688 | 1.7429 |
| | *(0.247)* | *(0.220)* | *(0.466)* | *(0.454)* | *(1.270)* | *(0.804)* | . | . | *(1.065)* | *(1.110)* |
| Number of observations | 753 | 753 | 1,343 | 1,343 | 588 | 588 | 1,124 | 1,124 | 609 | 609 |
| Number of Clusters | *47.000* | *47.000* | *81.000* | *81.000* | *37.000* | *37.000* | *60.000* | *60.000* | *36.000* | *36.000* |
| Number of Events | *45.000* | *45.000* | *110.000* | *110.000* | *41.000* | *41.000* | *27.000* | *27.000* | *40.000* | *40.000* |
| | *167.362* | *164.338* | *228.428* | *229.793* | *591.157* | *624.133* | *1,007.882* | *1,414.084* | *753.536* | *543.412* |
| Degree of Freedom | 7 | 6 | 8 | 7 | 8 | 7 | 7 | 6 | 8 | 7 |
| Adjusted R2 | 0.169 | 0.168 | 0.078 | 0.077 | 0.118 | 0.117 | 0.049 | 0.049 | 0.100 | 0.098 |

## 4.6 Discussion

In this essay, I investigated the effect of government VC investment in Canada on the domestic private VC ecosystem. Major government VC programs in Canada has been Labour-Sponsored Venture Capital Corporations (LSVCCs) and Business Development Bank of Canada (BDC). Previous empirical evidence suggested that government VC practices in Canada crowded-out domestic private VC investments (Cumming et al., 2016; Cumming and MacIntosh, 2007, 2006).

Unlike previous studies, the result does not provide ground for a pure crowding-out effect of government venture capital investments in Canada. Rather, the results show mixed effects of supportive role and displacing. Consistent with the evidence presented by Leleux and Surlemont (2003) for European countries, the results do not show any crowding-out effect of either LSVCC or federal BDC firms in Canada. Although both of LSVCC and BDC investments showed to have supportive effect on Canadian private VC firms to invest in domestic markets, the magnitude of these effects was negligible. I show that the investments by all types of government VC firms in Canada were associate with a negligible increase in the likelihood that a private VC firm invest another domestic VC investment. Unlike Cumming and MacIntosh (2007, 2006), who showed that Canadian LSVCCs crowded out private VC in almost all provinces, and Cumming et al. (2016), who found that LSVCCs in the province Quebec crowded out private VC investments, the evidence presented in this essay shows that LSVCCs neither crowded-out nor crowded-in private VC types. This advancement in the explanation can be due to my unique methodological approach in selecting a multi-level unit of analysis that focuses on VC firms, industry, and province level data to avoid possible biases in merely using aggregate province-level data. Furthermore, I showed that LSVCCs displaced private VC investment to cross-border investments.

# Chapter 5

# Conclusions

This dissertation contained three essays in the international venture capital research subject area. This concluding chapter summarizes the essays, brings together the main points, and provides overall concluding remarks and suggests possible topics for future research.

## 5.1 Summaries and Conclusions

Below is a brief recap of the main points discussed along with the conclusions in the three essays.

### 5.1.1 The First Essay

In the first essay, I focused on two components of organizational learning theory, namely experiential learning and vicarious learning, to explain how venture capital (VC) firms make international investment decisions. I focused on recent incidences of experiential and vicarious learning and offered systematic evidence that recent experience of a focal VC, and the recent investment pattern of other VCs, shape VCs' cross-border investment decisions. The analysis used event history analysis of US venture capital firms investing in a cross-border company during 2000-2013. I used a unique unit of analysis, namely, the ordered triplet of "VC firm-venture's country-venture's SIC code", which enabled a robust empirical analysis.

The most obvious finding to emerge from the first study is that recent experience of a VC firm in investing in a foreign company and the recent pattern of other VC firms investing in a foreign country are important sources of knowledge in shaping that VC firm;s subsequent international investment decisions. I showed that recent experience of a VC firm in investing in a foreign

company positively affects that focal VC firm's subsequent decision to invest again in that company's country. Also, recent experience of a VC firm in investing in a foreign company positively affect that focal VC firm's subsequent decision to invest again in that companies' country-industry. Moreover, the country-industry specific experience of a focal VC firm has more affect than the country-specific experience in forming that VC firm's decision to again invest in that country and industry. In other words, a VC firm is more likely to reinvest in country-industry in which it has had recent experience.

Additionally, the first essay discussed the reasons why VC firms learn vicariously from the recent international investment patterns of other VC firms located in their home country or home state when investing in international companies. Additionally, it has identified that a venture capital firm's decisions to invest in a country-industry are influenced more by its competitors/fellows at a closer geographical distance--in our case, the home state/province. In other words, the effect of state level-imitation is more than that of country-level imitation in this context.

Furthermore, this study has found that, generally, when both the focal VC firm's experience and other VCs' investment-patterns converge, i.e., when that focal VC firm and other VC firms located in the same state/province as the focal VC firm have recently invested in a specific country-industry, the reinforcing effect of that VC firm's recent experience grows substantially. In other words, experience has more effect than the urge to imitate other VC firms activities does, when imitation and experience effects converge. Nevertheless, the first essay has provided evidence that the size of venture capital firms is a moderating factor in these effects; i.e., smaller VC firms put more weight on vicarious learning than experiential learning when deciding on whether to invest in an international company. In general, therefore, it seems that for smaller VC firms, the effect of imitating other VC firms' recent experience increases. I have showed that the recent history of international VC investment in a country and industry is a knowledge source that can be used for future decisions to invest in that country-industry,

### 5.1.2 The Second Essay

In the second essay, I focused on the effect of mixe-structured and pure-structured government venture capital investments on international private VC flows. I answered this question: do government venture capital funds crowd-in or crowd-out international private venture capital investment? I investigated whether and how pure- and mixed- government venture capital investment structures affect domestic private VCs, as well as international private VCs. The analysis used a bilateral country-level framework. I transformed VC investment data from Thomson ONE, which contains 125,310 new investment rounds, into standard panel data, consisting of 10,400 observations.

Multiple regression analysis revealed that mixed structured investments crowd-in and pure structured investments crowd-out private VC investments. The results of this investigation identified that having more mixed structured government VC investments than pure-structured government investments in a country crowds-in domestic and foreign private venture capitalists internationally. In other words, more mixed- than pure-GVC investment structures have a crowding-in effect overall; i.e., they attract domestic and international private VC funds to invest in the domestic VC market, and lead to an increase in overall private venture capital funding in the domestic market. Similarly, more pure-structured government VC investment crowds-out private investment internationally; i.e., more investments that are solely managed by governments compared with syndicated government-private investments have a crowding-out effect. The crowding-in and crowding-out effect of both structures of GVC are greater on domestic capital than on international private venture capital.

The findings from the second essay add to a growing body of literature on beneficiary states of syndicated VC investment by government bodies together with private. We showed that more mixed structured government VC in a country promotes the domestic private VC ecosystem by attracting both domestic and international VC funds to invest in domestic companies.

### 5.1.3 The Third Essay

The third essay was designed to determine the effect of government VC investment in Canada on the domestic private VC ecosystem. The major government VC programs in Canada have been

the Labour-Sponsored Venture Capital Corporations (LSVCCs) and Business the Development Bank of Canada (BDC). I used Canadian VC investment data during 1994-2013 for the analysis, and event history analysis for the analytical framework.

The results of this investigation show that Canadian government VC practices have not been successful in promoting a private VC ecosystem. Government VC investments had positive, but not major, impacts on private investments. Also, the results show that on average, LSVCCs have displaced private VC investments to other countries, mainly the US. The results show that the LSVCCs' displacing effect was more pronounced in "Computer Software and Services" and "Semiconductors/Other Electronics" industries (Lerner, 2009, p. 122)(Lerner, 2009, p. 122).

The third essay adds to the body of academic work on the existence of links between government VC and both the domestic and cross-border behavior of private Vs, by analyzing the effect of government VC on domestic and cross-border private VC investments in parallel to each other.

## 5.2 Recommendations for Future Work

- The first essay is one of only a limited number of scholarly efforts to fully investigate vicarious and experiential learning in the international venture capital research stream. Many related topics need more considerations. Future research is required to empirical investigation the effect of vicarious learning using global VC investment data or data from other countries that have a major stake in international VC investments.
- In the first study, I found that a VC firm's size moderates the effects of vicarious and experiential learning. Therefore, future research could also be conducted to investigate other possible moderating factors of experiential and vicarious learning, i.e., the conditions under which vicarious learning will have more effect than experiential learning in the international VC context.
- Another important aspect of mixed-GVC investments is that GVCs co-invest with many non-GVC funds in mixed-GVC investments. In other words, a question exists on

whether more non-GVC funds in a syndicated mixed-GVC investment deal lead to favorable micro- and macro- level outcomes.

- More broadly, research is also needed to determine the conditions, sectors, and industries where government VC has stronger effects on promoting private VC ecosystems.

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# Appendix A

## Downloading the Data of Private Equity Investments

This appendix contains the explanation on venture capital investment data downloaded from Thomson and other sources and also explanations on the steps which generate a panel data using the raw database and macro-economic factors downloaded from World Bank Portal

The data for Private Equity (VC) investments has been downloaded via Thomson ONE Private Equity by Thomson Reuters companies. Before, this service was available through VentureXpert supported within the SDC Platinum platform, but it has been migrated to Thomson ONE Private Equity. Private Equity page can be reached through Screening & Analysis menu in Thomson ONE website. Different types of searches can be done through Private Equity page, including Companies and Investors as well as fundraising, investments, exits, and fund performance data. For an observed investment in the database, it is possible to access to information about the Company receiving funds, PE firms, PE funds, investment and limited partners (LPs).

Moreover, to control for country-level factors that might affect domestic, outgoing cross-border, and incoming cross-border VC investments, we include several control variables based on the literature regarding macroeconomic conditions. Also, we select the Worldwide Governance Indicators (WGI) as powerful instruments of domestic GVC. WGI. The WGI measures six dimensions of governance of 215 countries over period 1990-2013. Tables below provides explanation of the control and instrumental variables.

Thomson puts limitations on accessing the data, including: (1) number of variables can be retrieved from the database in a single download action, cannot exceed 16; (2) number of observations can be retrieved from the database in a single download action, cannot exceed 15000. This makes accessing to data hard for academic researchers, as they need to access a comprehensive set of variables and observations

Considering the limitations mentioned above, I had to do the following considerations to access to worldwide PE investment data for the period from 1975 to 2013: I Divide the time

periods of 1975-2003 to time intervals, in which number of PE investment observations does not exceed the 15000 limitation. These time intervals can be seen in the following table.

Time Intervals of downloading the PE investment data

| | Starting Date | Ending Date | | Starting Date | Ending Date |
|---|---|---|---|---|---|
| 1 | 01/01/1975 | 12/31/1982 | | 07/01/2002 | 12/31/2002 |
| 2 | 01/01/1983 | 12/31/1984 | | 01/01/2003 | 06/30/2003 |
| 3 | 01/01/1985 | 12/31/1986 | | 07/01/2003 | 12/31/2003 |
| 4 | 01/01/1987 | 12/31/1988 | | 01/01/2004 | 06/30/2004 |
| 5 | 01/01/1989 | 12/31/1990 | | 07/01/2004 | 12/31/2004 |
| 6 | 01/01/1991 | 12/31/1992 | | 01/01/2005 | 06/30/2005 |
| 7 | 01/01/1993 | 12/31/1994 | | 07/01/2005 | 12/31/2005 |
| 8 | 01/01/1995 | 12/31/1995 | | 01/01/2006 | 06/30/2006 |
| 9 | 01/01/1996 | 12/31/1996 | | 07/01/2006 | 12/31/2006 |
| 10 | 01/01/1997 | 12/31/1997 | | 01/01/2007 | 06/30/2007 |
| 11 | 01/01/1998 | 09/30/1998 | | 07/01/2007 | 11/30/2007 |
| 12 | 10/01/1998 | 12/31/1998 | | 12/01/2007 | 04/30/2008 |
| 13 | 01/01/1999 | 06/30/1999 | | 05/01/2008 | 09/30/2008 |
| 14 | 07/01/1999 | 11/30/1999 | | 10/01/2008 | 12/31/2008 |
| 15 | 12/01/1999 | 02/29/2000 | | 01/01/2009 | 06/30/2009 |
| 16 | 03/01/2000 | 04/30/2000 | | 07/01/2009 | 12/31/2009 |
| 17 | 05/01/2000 | 07/31/2000 | | 01/01/2010 | 06/30/2010 |
| 18 | 08/01/2000 | 10/31/2000 | | 07/01/2010 | 12/31/2010 |
| 19 | 11/01/2000 | 12/31/2000 | | 01/01/2011 | 06/30/2011 |
| 20 | 01/01/2001 | 03/31/2001 | | 07/01/2011 | 12/31/2011 |
| 21 | 04/01/2001 | 06/30/2001 | | 01/01/2012 | 06/30/2012 |
| 22 | 07/01/2001 | 10/31/2001 | | 07/01/2012 | 12/31/2012 |
| 23 | 11/01/2001 | 12/31/2001 | | 01/01/2013 | 06/30/2013 |
| 24 | 01/01/2002 | 06/30/2002 | | 07/01/2013 | 12/31/2013 |

1. Repeat the process of downloading with above time intervals, six times to access different variables. These variables are listed in the following table.

Variables in PE investment raw database

| | Variables Downloaded in Round 1 | | Variables Downloaded in Round 2 |
|---|---|---|---|
| 1 | *Company Name* | | *Company Name* |
| 2 | *Investment Date* | | *Investment Date* |
| 3 | *Firm Name* | | *Firm Name* |
| 4 | *Fund Name* | | *Fund Name* |
| 5 | Investment Location - World Location | 18 | Firm World Location |
| 6 | Investment Location - World Sub Location | 19 | Firm World Sub Location |
| 7 | Investment Location - State | 20 | Firm Nation |
| 8 | Investment Location - Nation | 21 | Firm State / Region |
| 9 | Deal Value (USD Mil) | 22 | Firm Zip Code |
| 10 | Equity Amount Disclosed (USD Mil) | 23 | Firm - First Investment Date |
| 11 | Equity Amount Estimated (USD Mil) | 24 | Firm - Last Investment Date |
| 12 | New or Follow on Investment | 25 | Firm - Total Number of Deals |
| 13 | No. of Funds at Investment Date | 26 | Firm Industry Focus |
| 14 | No. of Firms in Total | 27 | Firm Preferred Investment Role |
| 15 | No. of Funds in Total | 28 | Firm Preferred Maximum Investment (USD Mil) |
| 16 | Round Number | 29 | Firm Preferred Minimum Investment (USD Mil) |
| 17 | Investment Security Type(s) | 30 | Total Number of Companies Invested in by Firm |
| | Variables Downloaded in Round 3 | | Variables Downloaded in Round 4 |
| 31 | *Company Name* | 48 | *Company Name* |
| 32 | *Investment Date* | 49 | *Investment Date* |
| 33 | *Firm Name* | 50 | *Firm Name* |
| 34 | *Fund Name* | 51 | *Fund Name* |
| 35 | Company World Location | 52 | Company Technology Application |
| 36 | Company World Sub Location | 53 | Company VE Primary Industry Class |
| 37 | Company State / Region | 54 | Company VE Primary Industry Major Group |
| 38 | Company Nation | 55 | Company VE Primary Industry Minor Group |
| 39 | Company Zip Code | 56 | Company VE Primary Industry Sub-Group 1 |
| 40 | Company Investment Stage 1 at Round Date | 57 | Company VE Primary Industry Sub-Group 2 |
| 41 | Company Investment Stage 2 at Round Date | 58 | Company VE Primary Industry Sub-Group 3 |
| 42 | Company Investment Stage 3 at Round Date | 59 | NAIC Code |
| 43 | Valuation at Transaction Date (USD Mil) | 60 | SIC Code |

| | | | |
|---|---|---|---|
| 44 | Type of Preferred Stock | 61 | Company Founded Date |
| 45 | Company IPO Date | 62 | First Investment Received Date |
| 46 | Company Status | 63 | Last Investment Received Date |
| 47 | Total Funding To Date (USD Mil) | 64 | Round of Financing |
| | Variables Downloaded in Round 5 | | Variables Downloaded in Round 6 |
| | *Company Name* | | *Company Name* |
| | *Investment Date* | | *Investment Date* |
| | *Firm Name* | | *Firm Name* |
| | *Fund Name* | | *Fund Name* |
| 65 | Total Estimated Equity Invested by Firm to Date (USD Mil) | 78 | Fund World Location |
| 66 | Total Known Equity Invested by Firm to Date (USD Mil) | 79 | Fund World Sub Location |
| 67 | Fund Nation | 80 | Fund Zip Code |
| 68 | Fund - First Investment Date | 81 | Total Number of Companies Invested in by Fund |
| 69 | Fund - Last Investment Date | 82 | Total Known Equity Invested by Fund to Date (USD Mil) |
| 70 | Fund - Total Number of Deals | 83 | Total Estimated Equity Invested by Fund to Date (USD Mil) |
| 71 | Fund Estimated Equity Invested in Company at Investment Date (USD Mil) | 84 | Fund Known Equity Invested in Company at Investment Date (USD Mil) |
| 72 | Fund Industry Focus | 85 | Fund Status |
| 73 | Fund Stage | 86 | Firm Status |
| 74 | Fund Type | 87 | Firm Type |
| 75 | Fund Founded Date | 88 | Firm Founded Date |
| 76 | Fund Investor Type | 89 | Firm Capital Under Management (USD Mil) |
| 77 | Fund Size (USD Mil) | 90 | No. of Funds Managed by Firm |

As there has been a slight difference in data retrieved in each round of downloading the data, four variables: company name, investment date, firm name, and fund name; are repeated in each round as an identifier to merging the final database.

# Appendix B

## Sample Code and Programs Used in Chapter 2

```
CREATE TABLE vc_project.cbvc_temp (
    id_cbvc INT NOT NULL AUTO_INCREMENT,
    PRIMARY KEY (id_cbvc)
) SELECT m.firm_name,
    m.inv_loc_nation AS inv_country,
    m.year_inv AS yr,
    m.sic_code,
    m.firm_state,
    1 AS cbvc_event,
    m.fund_name,
    m.company_name,
    m.inv_date,
    m.company_nation AS company_country,
    m.firm_zip_code,
    m.fund_zip_code,
    m.firm_capital_under_management,
    m.firm_type,
    m.fund_investor_type,
    m.new_or_follow_on_inv,
    m.fund_esequity_company_atinv,
    m.fund_ind_focus,
    m.fund_size,
    m.fund_stage,
    m.no_of_funds_at_inv_date,
    m.total_est_byfund_todate,
    m.total_est_firm_to_date,
    m.total_funding_to_date,
    m.total_known_eq_byfund_todate,
    m.total_known_firm_to_date,
    m.type_of_preferred_stock,
    m.equity_amount_disclosed,
    m.equity_amount_estimated,
    m.company_founded_date,
    m.company_technology_application,
    m.company_ve_ind_major_group,
    m.company_ve_ind_minor_group,
    m.company_ve_indclass,
    m.naic_code FROM
    vc_project.vc_inv AS m
WHERE
    m.fund_nation != m.inv_loc_nation
        AND m.inv_loc_nation != 'United States'
        AND m.fund_nation = 'United States'
        AND m.firm_nation = 'United States'
        AND m.firm_name != 'Undisclosed Firm'
        AND m.year_inv >= 2000
        AND m.sic_code IS NOT NULL
ORDER BY m.firm_name , inv_country , sic_code , yr;
```

```
#-------------------------------------------------------------

CALL vc_project.standard_panel();

#-------------------------------------------------------------
#-------------------------------------------------------------
#Count experiences

CREATE table vc_project.domexp
SELECT
            t1.firm_name,
        t1.yr,
        t1.exp,
            #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM (
(SELECT
        firm_name,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, year_inv) as t1
JOIN
(SELECT
        firm_name,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, year_inv) as t2
ON t1.firm_name = t2.firm_name AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, yr;



#-------------------------------------------------------------------------------
CREATE TABLE vc_project.domexp_sic

SELECT
            t1.firm_name,
        t1.sic_code,
        t1.yr,
        t1.exp,
            #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
```

```
FROM(
(SELECT
        firm_name,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, sic_code, year_inv) as t1
JOIN
(SELECT
        firm_name,
        sic_code ,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, sic_code, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.sic_code = t2.sic_code AND ((t1.yr -1= t2.yr) OR
(t1.yr-2= t2.yr))
)
GROUP BY firm_name, sic_code, yr;


#-------------------------------------------------------------------------------
CREATE TABLE vc_project.domexp_sic_state

SELECT
             t1.firm_name,
        t1.firm_state,
        t1.sic_code,
        t1.yr,
        t1.exp,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM(
(SELECT
        firm_name,
        firm_state,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation = inv_loc_nation and
```

```
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, firm_state, sic_code, year_inv) as t1
JOIN
(SELECT
        firm_name,
        firm_state,
        sic_code ,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, firm_state, sic_code, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.firm_state = t2.firm_state AND t1.sic_code =
t2.sic_code AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, firm_state, sic_code, yr;



#-------------------------------------------------------------------------------
CREATE TABLE vc_project.fcexp

SELECT
             t1.firm_name,
        t1.inv_country,
        t1.yr,
        t1.exp,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM(
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, year_inv) as t1
JOIN
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp
```

```
FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.inv_country = t2.inv_country AND ((t1.yr -1=
t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, inv_country, yr;
#-------------------------------------------------------------------------------


#-------------------------------------------------------------------------------
CREATE TABLE vc_project.fsicexp

SELECT
             t1.firm_name,
        t1.sic_code,
        t1.yr,
        t1.exp,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM(
(SELECT
        firm_name,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, sic_code, year_inv) as t1
JOIN
(SELECT
        firm_name,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, sic_code, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.sic_code = t2.sic_code AND ((t1.yr -1= t2.yr) OR
(t1.yr-2= t2.yr))
)
```

```
GROUP BY firm_name, sic_code, yr;
#------------------------------------------------------------------------------



#------------------------------------------------------------------------------
CREATE TABLE vc_project.fcsicexp

SELECT
             t1.firm_name,
        t1.inv_country,
        t1.sic_code,
        t1.yr,
        t1.exp,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM(
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, sic_code, year_inv) as t1
JOIN
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, sic_code, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.inv_country = t2.inv_country AND t1.sic_code =
t2.sic_code AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, inv_country,sic_code, yr;
#------------------------------------------------------------------------------



#------------------------------------------------------------------------------
CREATE TABLE vc_project.fexp
```

```
SELECT
            t1.firm_name,
        t1.yr,
        t1.exp,
            #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM
(SELECT
        firm_name,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, year_inv) as t1
JOIN
(SELECT
        firm_name,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, year_inv) as t2
ON t1.firm_name = t2.firm_name AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY firm_name, yr;



#-------------------------------------------------------------------------------
CREATE TABLE vc_project.imi_c

SELECT
        t1.inv_country,
        t1.yr,
        t1.exp,
            #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM
(SELECT
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
```

```
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY inv_loc_nation, year_inv) as t1
JOIN
(SELECT
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'

GROUP BY  inv_loc_nation, year_inv) as t2
ON t1.inv_country = t2.inv_country AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY inv_country, yr;



#-------------------------------------------------------------------------------
CREATE TABLE vc_project.imi_sic

SELECT
             t1.sic_code,
        t1.yr,
        t1.exp,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM
(SELECT
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY sic_code, year_inv) as t1
JOIN
(SELECT
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp
FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL
```

```
GROUP BY sic_code, year_inv) as t2
ON t1.sic_code = t2.sic_code AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY sic_code, yr;



#-------------------------------------------------------------------------------
CREATE TABLE vc_project.imi_csic

SELECT
             t1.inv_country,
        t1.sic_code,
        t1.yr,
        t1.exp,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM
(SELECT

        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY inv_loc_nation,sic_code, year_inv) as t1
JOIN
(SELECT
        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY inv_loc_nation,sic_code, year_inv) as t2
ON  t1.inv_country = t2.inv_country AND (t1.sic_code = t2.sic_code) AND ((t1.yr -1=
t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY inv_country, sic_code,  yr;

#--------------------- based on States----------------------
#-------------------------------------------------------------------------------

CREATE TABLE vc_project.imi_c_state

SELECT
```

```
            t1.firm_state,
        t1.inv_country,
        t1.yr,
        t1.exp,
            #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM
(SELECT
        firm_state,
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and firm_state!='.'

GROUP BY firm_state,inv_loc_nation, year_inv) as t1
JOIN
(SELECT
        firm_state,
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm'  and firm_state!='.'

GROUP BY  firm_state,inv_loc_nation, year_inv) as t2
ON t1.firm_state = t2.firm_state AND t1.inv_country = t2.inv_country AND ((t1.yr -1=
t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY firm_state,inv_country, yr;



#-------------------------------------------------------------------------------
CREATE TABLE vc_project.imi_sic_state

SELECT
            t1.firm_state,
        t1.sic_code,
        t1.yr,
        t1.exp,
            #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM
(SELECT
        firm_state,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp
```

```
FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY firm_state,sic_code, year_inv) as t1
JOIN
(SELECT
        firm_state,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp
FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY firm_state,sic_code, year_inv) as t2
ON t1.firm_state = t2.firm_state AND t1.sic_code = t2.sic_code AND ((t1.yr -1= t2.yr)
OR (t1.yr-2= t2.yr))

GROUP BY firm_state,sic_code, yr;



#-------------------------------------------------------------------------------
CREATE TABLE vc_project.imi_csic_state

SELECT
             t1.firm_state,
        t1.inv_country,
        t1.sic_code,
        t1.yr,
        t1.exp,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) cum_exp
FROM
(SELECT

        firm_state,
        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY firm_state,inv_loc_nation,sic_code, year_inv) as t1
JOIN
```

```
(SELECT
        firm_state,
        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY firm_state,inv_loc_nation,sic_code, year_inv) as t2
ON  t1.firm_state = t2.firm_state AND t1.inv_country = t2.inv_country AND (t1.sic_code
= t2.sic_code) AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY firm_state,inv_country, sic_code,  yr;


CREATE TABLE vc_project.size_csic_state

SELECT
             t1.firm_state,
        t1.inv_country,
        t1.sic_code,
        t1.yr,
             #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(IF(t2.yr>=2000, t2.exp, 0)) exp,
             SUM(IF(t2.yr>=2000, t2.size, 0)) as size

FROM
(SELECT

        firm_state,
        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp,
             SUM(fund_size) AS size


FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY firm_state,inv_loc_nation,sic_code, year_inv) as t1
JOIN
(SELECT
        firm_state,
        inv_loc_nation as inv_country,
        sic_code,
        year_inv AS yr,
        count(firm_name) AS exp,
             SUM(fund_size) AS size
```

```
FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='United States' and firm_nation='United States' and
        firm_name!='Undisclosed Firm' and sic_code IS NOT NULL

GROUP BY firm_state,inv_loc_nation,sic_code, year_inv) as t2
ON  t1.firm_state = t2.firm_state AND t1.inv_country = t2.inv_country AND (t1.sic_code
= t2.sic_code) AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY firm_state,inv_country, sic_code,  yr;
#-------------------------------------------------------------
```

# Appendix C

## Sample Code and Programs Used in Chapter 3

```
CREATE table vc_project.vc_bilateral
#CREATE VIEW vc_project.t1 AS
             (id_bilateral INT NOT NULL AUTO_INCREMENT,PRIMARY KEY (id_bilateral))
SELECT
        fund_nation AS fund_country,
        inv_loc_nation AS inv_country,
        year_inv AS yr,
        SUM(IF(fund_nation != inv_loc_nation, 1, 0)) AS num_nir_total

FROM
        vc_project.vc_inv
WHERE
        fund_nation != inv_loc_nation
GROUP BY fund_country , inv_country , yr;
#------------------------------------------------------------------------------------

CALL vc_project.standard_panel();

CREATE VIEW vc_project.t2 AS
SELECT
        fund_nation AS fund_country,
        inv_loc_nation AS inv_country,
        year_inv AS yr,
        ifnull(SUM(IF(fund_nation = inv_loc_nation AND gvc = 1,
            1, 0)),0) AS ngvc_total
FROM
        vc_project.vc_inv
WHERE
        fund_nation = inv_loc_nation
GROUP BY fund_country , inv_country , yr;

#-------------------------------------  Attach two above tables

CREATE VIEW vc_project.t3 AS
SELECT
        t1.fund_country,
             t1.inv_country,
        t1.yr,
        t1.num_nir_total,
        ifnull(t2_1.ngvc_total,0) as ngvc_total_src,
        ifnull(t2_2.ngvc_total,0) as ngvc_total_dst
FROM
        vc_project.vc_bilateral as t1
        left join
             vc_project.t2 as t2_1 on (t1.fund_country=t2_1.fund_country and
t1.yr=t2_1.yr )
        left join
        vc_project.t2 as t2_2 on (t1.inv_country=t2_2.inv_country and t1.yr=t2_2.yr)

GROUP BY fund_country , inv_country , yr
```

```
order by fund_country , inv_country , yr
;

#------------------  Attach a sample Macro-economic Indice
create view vc_project.temp as
SELECT
    t3.fund_country,
    t3.inv_country,
    t3.yr,
    t3.num_nir_total,
       t3.ngvc_total_src,
    t3.ngvc_total_dst,

    s_gdp_us.value AS src_gdp,          d_gdp_us.value AS dst_gdp


FROM
    vc_project.t3
    LEFT JOIN
    vc_project.gdp_us AS s_gdp_us ON (t3.fund_country = s_gdp_us.country  AND t3.yr =
s_gdp_us.year)
    LEFT JOIN
     vc_project.gdp_us AS d_gdp_us ON (t3.inv_country = d_gdp_us.country AND t3.yr =
d_gdp_us.year)

GROUP BY fund_country , inv_country , yr;
```

# Appendix D

## Sample Code and Programs Used in Chapter 4

```
CREATE TABLE gvc.gvc_lsvcc

SELECT
        t1.f_state,
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM( t2.exp ) cum_exp

FROM
(SELECT

        inv_loc_state as f_state,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL
        and  fund_investor_type ='Retail'


GROUP BY f_state,inv_loc_nation,company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        inv_loc_state as f_state,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL
                and  fund_investor_type ='Retail'


GROUP BY f_state,inv_loc_nation,company_ve_ind_minor_group, year_inv) as t2
ON  t1.f_state = t2.f_state AND (t1.company_ve_ind_minor_group =
t2.company_ve_ind_minor_group) AND
((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr) )

GROUP BY f_state, company_ve_ind_minor_group,  yr;
```

```
#-----------------------------------------------------------

  CREATE TABLE gvc.gvc_gov

SELECT
        t1.f_state,
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM( t2.exp ) cum_exp

FROM
(SELECT

        inv_loc_state as f_state,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL
        and  fund_investor_type ='Government'


GROUP BY f_state,inv_loc_nation,company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        inv_loc_state as f_state,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL
                and  fund_investor_type ='Government'


GROUP BY f_state,inv_loc_nation,company_ve_ind_minor_group, year_inv) as t2
ON  t1.f_state = t2.f_state AND (t1.company_ve_ind_minor_group =
t2.company_ve_ind_minor_group) AND
((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr) )

GROUP BY f_state, company_ve_ind_minor_group,  yr;

#-----------------------------------------------------------



#-----------------------------------------------------------
```

```
#-------------------------------------------------------------
#Count experiences

CREATE table gvc.domexp
SELECT
        t1.firm_name,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(t2.exp) cum_exp
FROM (
(SELECT
        firm_name,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, year_inv) as t1
JOIN
(SELECT
        firm_name,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, year_inv) as t2
ON t1.firm_name = t2.firm_name AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, yr;


#-------------------------------------------------------------------------------
CREATE table gvc.domexp_sic

SELECT
        t1.firm_name,
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(t2.exp) cum_exp
FROM(
(SELECT
        firm_name,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp
```

```
FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        firm_name,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, company_ve_ind_minor_group, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.company_ve_ind_minor_group =
t2.company_ve_ind_minor_group AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, company_ve_ind_minor_group, yr;

#------------------------------------------------------------------------------


CREATE table gvc.domexp_state

SELECT
        t1.firm_name,
        t1.f_state,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(t2.exp) cum_exp
FROM(
(SELECT
        firm_name,
        inv_loc_state as f_state,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, f_state, year_inv) as t1
JOIN
(SELECT
        firm_name,
```

```
        inv_loc_state as f_state,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, f_state, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.f_state = t2.f_state AND ((t1.yr -1= t2.yr) OR
(t1.yr-2= t2.yr))
)
GROUP BY firm_name, f_state, yr;

#-------------------------------------------------------------------------------


CREATE table gvc.domexp_sic_state

SELECT
        t1.firm_name,
        t1.f_state,
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(t2.exp) cum_exp
FROM(
(SELECT
        firm_name,
        inv_loc_state as f_state,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, f_state, company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        firm_name,
        inv_loc_state as f_state,
        company_ve_ind_minor_group ,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation = inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
```

```
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, f_state, company_ve_ind_minor_group, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.f_state = t2.f_state AND
t1.company_ve_ind_minor_group = t2.company_ve_ind_minor_group AND ((t1.yr -1= t2.yr)
OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, f_state, company_ve_ind_minor_group, yr;



#-------------------------------------------------------------------------------
CREATE table gvc.fcexp

SELECT
        t1.firm_name,
        t1.inv_country,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(t2.exp) cum_exp
FROM(
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, year_inv) as t1
JOIN
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.inv_country = t2.inv_country AND ((t1.yr -1=
t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, inv_country, yr;
#-------------------------------------------------------------------------------
```

```
#------------------------------------------------------------------------------
CREATE table gvc.fsicexp

SELECT
        t1.firm_name,
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(t2.exp) cum_exp
FROM(
(SELECT
        firm_name,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        firm_name,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, company_ve_ind_minor_group, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.company_ve_ind_minor_group =
t2.company_ve_ind_minor_group AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, company_ve_ind_minor_group, yr;
#------------------------------------------------------------------------------



#------------------------------------------------------------------------------
CREATE table gvc.fcsicexp

SELECT
        t1.firm_name,
        t1.inv_country,
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM(t2.exp) cum_exp
```

```
FROM(
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        firm_name,
        inv_loc_nation as inv_country,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY firm_name, inv_loc_nation, company_ve_ind_minor_group, year_inv) as t2
ON t1.firm_name = t2.firm_name AND t1.inv_country = t2.inv_country AND
t1.company_ve_ind_minor_group = t2.company_ve_ind_minor_group AND ((t1.yr -1= t2.yr)
OR (t1.yr-2= t2.yr))
)
GROUP BY firm_name, inv_country,company_ve_ind_minor_group, yr;
#------------------------------------------------------------------------------

CREATE TABLE gvc.imi_c

SELECT
        t1.inv_country,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM( t2.exp ) cum_exp
FROM
(SELECT
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'
```

```
GROUP BY inv_loc_nation, year_inv) as t1
JOIN
(SELECT
        inv_loc_nation as inv_country,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm'

GROUP BY  inv_loc_nation, year_inv) as t2
ON t1.inv_country = t2.inv_country AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY inv_country, yr;



#-------------------------------------------------------------------------------
CREATE TABLE gvc.imi_sic

SELECT
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM( t2.exp ) cum_exp
FROM
(SELECT
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL

GROUP BY company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp
FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL

GROUP BY company_ve_ind_minor_group, year_inv) as t2
```

```
ON t1.company_ve_ind_minor_group = t2.company_ve_ind_minor_group AND ((t1.yr -1=
t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY company_ve_ind_minor_group, yr;



#-------------------------------------------------------------------------------
CREATE TABLE gvc.imi_csic

SELECT
        t1.inv_country,
        t1.company_ve_ind_minor_group,
        t1.yr,
        t1.exp,
        #(@cnt:=@cnt+ temp.exp) as dom_exp
        SUM( t2.exp ) cum_exp
FROM
(SELECT

        inv_loc_nation as inv_country,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL

GROUP BY inv_loc_nation,company_ve_ind_minor_group, year_inv) as t1
JOIN
(SELECT
        inv_loc_nation as inv_country,
        company_ve_ind_minor_group,
        year_inv AS yr,
        count(firm_name) AS exp

FROM
        vc_source.vc_all
WHERE
        fund_nation != inv_loc_nation and
        fund_nation='Canada' and firm_nation='Canada' and
        firm_name!='Undisclosed Firm' and company_ve_ind_minor_group IS NOT NULL

GROUP BY inv_loc_nation,company_ve_ind_minor_group, year_inv) as t2
ON  t1.inv_country = t2.inv_country AND (t1.company_ve_ind_minor_group =
t2.company_ve_ind_minor_group) AND ((t1.yr -1= t2.yr) OR (t1.yr-2= t2.yr))

GROUP BY inv_country, company_ve_ind_minor_group,  yr;
```