# The Performance of Governmental Venture Capital Firms: A Life Cycle Perspective and Evidence from China

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## Abstract

This paper investigates the difference between governmental venture capital firms (GVCs) and private venture capital firms (PVCs) from the perspective of a VC life cycle. Compared to PVC, GVCs put in less effort over the whole cycle due to the lack of a link between current performance and future fundraising, and a less efficient compensation mechanism for those involved. Using data on VC investments in the Chinese market between 1991 and 2010, the empirical results show that portfolio companies backed by GVCs underperform those backed by PVCs in going public. The results are supported by a series of robustness checks and selection bias tests. When taking into consideration unobservable factors which may affect the possibility of being backed by GVCs and achieving an IPO, portfolio companies backed by GVCs have a 31-percentage-point lower possibility of getting listed on the stock market compared with those backed by PVCs.

Keywords: Venture Capital Firms, Life Cycle, Performance, Government, China

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## 1. Introduction

Recently, there has been growing interest in the role of government in catalysing the development of the venture capital market. To bring both funding and players to their domestic venture capital market, many countries have set up governmental venture capital firms (hereafter GVCs). Given their increasing importance, there has therefore been increasing concern about the performance of GVCs.

Researchers have evaluated the effect of GVCs established in different countries. Although the Yozma Program in Israel and SBIC (Small Business Investment Company) in the USA (Gompers & Lerner, 2004; Howell, 2014) are widely recognized as the successful cases of promoting both the local venture capital market and economic development, many efforts by the governments of other countries have turned out to be failures (Lerner, 2009). The typical proxies for evaluating venture capital firms are whether there is a successful exit through IPOs (Initial Public Offering) or M&As (Merger and Acquisition), and whether there is a steady growth in the business of the portfolio companies. In seven European countries (Belgium, Finland, France, Germany, Italy, Spain and the U.K.) (Cumming *et al.*, 2014) and in Canada (Brander *et al.*, 2008), the enterprises financed by GVCs underperformed those backed by private VC firms (PVCs hereafter) in terms of the likelihood of successful IPOs and M&As. Compared to companies backed by PVCs, those invested in only by GVCs experience a decrease in their sales growth (Grilli & Murtinu, 2014a), a significant reduction in productivity three years after the investment (Alperovych *et al.*, 2015), and a minor increase in patents (Brander *et al.*, 2008).

As well as the underperformance of the portfolios backed by GVCs, the behaviour of GVCs has also been examined. GVCs are less active than private peers in helping their portfolios to raise further funding and to recruit managers (Bottazzi *et al.*, 2008). As for the impact of GVCs on the local venture capital industry, in Canada Cumming & MacIntosh (2006) found a “crowding out” effect of GVCs on PVCs’ fund-raising and investment.

In the Chinese VC market context, researchers obtain different results for the impact GVCs on investees compared to PVCs when controlling for different factors in their empirical analysis. Jiang & Liu (2014) found that when the investment specialization of VC firms was controlled for, the government background (interpreted as the records in PEdata without correction) of a venture capital firm has an insignificant effect on the probability of successful exit from portfolios. Ke & Wang (2015) found that the portfolios of GVCs (which are defined as VC firms with more than 50% of funds raised within the first three months since establishment came from government agencies or government controlled business enterprises) underperform those of PVCs in successful exits and patent applications.

China provides an interesting and unique context for exploring the performance of GVCs. On one hand, GVCs in China are governed as state-owned enterprises, which are assessed annually by the government; one the other hand, GVCs enjoy the privileged access to IPO quota allocated to each region, which is crucial to the successful exit from portfolios. At the same time, GVCs in China also share some common characteristics with GVCs in EU countries in terms of the establishment statute and compensation mechanism. Thus, the results of this research can be also generalized to other countries.

The extant literature identified the main reason for the different performance of portfolio companies backed by GVCs and PVCs as the different characteristics of GVCs compared to PVCs. The strength of GVCs comes from their close ties with the government, via privileged access to governmental resources. The weaknesses of GVCs have more aspects, which include the absence of well-negotiated contracts between limited partners and VC firms, less efficient compensation provisions and less decision-making independence (Cumming *et al.*, 2014), and diversified economic and political goals other than making profits (Lerner, 2009). However, the venture capital literature summarizes the advantages and disadvantages of GVCs in a fragmented way. It tends to focus on only one or a few facets of GVCs.

This paper provides a systemic framework for recognizing the distinction of GVCs from PVCs in a structured way, by scrutinizing them in each stage of a venture capital life cycle. The fundamental distinction of GVCs from PVCs is, on the VC firm level, whether there is a link between the firms' current performance and their future fund-raising, and on the individual level, whether there is an efficient compensation mechanism.

Based on VC life cycle analysis, the hypotheses of this paper are: (1) Portfolio companies backed by GVCs are less likely to achieve a successful exit, compared to those backed by PVCs; (2) Early-stage investments by GVCs do not have a higher possibility of achieving a successful exit than those by PVCs; (3) The disadvantage of portfolio companies backed by GVCs compared to those backed by PVCs is alleviated if the companies are invested in by their local GVCs.

The hypotheses are tested and supported by the results of empirical analysis, using data on venture capital investment from 1991 to 2010 in the Chinese VC market. Portfolio companies backed by GVCs have about a 7-percentage-point lower possibility of achieving an IPO than those backed by PVCs. If unobservable variables, which may affect the propensity of being backed by GVCs and achieving an IPO, are taken into consideration, Portfolio companies backed by GVCs have about a 31-percentage-point lower possibility of achieving an IPO than those backed by PVCs.

The results are robust to a series of alternative tests, when using further financing rounds and successful exit excluding those listed on NEEQ (National Equity Exchange and Quotations, which is regarded as a less liquid stock exchange) as proxies for the performance of portfolio companies.

The paper proceeds as follows. The second section discusses the background. Section 3 introduces the framework of the VC life cycle for comparing GVCs and PVCs, and explains how the fundamental characteristics of GVCs leads to a lower effort level compared to PVCs. Section 4 shows the hypothesis and uses regressions results to support the hypothesis. Section 5 discusses the selection bias problems using three different methods. It is followed by further robustness checks in section 6. Section 7 draws conclusions and provides policy suggestions.

## 2. Background

### 2.1. Purpose of setting up GVCs

The primary consideration in establishing governmental venture capital firms is to bridge the gap between the strong funding demand of SMEs (small and medium-sized enterprises) and high-tech industries, and the limited funding supply from traditional financial sector (White *et al.*, 2002). When the Chinese VC industry was still in its infancy in the 1990s, it was believed the intervention of the government can lead to a virtuous cycle in the immature market when all participants (entrepreneurs, venture capitalists, intermediaries such as lawyers and accountants, and institutional investors) become familiar and confident with the VC process (Lerner & Watson, 2008). Thus, GVCs were established to bring players as well as fund resources for the VC industry at the very beginning.

Furthermore, the motivation of establishing GVCs stems particularly from the wish to invest in Seed and early-stage projects, which have higher risk and are less attractive to private VC firms (Yu *et al.*, 2014).

GVCs set up by local authorities dominated the VC market in China before 1996 (Liu *et al.*, 2006). By the end of 2000, there was increasing participation of both domestic and foreign PVCs in the market. As a consequence, the proportion of GVCs dropped to 53% by the year 2002 and less than half afterwards (S. Wang, 2005).

### 2.2. Definition of GVCs

The term GVCs appears in the extant literature with different meanings, for example government-owned venture capital firms (Bottazzi *et al.*, 2008), public ownership of VC firms (Buzzacchi *et al.*, 2013), governmental venture capital (Alperovych *et al.*, 2015; Colombo *et al.*, 2014) and government-managed venture capital (Grilli & Murtinu, 2014a). In this paper we use the concept which best maps into actual behaviour in China and use the term GVCs to refer to “Government-established, owned and operated venture capital firms”, with the following

three features.

First, GVCs refer to governmental VC firms rather than governmental VC funds. The mixing-up of these two terms would cause confusion in analysing the characteristics of GVC firms and the effect of government financial support for the VC industry. Governmental funds refer to the funds which come entirely or mainly from the government budget but can by operated by any kinds of venture capital firms. Some governmental VC funds are similar to subsidies to PVCs, which can be regarded as the support of PVCs' fundraising (Grilli & Murtinu, 2014b; Leleux & Surlemont, 2003). The governments only act as the fund resource (Limited Partner) rather than players (General Partner). Typical examples are the Israeli Yozma program, the U.S. Small Business Innovation Research program and the New Zealand Seed Investment Fund (Lerner, 2009). The investment decision of this kind of governmental VC funds is made by selected qualified private VC firms, without establishing government VC firms.[2]

By contrast, governmental venture capital firms are set up by governments and operated by managers appointed by governments. The governments adopt a "hands-on" (Grilli & Murtinu, 2014b) policy approach, involving themselves intensively in the investment choices and decision-making of GVCs. This mode is not unique to China. European countries have also set up GVCs, which share similar features to GVCs in China.

Secondly, GVCs in China rely on local government budgets as the primary funding resources, where the said localities are larger than most European countries. The most frequently used name of a GVC is the combination of the province/city name and "high-tech venture capital", which reflects the strong relationship between GVCs and local governments. Most GVCs have a mandate to invest locally to favour the development of the local economy. The local knowledge and network endow each GVC with the strength in accessing local resources. Thirdly, state ownership is the distinctive feature of GVCs, which must obey the regulations relating to state-owned assets. Like other state-owned enterprises, GVCs are regulated by the local State-owned Asset Supervision and Administration Commission (SASAC hereafter) and must meet the annual assessment goals set by SASAC.

In this paper, a venture capital firm is designated as a GVC if it meets the following criteria: First, the funding resource of the VC firms when established is mainly from local government, and the decision of further funding is also dependent upon local government; secondly, the VC firms have the advantages in accessing to local

[2] The Chinese government has also set up such governmental VC funds known as Government-guided Venture Capital Fund after 2009, which adopt the form of Fund of Funds (FOFs) and are operated in a more market-oriented way (J. Chen, 2010). However, due to its short history, it is not the focus of this research.

resources due to their special relationship with local government; thirdly, the VC firms are under the supervision of SASAC. VC firms in China which meet the criteria include those established by:

- Local government
- Bureau of Finance in local government
- Bureau (or Commission) of Science and Technology in local government
- Local State-owned Asset Supervision and Administration Commission
- Asset management companies set up by local SASAC
- City construction and development companies set up by local government
- Local Economic Development Zone Management Committee

It is also meaningful to distinguish GVCs from those PVCs with some relationship ("GuanXi" in Chinese) with the government. The relationship between GVCs and their local governments are entirely different from the PVCs which possess "GuanXi" with government officials. The former is stable and naturally formed after the establishment of GVCs while the latter is contingent and has to be acquired. Wang *et al.*(2013) argued that if the founder/manager of a PVC has formerly worked for the government, this can also improve the possibility of achieving a successful exit. However, such a relationship with the government can be acquired through investment experience. In the interview research conducted by Ahlstrom *et al.* (2007), VC managers reported the "GuanXi" set up with a particular government official sometimes would end as soon as "he left that office".

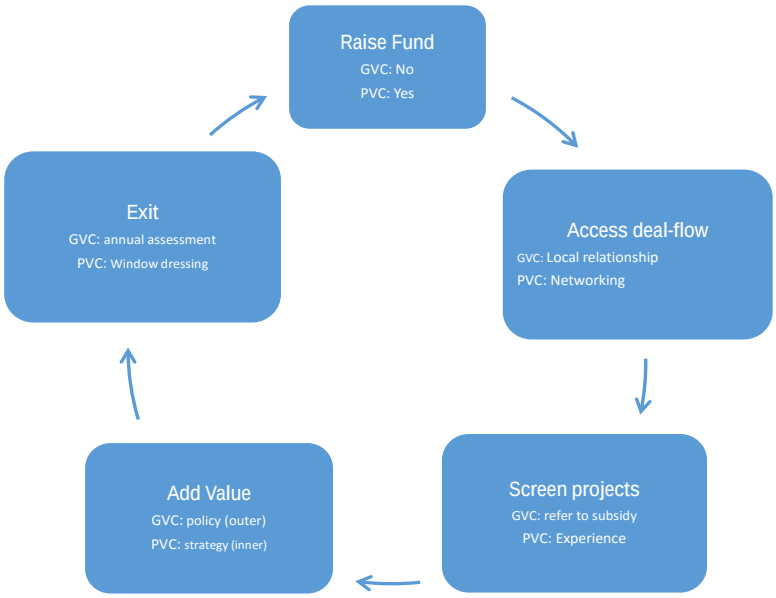
## 3. Difference of GVCs and PVCs in a VC life cycle

A typical venture capital fund begins its cycle with fund-raising and comes to an end when VC exits from portfolios, followed by another round of fund-raising (Gompers & Lerner, 2004). In this section, we compare the different aspects of GVCs and PVCs in each stage of a venture capital life cycle, and discuss how they influence the exit performance of their portfolio companies (exit being the only measure of performance available).

Figure 1 shows the characteristics of GVCs compared with PVCs in each stage of a venture capital cycle. This cycle mainly has five phases: raising funds, accessing potential projects, screening projects, monitoring portfolios and sending them to public to get a successful exit. While the activities of PVCs through the cycle are well known, GVCs behave differently. The following discussion is to show how the advantages and disadvantages of GVCs in each stage influence the performance of their portfolios.

Figure 1

Differences of GVC and PVC in a VC life cycle




### 3.1. Fund-raising

Fund-raising involves the interaction between investors and venture capitalists. The most significant difference between GVCs and PVCs is that the funds managed by GVCs come from government budgets rather than from limited partners. Previous studies at the macro level found that government-funded VC firms are less sensitive to the determinants of funding, e.g. IPOs in the previous year and other macroeconomic indexes (Jeng & Wells, 2000), but the micro-level motivation of fund-raising has not been explored.

Generally, limited partners make their decisions on whether or not to put their money in a fund, according to the reputation of a VC firm. The reputation refers to the VC firm's previous investment performance, especially the successful exit rate from portfolios. Contract theory suggests that Pareto efficiency can be achieved through the design of the contract. Whenever a venture capital firm's level of capability is unknown (a learning model) or possessed by VC firms itself (a signalling model), limited partners can ensure optimal effort-exertion by venture capitalists (Gompers & Lerner, 2004).

PVCs in China have similar funding resources as their foreign peers. According to the survey done by the China Venture Capital Institute, non-financial companies (including both listed and private companies), wealthy individuals and financial institutions are the main funding resources of PVCs in China between 2003 and 2010 (China Venture Capital Institute, 2012). Limited partners mainly refer to PVCs' track record before making the commitment decision.

By contrast, the motivation and decision of local governments on whether to finance a GVC is mainly affected by the need for promoting the local economy and venture industry. Thus, the financial performance of GVC become less important when local authorities assess the rationality of further funding[3]. The purpose of facilitating fund-raising in next round faced by PVCs does not apply to GVCs. Therefore, the managers of GVCs may not exert enough effort to pursue a good performance in the current investment.

### 3.2. Accessing projects

GVCs and PVCs have different channels for accessing potential investment opportunities. PVCs mainly rely on networking set up from previous investment and syndication (Hochberg *et al.*, 2007). By contrast, GVCs are assumed to have better access to local potential investment projects through the following three channels.

First, some projects received government subsidies when they were still in government-established incubators, in which high-tech start-ups enjoy tax benefits, lower office rents, better social services and other policy support (Chandra *et al.*, 2007; Zhang *et al.*, 2008). The incubators, supported by local government keep a close relationship with local GVCs on a daily basis. Therefore, GVCs have the easy access to information about the natures of a project for marketization and further development.

Secondly, researchers at universities and research institutes are also a good source of new ventures (Ahlstrom *et al.*, 2007; Phan *et al.*, 2005). GVCs have a better access to these potential investees, because governments allocate R&D subsidies to these researchers and can introduce investment opportunities to their local GVCs as soon as a technological innovation transforms into a marketable product.

Thirdly, with the endorsement of local governments, GVCs also have the priority to access the projects that are still immature and risky from the perspective of PVCs. Such projects mainly focus on emerging industries and have not got a definite future due to their high-risk characteristics. When these high-growth and high-tech enterprises lobby and sell their ideas to government officials, the local authorities will express support to the project according to the expected benefit to the local economy. Due to the tight relationship between GVCs and the local government, government officials often regard GVCs as an option for financing. For those projects with

[3] For example, the local government of Pudong District of Shanghai decided to provide another 100 million RMB capital for both Pudong Science and Technology Investment Co., Ltd. and ZhangJiang VC Investment Co., Ltd, the two local GVCs established by the Pudong government in 1999 and 2000 respectively. The main purpose of the further financing of the two GVCs by the Pudong government was to "promote the economic development and restructuring in Pudong as a pioneer cluster of high-tech start-ups" (The Government of Pudong District, 2010). Meanwhile, the profitability of these two GVCs were not attractive. According to the data from PEdata, the IPO percentages of investment by Pudong Science and Technology Investment Co., Ltd. (10%) and ZhangJiang VC Investment Co., Ltd (33%) are far below the VC market average level in China (40.63%), and are even lower than average IPO rate of GVCs (38.83%). Thus the previous performance of these two GVCs were not the incentive of further financing by local government.

a moderate need for funds and a much closer relationship with consumers, government officials will suggest the local GVCs invest in those projects. Although GVCs still need to appraise the investments, the support intention of government officials could be regarded as the necessary endorsement to certify the project. Furthermore, the certification effect may become the signal to PVCs that the project is politically legitimate and therefore a qualified recipient of financing (Zhang *et al.*, 2008).

### 3.3. Screening projects

In the 1990s, the managers of PVCs in China mainly came from two streams, one of which is those venture capitalists spun off from experienced overseas VC firms and the other is those transferred from securities firms or banks (Zhang *et al.*, 2008). They can draw on their management and operational expertise in selecting and monitoring portfolio companies.

By contrast, most GVCs were established when there was only a fledgling venture capital market in China. Most local governments established management teams by themselves. Government officials, with very limited experience in screening projects (Zhang *et al.*, 2008), were directly appointed by the government and transformed from a government official to a venture capitalist overnight. The appointment of management by local authorities leads to a less efficient selection of talent, compared to the market competition and global perspective used by PVCs in recruiting (X. Chen & Shen, 2007).

GVCs' complicated decision-making process also causes deficient project-screening. Because the funds operated by GVCs are treated as state-owned assets, the investments and exits need confirmation by SASAC. The typical process of an investment is that 1) the management team makes an investment suggestion on a project after due diligence; 2) the board of directors, mainly comprising government officials from different departments, discusses whether or not to invest; and 3) the investment proposal is approved by State-owned Asset Evaluation Centre of SASAC as the final decision. Generally, the whole process takes six months, which is much longer than that in PVCs (X. Chen & Shen, 2007), because it often involves organizing meetings of government officials and administrative approval several times (Shanghai Pudong Industrial Economy Research Institute, 2011). Some valuable investment opportunities are missed due to the complex approval requirements.

However, GVCs have alternative channels for strengthening their screening efficiency by referring to the officials and specialists who have participated in evaluating the projects previously when allocating subsidies. For example, projects that have already gained recognition through government subsidies in the areas of technology and R&D can obtain priority during due diligence (Shanghai Pudong Industrial Economy Research Institute, 2011). By

comparison, PVCs have to pay a higher cost (both money and time) in their due diligence to obtain similar information.

### 3.4. Monitoring and value-added activities

Although both GVCs and PVCs can add value to their entrepreneurial companies, they differ in the specific benefits they can offer. In general, PVCs tend to underpin the inner structure of a portfolio firm, such as suggesting product and marketing strategies and helping to recruit talent with their expertise developed from previous investments (Zhang *et al.*, 2008). For the similar reasons mentioned in the section of 3.3, GVCs possess less experience and knowledge in monitoring portfolio companies.

However, GVCs do have their strength in nurturing their portfolios, albeit in a different way. The value-added activities of GVCs mainly focus on empowering their portfolio firms to enjoy favourable local policies (e.g. subsidies and public procurement). GVCs have preferential access to government resources and are more familiar with relevant red tape. The managers of GVCs are often consulted in the government policy-making process and, as a result, have their understanding of policies enhanced.

Furthermore, portfolios backed by GVCs enjoy a greater chance of getting IPO quota. CSRC (Chinese Securities Regulation Commission) allocated annual IPO quota to each province (cities) (Guo & Jiang, 2013; L. Tian, 2011). This arrangement has an impact on the IPOs in China even today[4].

Since both internal competitiveness provided by PVCs and the external environment provided by GVCs are crucial to the development of an enterprise, it is hard to evaluate which kind of value-added activities have a greater positive impact on portfolios.

### 3.5. Exit and making profit

Successful exits from portfolios either through IPOs or acquisitions are the main channels for VC firms to make a profit. Besides profits, good exit performance can also bring better reputation, a stronger network position and broader experience to venture capital firms. It will ultimately facilitate the fund-raising of a VC firm for a new round.

Besides the purpose of sending portfolio companies to IPO and making a profit, GVCs in China have more short-term goals. GVCs bear the responsibility of ensuring the safety and reasonable profitability of state-owned assets;

[4] In December 2015, the executive meeting of the Chinese State Council made the decision of reforming IPO registration in the next two years (State Council of China, 2015).

they are evaluated every year by SASAC like ordinary state-owned companies, ignoring the fact that venture capital investment generally needs five years or even longer to make a profit. To meet the requirement of SASAC, managers of GVCs either choose to send portfolio enterprises to IPO earlier before they are fully mature, or pursue short-term returns by investing in late-stage or pre-IPO projects.

Ironically, this "window-dressing" effect of seeking exits even if they are not as profitable as they might be and do not address the main phases of difficulty firms face in raising finance is also common among private VC firms, thus, it is difficult to judge whether PVCs are superior to GVCs when pursuing exit from portfolios. To get a convincing track records to facilitate future fundraising, VC firms (especially young firms) tend to send their portfolio companies to IPO earlier, even when the profit is still not attractive (Gompers & Lerner, 2004). However, the purpose of the windows-dressing of PVCs is different from GVCs, as it is directly related with whether PVCs can successfully raise funds for its future operation.

### 3.6. The link between each cycle

After scrutinizing the difference between GVCs and PVCs in each stage of a venture capital life cycle, it is still ambiguous whether GVCs have a more or less positive impact on the exit performance of their portfolios, compared to PVCs (See Figure 2).

| Stage | GVCs | PVCs | Impact of GVCs on portfolios' exit |
|---|---|---|---|
| Deal flow accessing | Local government recommendation | Networking (Other VC firms, previous portfolio companies) | Positive/Negative |
| Screening | Refer to government subsidy assessment records | Experience in VC investment or industry | Positive/Negative |
| Monitoring | Access to favourable policies | Strategy implementation | Positive/Negative |
| Exit | Annual assessment of state-owned asset | Window-dressing | Positive/Negative |

Figure 2

But when we look at the VC life cycle from a continuous perspective, one fundamental distinction between GVCs and PVCs is whether there is a link between current exit performance and future fund-raising (see Figure 1). The purpose of a PVC is not only to maximize profits in a finite fund life (typically 10 years), but also to gain sustainable operation for the indefinite future (as long as possible). Therefore, the performance today is crucial for the fundraising tomorrow. Such influences serve as an incentive for VC firms to exert considerable effort in selecting and nurturing their portfolio companies.

By contrast, when the funds operated by GVCs are granted by government statute, GVCs need not compete with

other VC firms to raise funds after the maturity of the current funds. Thus, the life cycle of GVCs is incomplete as there is a link missing, leading to a lack of incentive for GVCs to exerting optimal effort level.

### 3.7. The incentive and compensation for individual venture capitalists

The VC life cycle analysed above is on the venture capital firm level. Nevertheless, there is one factor which may affect venture capitalists' effort on individual level. The compensation mechanism influence the willingness of each venture capitalist to put an optimal effort in each stage of the VC life cycle. Thus, it is reasonable to augment the analysis on the difference between GVCs and PVCs by including their different compensation practices.

The design of GVCs' compensation in China leads to a lower effort level to put into portfolios. The common benefit of PVCs is the management fee plus carry, i.e. 20% of the extra profit; while the principal remuneration mechanism for the managers of GVCs is the annual salary plus annual bonus[5], which means there is a cap on the total income of GVCs' managers. Such an arrangement is similar to the salary of the directors in state-owned enterprises, ignoring the characteristics of the venture capital industry. Therefore, it is hard for the government to stimulate the venture capitalists in GVCs to exert the optimal effort level to maximize the investment profit. That is also why it is hard for GVCs to retain VC talents with experience when facing the competition from PVCs.

To summarize the analysis on VC life cycle, we expect a lower effort level of GVCs due to the firm level factor—the lack of the link between current performance—and future fundraising and the individual level factor—the less efficient compensation mechanism than for PVCs.

## 4. Empirical analysis of GVCs and PVCs

### 4.1. Hypothesis to test

According to the analysis in Section 3, GVCs are expected to put less effort than PVCs into investment, thus leading to an underperformance of their portfolio companies. Controlling for the characteristics of VC firms and portfolio companies which can affect the exit performance, the baseline hypothesis is as following.

*Hypothesis 1. Portfolio companies backed by GVCs are less likely to achieve a successful exit than those backed by PVCs.*

Although the government policy in China has been directing GVCs to early-stage investments, the concerns about whether GVCs can meet the obligation remain. Early-stage investment needs more effort in nurturing the portfolio

[5] For example, the SASAC (State-owned Assets Supervision and Administration Commission) of ShenZhen has the regulation that the cap on the annual bonus for the managers of state-owned enterprises is three times their annual salary.

companies, and a longer period to exit. Due to the lack of the link and a less effective compensation mechanism shown in the analysis in Section 3, GVCs may be inclined to exert a lower level of effort in investment. Thus, compared to PVCs, GVCs are expected to have no advantage in helping start-ups to achieve a successful exit.

*Hypothesis 2. Early-stage investments by GVCs do not have higher probability of achieving a successful exit than those by PVCs.*

GVCs are established to boost local economic development. Hence, GVCs are expected to possess more strength in helping local entrepreneurs, mainly due to GVCs' privileged access to local resources, especially the opportunities for getting listed on the stock market.

*Hypothesis 3. The disadvantage of portfolio companies backed by GVCs compared to those backed by PVCs is alleviated if the companies are invested in by their local GVCs.*

### 4.2. Data and sample

The primary data source for this research is PEdata, a commercial database developed by Zero2IPO Research Centre, tracing the venture capital investments in China. We augment the database with CSMAR (China Stock Market Accounting Research) to crosscheck the IPO records.

For the classification of GVCs and PVCs, we check the detailed description of venture capital firms in PEdata and augment the data by cross-checking the website of each VC firm to ensure a reliable classification, according to the criteria explained in Section 2[6].

The sample is restricted to the venture capital investments made from the beginning of 1991 to the end of 2010 in the Chinese VC market. Because the boundary between venture capital firms (VC) and private equity firms (PE) is not clear in China (VC firms also engaged in late stage and pre-IPO investment, while PE firms invested in early-stage as well) (Gompers *et al.*, 2012), this paper adopts a broader definition of venture capital investment (Wright, 2007), including investments by both VC and PE in the sample. To follow the general practice in VC industry research that provides five years for VC-backed enterprises to mature, we drop the new investments after 2010 to ensure a meaningful interpretation of the exit from portfolios.

We exclude the investment records with missing identities of VC firms or portfolio companies. We combine the

[6] Venture capital firms which are established by State-owned companies (except those categories mentioned above), state-controlled commercial banks or state universities are not defined as GVCs, for those VC firms need not report directly to SASAC, nor is the further funding decision made by local government. It is their parent companies (banks or universities) that make funding decision due to the previous performance of those VC firms.

investment records which were made by the same VC firm, on the same date in the same portfolio company, whilst using several funds it managed. In such circumstances, we sum up the investment amount and regard it as one investment record.

We classify portfolio companies as GVC-backed or PVC-backed if the company gets its first round VC investment from a GVC or a PVC. The identification method by referring to the first round investment a portfolio company receives is widely used in previous research (Cumming *et al.*, 2014; De Clercq & Dimov, 2008; Sorensen, 2007; Lerner, 1994), for this can effectively eliminate the fact that the decisions on later round investments may be heavily influenced by the first round (L. Wang & Wang, 2011).

To ensure the validity of the analysis, we follow the methods taken by previous studies (Gompers *et al.*, 2008; Gompers *et al.*, 2009) to classify the portfolio companies into seven broad categories[7] (Internet and Computers, Communication and Electronics, Biotech and Health Care, Consumer, Industry and Energy, Financial Services, and Others). The classification is consistent with Venture Economics Industry Codes, the most widely used database for the U.S. VC market. We exclude the investments in real estate development and film/television programme production from the sample, because the successful exit from such investments cannot be gauged by IPO or M&A.

We also exclude records where the investment amount is missing from the sample. Due to the large proportion (nearly 1/3) of missing value in the whole sample, we compare the two groups of samples with and without available investment amount information, and found the two groups of samples have no systematic difference with regards to whether a portfolio company is backed by GVCs or PVCs. In unreported analysis, the regression using the full sample (excluding investment amount from independent variables) does not change the sign and significance of other coefficients estimated, compared to the regression using the sample that contains investment amount information.

Table 1 summarizes the definitions of the variables.

[Insert Table 1]

*Exit* is a dummy variable, which equals 1 when the investment has a successful exit from portfolio companies through IPO, equals 2 when exiting through M&A, and 0 otherwise. Because exit through IPO (or M&A)

[7] The original industry classification in PEdata contains 22 different industries, some of which are specific (e.g. Integrated circuit) and others are general (e.g. Information Technology).

brought the highest profit to venture capitalists, it becomes the most typical proxy for successful investments in venture capital literature (H. Chen *et al.*, 2010; Ewens & Rhodes-Kropf, 2015; Hochberg *et al.*, 2007; Sorensen, 2007).

*GVC* is a dummy variable which equals 1 if the investment is done by a GVC, as defined in Section 2.2. It is also the variable of interest in this research.

*Amount* is the total amount of first-round investment received by an enterprise in million US dollars. Investments made in other currencies are converted into US dollars, according to the exchange rate by the end of the investment year. The amount of the first-round investment is an indicator of the valuation of the project and also a reflection of the risk assessment of the project by venture capitalists (Brander *et al.*, 2014).

*Scale* is the total value of funds (USD, million) under management by a VC firm before the focal investment. Economies of scale and the decreasing return to scale (Kaplan & Schoar, 2005) may explain the efficiency of the VC firm, thus, affect the performance of its portfolio companies. We include the quadratic form of scale in the regression to gauge its impact.

*Experience* is the accumulated investment rounds done by a VC firm prior to the focal investment. Sorensen (2007) showed that in a mature VC market like the U.S., more experienced VC firms are more likely to get their portfolio companies listed. Since the relationship between VC firms' previous experience (investment rounds) and the performance of their portfolios are concave (Gu & Lu, 2014), We add the quadratic term in the regression to control for the effect of experience. Some researchers use specific experience (investment made in the same industry as the focal investment) in their research (Bottazzi *et al.*, 2008; De Clercq & Dimov, 2008; Hopp & Lukas, 2014), because they believe it is the better understanding of a specific industry that enables VC firms to develop their portfolios better. We use *Industry Experience* (accumulated investment rounds done by a VC firm in the same industry as the focal investment) as an alternative to *Experience* in the regression.

*Early* is a dummy variable which equals 1 if an investment is a "seed" or "start-up" investment. Early stage investments are believed to have higher risk, therefore, lower possibility to go public (Bottazzi *et al.*, 2008; Hochberg *et al.*, 2014; Sorensen, 2007). Due to some missing values of investment stage in PEdata, we augment the data by comparing the investment date and the establishment date of an enterprise. If the difference is within two years, then we defined it as an "Early" stage investment. A similar definition of early stage investment is also used in prior literature (Cumming *et al.*, 2014).

*Local Knowledge* is a dummy variable which equals 1 if the location of a VC firm's headquarters is in the same

region (province) as the portfolio company. Geographic proximity is regarded as an important advantage of VC firms to keep consistent contact in screening and monitoring portfolio companies (Sorenson & Stuart, 2001; X. Tian, 2011). Thus, we use the dummy variable of *Local Knowledge* as the proxy for both the proximity of VC firms to its portfolios in general and GVCs' privileged access to local resources.

*VCcluster* is a dummy variable which equals 1 if the headquarters of a VC firm is located in Beijing, Shanghai or Guangzhou, three clusters of VC industry in China. The three centres of venture capital activity in China are home to 42% (722 out of 1710) VC firms head offices in the sample. Furthermore, 58% first round individual investments between 1991 and 2010 are done by these VC firms located in the VC industry clusters. Previous research shows that VC firms tend to locate in cities where venture capital investment have been previously successful and where innovation activities are prosperous (H. Chen *et al.*, 2010). The information-share effect and more investment opportunity will positively affect the performance of VC firms and, therefore, their portfolio companies.

*IPOpreviousYear* is a variable of controlling for the macroeconomic environment of the VC industry. During booming years of IPOs, more funds flow into the VC industry, while during the periods of IPOs depression, the funds inflow into VC industry would be decreased. Higher inflow of funds means, on one hand, more severe competition among the VC market (Gompers & Lerner, 2000; Hochberg *et al.*, 2007), and also means, on the other hand, more interaction and a healthy growth environment for the VC industry in an emerging market like China (L. Wang & Wang, 2011). Since PEdata has many missing values in the funds raised every year, we use the number of IPO cases of Chinese enterprises both domestic and abroad in the preceding year of the focal investment as the control variable of the macro economic environment for VC investment.

*Industry* fixed-effects are also included in the regression.

The descriptive statistics is reported in Table 2.

[Insert Table 2]

As shown in Table 2, less than a third of portfolio firms achieve a successful exit, about three quarters of those through IPOs rather than mergers and acquisitions. On average, portfolio companies are backed by VC firms with about 20 rounds of investment experience (or about 6 rounds investment in the focal industry). One sixth investments are made by GVCs. More than one third investments are focused in the early stage, and more than 40% companies are backed by VC firms with headquarters located in the same city as the portfolio companies. The quantile and median values show that both investment amount and experience (total investment rounds or

industry rounds) are highly skewed. 75% investments are less than 8.3 million USD and 75% portfolio companies are backed by VC firms with less than 26 investment rounds experience (or only 5 rounds experience in the same industry).

The t-test of the difference of means of investments by PVCs and GVCs (reported in Table 3) shows that PVCs and GVCs in China do differ from each with regards to investment preference and performance. Portfolio companies backed by PVCs in their first round investment have a larger investment amount, are more concentrated in Consumer and Internet industries and have a higher possibility of achieving a successful exit. In contrast, GVCs tend to invest in the early stage, with a smaller investment amount and relatively focus on Telecommunication, Industry& Energy, and Medical industries. The stage preference of GVCs is consistent with the central government regulation that GVCs should bridge the gap between the demand of early stage investment and the supply of PVCs which are concerned about higher risk and lower profit. The industry preference of GVCs also reflects the influence of the central government on promoting the development of "Strategic Emerging Industries."[8]

[Insert Table 3]

The fact that GVCs prefer to invest in the local portfolio companies is also consistent with the mandate of most local GVCs. The main purpose of local GVCs is to catalyse the local SMEs and boost the local economic development. It is not unusual to find the provisions of governmental funds which explicitly require the funds should be only invested in enterprises which are registered within the provincial (or municipal) administration area, in order to benefit the local economy.

### 4.3. Regressions and results

We use multinomial regressions to test the different exit performance of portfolio companies backed by GVCs and PVCs, with the following specification:

$$Exit = \beta_0 + \beta_1 Amount + \beta_2 Early + \beta_3 Local + \beta_4 GVC + \beta_5 Experience + \beta_6 Local * GVC + \beta_7 Early * GVC + \beta_8 Scale + \beta_9 VCcluster + \beta_{10} IPOlastyear + \beta_{11} Industry$$

All variables are defined in Table 1.

Table 4 reports the regression results. *Experience* (or *Industry experience* as a replacement in Model 2) and *Scale* showing a U-shaped relationship between accumulated investment rounds and successful exits. The main

[8] According to the Resolution of Nurturing and Developing Strategic Emerging Industries (the Stage Council of China, 2010), Strategic Emerging Industries include medical, telecommunication and high-end manufacturing, but exclude consumer industry.

reason is that the Chinese VC market is relatively new, thus, a lot of investments are conducted by VC firms with little experience and limited scale when established. The investment experience and the economies of scale are not likely to have a positive effect until the investment rounds and funds under management reach a certain level.

[Insert Table 4]

#### 4.3.1.Effect of GVCs on portfolios' exit performance

The key insight of the results shown in Table 4 is that compared to those backed by PVCs, enterprises backed by GVCs are less likely to go public, which supports Hypothesis 1. Since there are interaction terms in the regression, we calculate the marginal effects of being backed by GVCs and reported the result in Table 5 column (1). Since being backed by GVCs does not have a statistical significant impact on the possibility of exit through M&A, we only show the comparative marginal effect of GVCs and PVCs on the exit of portfolio companies through an IPO. In general, portfolio companies backed by GVC had 7.2 percentage points lower achievement of an IPO.

#### 4.3.2.Effect of GVCs on early-stage investment

Early stage investment shows a negative relationship with IPO but a positive relationship with M&A. While it is to be expected that young companies will find it hard to succeed in an IPO before they have full developed, M&A by a purchaser who sees how they could develop the firm as part of their portfolio or as a supplier is also to be expected.

The interaction term of Early and GVCs is not statistically significant in terms of sending portfolios to IPO. Furthermore, if a start-up is backed by GVCs, it will have a lower possibility of exiting successfully through M&A. Although GVCs tend to invest in the early stage, as shown in the t-test in Table 3, GVCs have no advantages in selecting and nurturing early stage investments compared to PVCs, keeping other factors constant. Thus, hypothesis 2 is also supported by the results.

#### 4.3.3.Effect of GVCs on local investment

Although the coefficient of Local is not statistically significant in all regression, the interaction term of *local knowledge* and *GVC* is positive and statistically significant when the successful exit is gauged by IPO. The marginal effects of being backed by GVCs when VC firms do and do not have local knowledge of their portfolio companies are shown in Table 5 Column (2) and (3).

[Insert Table 5]

If a portfolio company is backed by a local GVC, it will have even a slightly higher possibility of going public than those backed by PVCs, albeit the difference between the marginal effect is small (2.4 percentage points) and statistically insignificant. If a portfolio company is backed by VC firms without local knowledge, i.e. being invested in by VC firms located in a different province from the portfolio company itself, those backed by GVCs will have a 13.2-percentage-point lower possibility than those backed by PVCs in achieving an IPO.

The results support Hypothesis 3 that the lower possibility of achieving a successful exit of portfolio companies backed by GVCs is alleviated when they are invested in by a local GVC, due to the GVCs' privileged access to local resources. When PVCs are located in the same city as their focal portfolio company, the main advantage of PVCs is the lower cost of monitoring the company when taking a proactive involvement in constant supervising their portfolios (Zhang *et al.*, 2008). By comparison, when GVCs invest in enterprises located in the same city, the GVCs have full access to the local government resources, in addition to the proximity effect of monitoring the portfolio company.

It is worth mentioning that the evidence of GVCs' advantage in local knowledge is limited in obtaining IPO opportunities. The interaction term of local knowledge and GVCs is not statistically significant when the dependent variable value takes the value of 2 (i.e. exit through M&A). Thus, there is no evidence to show that local GVCs possess any advantage in helping their portfolios find good acquirers as a successful exit alternative. The result is consistent with the fact that CSRC (Chinese Securities Regulation Commission) allocated an annual IPO quota to each province (cities) (Guo & Jiang, 2013; L. Tian, 2011), thus those companies backed by GVCs are more likely to obtain quota and go public.

## 5. Selection bias

Potential selection bias is a major concern of corporate finance research. In this paper, the main concern is whether the lower possibility of achieving an IPO by GVCs-backed portfolios is caused by the fact that companies with a lower possibility of a successful exit tend to be invested in by GVCs. If GVCs deliberately select those enterprises which are harder to get listed on the stock market or find a good acquirer, according to some characteristics which are unobservable, then the results of Table 4 may be driven by selection bias.

### 5.1. Instrument variable

The typical solution to selection bias is to find an effective instrumental variable (IV hereafter) which is related to the potentially endogenous variable (whether a portfolio is supported by GVCs), but is unrelated to the exit performance of the portfolio companies (whether a portfolio has an IPO). The average level of a certain market,

which has been widely used in previous VC research (Bottazzi *et al.*, 2008; Chemmanur *et al.*, 2011), is regarded as exogenous.

To do this, we use the "*Availability of GVCs"* in a certain year in China as the IV of the binary variable *GVC*. *Availability of GVCs* is defined as the percentage of investment amount made by GVCs in total VC investment in each year, presenting how likely a portfolio company was invested in by GVCs in that year. The higher the proportion, the more likely a portfolio company was invested by a GVC. However, the numbers of GVCs available in the whole Chinese VC market in a specific year is expected to have no causal relationship with the possibility of a portfolio firm achieving a successful exit. The investment amount of the focal portfolio company backed by GVCs is excluded from both the numerator and denominator of the percentage, to avoid endogeneity problems with the IV.

Since both the dependent variable (*IPO*) and potential endogenous variable (*GVC*) are binary, we run a bivariate probit regression to solve the self-selection problem. The control function estimators first estimate the model of endogenous variable (*GVC*) as a function of instruments, like the "first stage" of 2SLS (Wooldridge, 2010).

$$GVC = \beta_0 + \beta_1 Amount + \beta_2 Early + \beta_3 Local + \beta_4 Experience + \beta_5 Scale + + \beta_6 GVCavailability + \beta_7 Industry$$

In the "first stage" regression, *GVC* is the dependent variable. *GVC availability* is used as an explanatory variable. Because the *GVC availability* is a year base variable, we exclude year fixed effects from the regression to avoid collinearity. When a company seeks VC funding, it may select VC firms with a certain level of experience and scale. Thus, we exclude the quadratic forms of *Experience* and *Scale* and only retain the log values of *Experience* and *Scale* in the first stage regression.

The results in Column (1) Table 6 show that *GVC availability* is positively and statistically significantly related with whether a portfolio is backed by GVCs.

[Insert Table 6]

After estimating the possibility of being backed by a GVC, we insert the error terms from the first stage regression as an additional regressor in the main model. Similar application can be found in (Lewbel *et al.*, 2012). The dependent variable is *IPO*, which equals 1 if the portfolio company got listed on stock markets. Results are consistent with those in Table 4. GVC-backed portfolios are less likely to achieve an IPO. More importantly, the marginal effect of *GVC* become more noticeable compared to the result in Table 5. Portfolio companies backed by GVCs have a 23.9-percentage-point lower possibility of achieving an IPO than those backed by PVCs. Column (2) in Panel B, Table 6 has shown that even those portfolios backed by local GVCs

still underperform others backed by PVCs, statistically significant at 10% level.

### 5.2. Propensity score matching

We employ propensity score matching as a supplementary method to explore the potential endogeneity problem. Since 16.8% of portfolio companies are backed by GVCs in the sample, we match each investment by GVCs with at least two investments by PVCs with the similar (the closest propensity score) experience, investment amount, stage, industry, and investment year to the each observation of GVCs. This is to ensure that only those GVC-backed and PVC-backed companies with similar characteristics are compared. The average treatment effect of being backed by GVCs compared to those backed by PVCs is reported in Table 7.

[Insert Table 7]

In general, companies backed by GVCs have a 6-percentage-point lower possibility of having a successful exit through IPO than those backed by PVCs. When we split the sample into two groups: companies backed by VC firms with and without local knowledge, the marginal effects of being backed by GVC are quite different. If a portfolio company is invested in by a local GVC, then it will have no statistically significant difference from those backed by a local PVC in achieving an IPO. By contrast, if the company is backed by a non-local GVC, its possibility of going public will be 15.3 percentage points lower compared to those backed by a non-local PVC. The results is consistent with the baseline regression and the economic implication is similar.

### 5.3. Heckman treatment effect

Another concern about the potential endogeneity problem in this research is that there may be some unobservable characteristics of the portfolio firms (which may include the quality of the project, the potential risk of the project and even the capability of the entrepreneurs) not only affect the company's choice of being backed by GVCs or PVCs, but also affect the company's ability to achieve an IPO.

$$\mathrm{GVC}_i = \gamma' \mathrm{Z}_i + \varepsilon_i$$

ε is unobservable factors which is known be the portfolio firms themselves, but are not revealed by VC firms. Z is a bundle of observable variables which affect the possibility of being backed by GVCs.

$$\mathrm{IPO}_i = \mathrm{GVC}_i + \beta \mathrm{X}_i + \mu_i$$

μ is unobservable factors which affect the IPO propensity of a portfolio company. If the unobservable factors μ simultaneously drive the GVC possibility, then ε is correlated with μ, i.e. the baseline regression results would be biased.

Here, we employ the Heckman treatment effect method (Heckman, 1990) to run an unbiased regression. In the first step, *GVC* is run upon a set of variables which may affect the possibility of portfolios being backed by GVCs. After the first stage regression, an Inverse Mill Ratio type of control factor (λ lambda) is calculated using the algorithm $\lambda = \frac{\phi(\check{\gamma}Z_i)}{\Phi(\check{\gamma}Z_i)}\ when\ (GVC = 1)\ and\ \lambda = \frac{\phi(\check{\gamma}Z_i)}{1-\Phi(\check{\gamma}Z_i)}\ (when\ GVC = 0)$ (Schenone, 2004), ϕ is the normal distribution density of the estimated value of being backed by GVC (i.e. $\check{\gamma}Z_i$), Φ is the normal distribution of the estimated value of being backed by GVC.

In the second step, λ is added into the regression with other observable control variables. Now the equation can be estimated consistently using logistic regression. The results of the two steps are reported in Table 8.

[Insert Table 8]

The results have remained qualitatively the same as the regressions of the IV method. The estimated correlation between the treatment-assignment errors and the outcome errors is ρ 0.285 and statistically significant at 1% level, indicating that unobservable variables that raise the IPO propensity tend to occur with unobservable variables that increase the possibility of being backed by GVCs.

In order to clearly interpret the economic significance of the results, we calculate the average treatment effect of *GVC* on the possibility of going public, as shown in Panel B Table 8. When taking those unobservable factors into consideration, the marginal effect of being backed by GVCs could lead to an even lower possibility of getting listed on the stock market. The predictive marginal effect of being backed by GVCs is 30.9 percentage points lower to get listed compared to those backed by PVCs. By comparison, when the variable GVC is regarded as exogenous, the margin effect of being backed by GVCs is only 7.2 percentage points lower than PVCs (as shown in Table 5) in achieving a successful exit through IPO.

## 6. Robustness check

Although IPO is the most widely used proxy for the performance of good VC investments, there are potential problems. First, If GVCs want to nurture “Seed” and early stage investment, and then attract PVCs to follow up the investment in later rounds, then the certification effect of GVCs (being backed by GVCs is interpreted by other VC firms as signalling the government’s support and public value of the project (Leleux & Surlemont, 2003)) still can be regarded as a success of the government policy. Secondly, not all IPOs could be regarded as an ultimate successful exit, because some boards (e.g. National Equities Exchange and Quotations) in Chinese stock markets are highly illiquid. Getting listed on such an illiquid board provides a much lower return to VC firms compared to exiting through the main boards (e.g. Shanghai Stock Exchange). Thus, we use several tests

to check the robustness of the previous regression results.

### 6.1. Further investment

Stage financing is one of the most important features of venture capital. Subsequent investments are regarded as a symbol of the healthy development of the portfolio companies, especially for early stage investments. A larger number of financing rounds is found to be positively related with the entrepreneurial firms' propensity to go public (X. Tian, 2011). Thus, we use further investments as a proxy for the successful investments.

Previous empirical research in the context of European countries shows that GVCs are less likely to help their portfolio companies obtain additional financing (Bottazzi *et al.*, 2008). We test for a similar effect by constructing a dummy variable *Further Financing* which equals 1 if a portfolio company gets more VC financing after its first round VC investment. Further, to gauge exit performance, we give each portfolio company at least five years to get further financing, i.e. setting the value of *Further Financing* as 1 if a company got its second round or more financing by the end of the year 2015.

We use *Further Financing* as the dependent variable and run the regression to see whether entrepreneurial companies backed by GVCs in their first round investment will have a lower possibility of obtaining further financing. The independent variables are the same as the baseline regression. The results are shown in Table 9.

[Insert Table 9]

The result is consistent with the baseline regression. The coefficient of "Early" stage investment is positive, because early investments need more financing rounds to mature and get ready for IPOs or acquisitions. The interaction term of Early and GVC is negative and statistically significant. That means if a portfolio company is backed by GVC in its first round investment in early stage, it will be less likely to get further financing compared to those backed by private VC firms. It provides further evidence that GVCs do not have any advantages in helping start-ups, as stated in *Hypothesis 2*. From the perspective of getting further financing for their portfolios, GVCs perform worse than PVCs.

By calculating the marginal effect (reported in Panel B Table 9), we can clearly see that portfolio companies backed by GVCs are less likely (7.7 percentage points lower compared to those backed by PVCs) to get further financing. Furthermore, if it is an early-stage investment, portfolio companies backed by GVCs will have an even lower possibility (14.9 percentage points lower than those backed by PVCs) of getting further financing.

### 6.2. NEEQ effect

Launched in late 2012 as an over-the-counter (OTC) exchange and known as the "new third board" in China, NEEQ (National Equity Exchange and Quotations) provides another option for entrepreneurial corporations to go public. According to CVSource, NEEQ had hosted 5129 listing by the end of 2015 (Shi, 2016). The requirement of listing on NEEQ is relatively easier compared to the main boards (Shanghai and Shenzhen exchanges), Shenzhen Small and Medium Enterprise board and ChiNext (Shenzhen's Nasdaq-style start-up board). The listed companies on NEEQ are supposed to transfer to major exchanges when higher requirements (e.g. profitability) are met.

However, the trading at NEEQ is still limited to qualified institutional investors. Moreover, the lack of market-makers and lack of a clear upgrade path to major exchanges has led to illiquidity on NEEQ (Li, 2015). Among 5129 listed companies at NEEQ by the end of 2015, nearly half have no trading in their shares (Shi, 2016). Some researchers claim that sending portfolio companies to registration at NEEQ should not be regarded as an ultimate successful exit for VC firms.

Among 860 successful exits through IPO in the sample, 157 of which are through NEEQ. We compare the characteristics of the portfolio companies (and their VC firms) which are listed on NEEQ and other exchanges. The t-tests of the companies listed on NEEQ and other exchange markets (Table 10) show that portfolio companies listed on NEEQ are more likely to be backed by GVCs. Moreover, NEEQ tends to provide a platform for early-stage investments with smaller investment value (although not statistically significant). Portfolio companies exiting through listing on NEEQ are more likely to be backed by VC firms with better local knowledge.

[Insert Table 10]

Due to the difference between firms listed on NEEQ and other exchanges, it is meaningful to test whether the lower possibility of enterprises backed by GVCs going public is caused by their less preference for exiting through NEEQ.

We use *IPOexcludingNEEQ* (a dummy variable equals 1 if the portfolio company goes to public on any exchange market except NEEQ) as the dependent variable and run the regressions similar to the baseline regression.

[Insert Table 11]

Table 11 shows the results. All coefficients estimated remain of the same sign and significance as the baseline

regression.

## 7. Conclusion

Prior research shows portfolio companies backed by GVCs and PVCs have different exit performance. However, there is a lack of systematic analysis of what leads to the different performance. This paper compares the characteristics of governmental venture capital firms (GVCs) and private ones (PVCs) in each stage of a VC life cycle and explains the fundamental difference that at the VC firm level GVCs do not have the link between current performance and future fundraising, and at the individual level that GVCs' compensation mechanism is less efficient.

Using data on venture capital investment from 1991 to 2010 in the Chinese VC market, the empirical results show that companies backed by GVCs in their first stage investment are less likely to go public, compared to those backed by PVCs. The advantages of GVCs are mainly limited in accessing local resources, especially the IPO quota. Furthermore, there is no evidence to show that GVCs have any advantages in selecting or nurturing early stage investment, despite the fact that GVCs made more early stage investment than PVCs. The results are robust to several robustness checks.

When taking into consideration the potential selection bias problem, the economic significance of the negative impact of being backed by GVCs gets more noticeable. Those unobservable factors which may lead to a higher possibility of being backed by GVCs also lead to a higher possibility of achieving an IPO. To some extent, it provides evidence that GVCs had been cherry-picking the best projects that are more likely to go public, rather than supporting those marginal projects with higher risk. However, the outcome of being backed by GVCs is not promising. Portfolio companies invested by GVCs have a 31-percentage-point lower possibility of achieving an IPO than those by PVCs.

There are clear implications for policy makers. To improve the performance of GVCs, government should not only give their local GVCs the right to raise funds from diversified resources to stimulate the development of GVCs, but also reform the compensation mechanism to combat the competition from PVCs. Considering that current GVCs in China are supervised by their local SASAC, it is practical for the local SASAC to take into consideration the high-risk and low illiquidity characteristics of VC industry when designing the state-owned assets assessment regime.

Due to the constraint of data accessing, there is a limitation of this research regarding the impact of GVCs on promoting portfolio companies' innovation and competency. The patent number and other financial data of

private companies are hard to track in China. Alternatively, some researchers limit their samples within the companies listed on the stock market, because the data of public traded companies are easily to access. Such practice only throws light on those VC investments with successful exits through IPO. Thus, whether GVCs have met their goals of catalysing the high-tech and young firms' innovation remains unknown. Further research may be directed to this area with the access of private companies' data.

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Table 1

## Variable Definitions

| *Variable* | Description |
|---|---|
| *Exit* | A categorical variable that takes the value 1 if the portfolio company has successfully been listed on stock market, 2 if it has been acquired through Merger & Acquisition, and 0 otherwise. |
| *Further investment* | A dummy variable that takes the value 1 if the portfolio company got further financing from VC firms after its first round investment. |
| *IPO excluding NEEQ* | A dummy variable that takes the value 1 if the portfolio company has successfully been listed on stock market but not on National Equities Exchange and Quotations (NEEQ). |
| *GVC* | A dummy variable that takes the value 1 if the first round VC investment of the portfolio company is made by a GVC. (The definition of governmental VC firms are explained in Section 2.2) |
| *Early* | A dummy variable that takes the value 1 if the first round VC investment in the portfolio company is in “Seed” or early stage investment. |
| *Local Knowledge* | A dummy variable that takes the value 1 if the headquarters of the VC firm is in the same province as the portfolio company. |
| *VC cluster* | A dummy variable that takes the value 1 if the headquarters of the VC firm is located in Beijing, Shanghai or Guangzhou, three clusters in the Chinese VC market. |
| *Amount* | Investment amount in million US dollar. The value in regression is log(1+amount). |
| *Scale* | The sum of the investment amount by a VC firm in the last five years prior to the focal investment. The value in regression is the log value of (1+scale). |
| *Experience* | The accumulated investment rounds in all industries done by a VC firm before it invests in the focal portfolio company. The value in regression is log(1+experience). |
| *Industry Experience* | The accumulated investment rounds in the same industry as the focal investment done by a VC firm before it invests in the focal portfolio company. The value in regression is the log value of (1+Industry experience). |
| *IPO Previous year* | The number of Chinese companies going public home and abroad in the preceding year of the focal investment. The value in regression is log(IPOpreviousyear). |
| *Industry* | A set of mutually exclusive dummy variables that equals 1 if the portfolio company is in one of the following industries: Internet and Computers, Communication and Electronics, Biotech and Health Care, Consumer, Industry and Energy, Financial Services, and Others. |
| *GVC Availability* | The percentage of investment amount made by GVC in total VC investment in China in a certain year, as the instrument variable of GVC. |

Table 2

## Descriptive Statistics

The table provides descriptive statistics for all the dependent and independent variables, which are defined in Table 1. The sample contains 3,793 investments in the China Venture capital market during 1991-2010.

| Variable | Mean | Std. Dev. | Min | 25 quantile | Median | 75 quantile | Max | Obs |
|---|---|---|---|---|---|---|---|---|
| Investment Amount (USD, m) | 15.070 | 86.998 | 0.01 | 1.224 | 3.030 | 8.243 | 2351.515 | 2,563 |
| Scale (USD, m) | 171.177 | 420.952 | 0.027 | 6.000 | 32.122 | 150.789 | 7070.021 | 3,502 |
| Experience | 24.035 | 44.130 | 0 | 1 | 7 | 26 | 318 | 3,793 |
| Industry Experience | 5.720 | 13.517 | 0 | 0 | 1 | 5 | 154 | 3,793 |
| Early stage | 0.374 | 0.484 | 0 | | | | 1 | 3,784 |
| GVCs | 0.169 | 0.375 | 0 | | | | 1 | 3,793 |
| Local Knowledge | 0.407 | 0.491 | 0 | | | | 1 | 3,793 |
| VC Cluster | 0.578 | 0.494 | 0 | | | | 1 | 3,793 |
| IPO Previous year | 154.044 | 51.323 | 11 | 118 | 148 | 176 | 264 | 3,793 |

| Exit | Percentage | Observation |
|---|---|---|
| IPO | 22.67% | 860 |
| M&A | 6.56% | 249 |
| Others | 70.76% | 2,684 |

| Industry | Percentage | Observation |
|---|---|---|
| Telecommunication | 18.29% | 694 |
| Consumer | 10.96% | 416 |
| Financial | 3.77% | 143 |
| Industry & Energy | 22.72% | 862 |
| Internet | 19.82% | 752 |
| Medical | 10.25% | 389 |
| Other Industries | 14.18% | 538 |

Table 3

## Univariate Tests—Portfolio Company Level

This table presents univariate non-parametric tests for the difference of means of investments conducted by PVCs and GVCs respectively. Portfolio companies invested by PVCs have higher possibility of a successful exit (through IPO or acquisition), larger investment amount, and are concentrated in Consumer and Internet industries. In contrast, GVCs tend to invest in early stage, within the city of their headquarters, with smaller investment amount, and focus on Telecommunication, Industry& Energy, and Medical industries. Difference significant at the 1%, 5%, and 10% level are identified by $^{**}$, $^{*}$, and $^{+}$.

| | Portfolio companies backed by PVC | Portfolio companies backed by GVC | |
|---|---|---|---|
| IPO | 0.233 | 0.195 | * |
| Early Stage | 0.365 | 0.419 | ** |
| Local Knowledge | 0.332 | 0.775 | ** |
| Amount | 17.293 | 3.984 | ** |
| Scale | 183.681 | 111.302 | ** |
| Experience | 20.547 | 41.216 | ** |
| Industry Experience | 5.189 | 8.333 | ** |
| Industry Category | | | |
| Telecommunication | 0.175 | 0.223 | ** |
| Consumer | 0.121 | 0.053 | ** |
| Financial | 0.038 | 0.036 | |
| Industry & Energy | 0.214 | 0.291 | ** |
| Internet | 0.207 | 0.156 | ** |
| Medical | 0.095 | 0.138 | ** |
| Other Industries | 0.149 | 0.103 | ** |

Table 4

## The Impact of GVCs and PVCs on the Exit Performance of Portfolios

The sample includes all the first round investments by GVCs and PVCs individually from 1991 to 2010 in the Chinese VC market. Multinomial regression is used to estimate the results. We report the coefficient, computed using (Huber-White) heteroscedasticity-robust standard errors (in parenthesis), and clustered by the location of portfolio companies. Values significant at 1%, 5% and 10% are identified by $^{**}$, $^{*}$, and $^{+}$.

| | Model(1) | | Model(2) | |
|---|---|---|---|---|
| | IPO (Exit=1) | M&A (Exit=2) | IPO (Exit=1) | M&A(Exit=2) |
| Amount | 0.062 | 0.092 | 0.115$^{+}$ | 0.068 |
| | (0.074) | (0.107) | (0.067) | (0.86) |
| Scale | -0.437$^{**}$ | -0.309$^{**}$ | -0.508$^{**}$ | -0.161 |
| | (0.100) | (0.102) | (0.088) | (0.114) |
| Scale$^2$ | 0.035$^{**}$ | 0.035$^{**}$ | 0.035$^{**}$ | 0.053$^{+}$ |
| | (0.013) | (0.013) | (0.012) | (0.011) |
| Experience | -0.173$^{*}$ | 0.447$^{**}$ | | |
| | (0.077) | (0.145) | | |
| Experience$^2$ | 0.019 | -0.089$^{**}$ | | |
| | (0.016) | (0.030) | | |
| Industry Experience | | | -0.216$^{*}$ | 0.161 |
| | | | (0.106) | (0.281) |
| Industry Experience$^2$ | | | 0.074$^{*}$ | -0.056 |
| | | | (0.029) | (0.053) |
| Early | -1.134$^{**}$ | 0.297$^{*}$ | -1.152$^{**}$ | 0.301$^{+}$ |
| | (0.090) | (0.133) | (0.091) | (0.129) |
| GVC | -0.828$^{**}$ | 0.376 | -0.946$^{**}$ | 0.188 |
| | (0.322) | (0.546) | (0.347) | (0.515) |
| Early×GVC | 0.295 | -0.913$^{*}$ | 0.346 | -0.862$^{+}$ |
| | (0.354) | (0.431) | (0.367) | (0.440) |
| Local Knowledge | -0.140 | -0.121 | -0.154 | -0.109 |
| | (0.124) | (0.164) | (0.127) | (0.167) |
| Local×GVC | 0.837$^{*}$ | -0.383 | 0.902$^{**}$ | -0.196 |
| | (0.336) | (0.675) | (0.329) | (0.641) |
| VCcluster | 0.413$^{**}$ | 0.205 | 0.385$^{**}$ | 0.185 |
| | (0.104) | (0.202) | (0.105) | (0.188) |
| IPOpreviousYear | -0.031 | -0.274 | -0.019 | -0.298 |
| | (0.150) | (0.395) | (0.149) | (0.391) |
| _cons | 0.687 | -1.036 | 0.633 | -0.814 |
| | (0.674) | (1.230) | (0.668) | (1.836) |
| Industry dummies | Yes | Yes | Yes | Yes |
| Pseudo $R^2$ | 0.0677 | 0.0677 | 0.0669 | 0.0669 |
| Log pseudolikelihood | -1938.5472 | -1938.5472 | -1940.1392 | -1940.1392 |
| *N* | 2554 | 2554 | 2554 | 2554 |

Table 5

## Marginal Effect of being Backed by GVCs

The sample includes all the first round investments by GVCs and PVCs individually from 1991 to 2010 in the Chinese VC market. Multinomial regressions (shown in Table 4) are run before calculating the marginal effect. Column (1) compare the marginal effect of being backed by GVCs, while Column (2) and (3) take a further look at the marginal effect of GVCs when the VC firms do and do not have local knowledge of their portfolios. Values significant at 1%, 5% and 10% are identified by $^{**}$, $^{*}$, and $^{+}$.

| | (1)<br>Difference of the marginal effect on IPO | (2)<br>when Local Knowledge=1 | (3)<br>when Local Knowledge=0 |
|---|---|---|---|
| 1 vs 0 (GVCs vs PVCs) | -0.072$^{*}$ | 0.024 | -0.132** |
| | (0.030) | (0.031) | (0.045) |

Standard errors in parentheses

Table 6

## The Selection Bias Test Using Instrument Variable

The sample includes all the first round investments by GVCs and PVCs individually from 1991 to 2010 in the Chinese VC market. Bivariate Probit regression is used. *GVC Availability* is used as the instrument variable of the potential endogenous variable *GVC*. We report the coefficient, computed using (Huber-White) heteroscedasticity-robust standard errors (in parenthesis), and clustered by the location of portfolio companies. Values significant at 1%, 5% and 10% are identified by $^{**}$, $^{*}$, and $^{+}$.

| Panel A | (1) GVC | (2) IPO |
|---|---|---|
| Amount | -0.226** | 0.014 |
| | (0.064) | (0.049) |
| Experience | 0.419** | -0.094* |
| | (0.073) | (0.041) |
| Experience$^2$ | | 0.023* |
| | | (0.010) |
| Scale | -0.139 | -0.240** |
| | (0.086) | (0.057) |
| Scale$^2$ | | 0.016* |
| | | (0.008) |
| Early | -0.043 | -0.658** |
| | (0.084) | (0.054) |
| Local Knowledge | 1.177** | 0.103 |
| | (0.303) | (0.140) |
| GVCavailability | 3.406** | |
| | (1.128) | |
| GVC | | -1.301** |
| | | (0.404) |
| Early×GVC | | 0.212 |
| | | (0.170) |
| Local×GVC | | 0.633** |
| | | (0.199) |
| IPOpreviousyear | | -0.017 |
| | | (0.076) |
| VCcluster | | 0.231** |
| | | (0.060) |
| _cons | -1.915** | 0.336 |
| | (0.190) | (0.346) |
| Industry dummies | Yes | Yes |
| chi2 | | 7861.129 |
| ρ | | 0.438 |
| Wald $\chi^2$=4.12876 | | Prob > $\chi^2$= 0.0422 |
| *N* | | 2554 |

| Panel B | (1) Difference of the marginal effect on IPO | (2) when Local Knowledge=1 | (3) when Local Knowledge=0 |
|---|---|---|---|
| 1 vs 0 (GVCs vs PVCs) | -0.239** | -0.183+ | -0.276** |
| | (0.067) | (0.099) | (0.049) |

Table 7

## With and Without Local Knowledge --Propensity Score Matching

The sample includes all the first round investments by GVCs and PVCs individually from 1991 to 2010 in the Chinese VC market. Propensity score matching is used to calculate the treatment effect of being backed by GVCs and PVCs. Each investment by GVCs is matched with at least two investments by PVCs, according to other explanatory variables included in Table 4 (investment amount, experience, stage, industry, year, etc.). Column (1) use full samples, while Column (2) and (3) use samples of portfolios backed by local VC firms and VC firms from other provinces respectively. Values significant at 1%, 5% and 10% are identified by $^{**}$, $^{*}$, and $^{+}$.

| | (1) | (2) | (3) |
|---|---|---|---|
| | Full Sample | Local=1 | Local=0 |
| Average Treatment Effect | | | |
| 1 vs 0 (GVC vs PVC) | -0.061$^{**}$ | -0.005 | -0.153$^{**}$ |
| | (0.028) | (0.037) | (0.076) |
| *N* | 2527 | 985 | 1481 |

Standard errors in parentheses

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$

Table 8

## Heckman Treatment Effect

The sample includes all the first round investments by GVCs and PVCs individually from 1991 to 2010 in the Chinese VC market. Heckman two-step treatment effect method is used to ensure an unbiased regression. In the first step, the possibility of being backed by GVCs is estimated by a Probit regression. Then λ (inverse Mills ratio type control variable) is calculated based on the estimated value of being backed by GVCs. In the second step, λ is added in the regression when using IPO (whether portfolios have successful exits through IPO) as the dependent variable in the Probit regression. $\rho$ in the report refers to the correlation coefficient between the error terms of the first step and the second step. Values significant at 1%, 5% and 10% are identified by $^{**}$, $^{*}$, and $^{+}$.

| | (1) | (2) |
|---|---|---|
| Panel A | GVC | IPO |
| Amount | -0.222** | -0.001 |
| | (0.061) | (0.012) |
| Experience | 0.421** | -0.039+ |
| | (0.055) | (0.022) |
| Experience$^2$ | | 0.008+ |
| | | (0.004) |
| Scale | -0.140** | -0.079** |
| | (0.048) | (0.022) |
| Scale$^2$ | | 0.006* |
| | | (0.003) |
| Early | -0.034 | -0.210** |
| | (0.077) | (0.021) |
| Local Knowledge | 1.188** | 0.019 |
| | (0.075) | (0.024) |
| GVC | | -0.403** |
| | | (0.088) |
| Early×GVC | | 0.071 |
| | | (0.047) |
| Local×GVC | | 0.204** |
| | | (0.056) |
| IPO previous year | | -0.003 |
| | | (0.024) |
| VC cluster | | 0.074** |
| | | (0.019) |
| GVC availability | 2.826** | |
| | (0.805) | |
| _cons | -1.902** | 0.596** |
| | (0.128) | (0.123) |
| Industry dummies | Yes | Yes |
| ρ | | 0.285** |
| | | (0.076) |
| λ | | 0.126** |
| | | (0.034) |
| *N* | | 2554 |

## Contrasts of Predictive Margins

| Panel B<br>Average Treatment Effect | (1)<br>Heckman Treatment | (2)<br>Probit model (if GVC is exogenous)<br>(as shown in Table 5) |
|---|---|---|
| 1 (GVC) | 0.034+ | 0.229** |
| | (0.101) | (0.028) |
| 0 (PVC) | 0.344** | 0.300** |
| | (0.028) | (0.010) |
| 1 vs 0 (GVC vs PVC) | -0.309** | -0.072* |
| | (0.118) | (0.030) |

Table 9

## The Impact of GVCs and PVCs on their Portfolios' Further Financing

The sample includes all the first round investments by GVCs and PVCs individually from 1991 to 2010 in the Chinese VC market. Logistic regression is used in the following regressions, using *further financing* as the dependent variable. We report the coefficient, computed using (Huber-White) heteroscedasticity-robust standard errors (in parenthesis), and clustered by the location of portfolio companies. Values significant at 1%, 5% and 10% are identified by $^{**}$, $^{*}$, and $^{+}$.

| Panel A | (1) Further Investment | (2) Further Investment |
|---|---|---|
| Amount | 0.030 | 0.030 |
| | (0.046) | (0.042) |
| Experience | -0.100 | |
| | (0.091) | |
| $Experience^2$ | 0.030$^{*}$ | |
| | (0.014) | |
| Industry Experience | | -0.048 |
| | | (0.086) |
| Industry $Experience^2$ | | 0.032 |
| | | (0.024) |
| Scale | -0.110 | -0.134 |
| | (0.112) | (0.083) |
| $Scale^2$ | 0.014 | 0.018$^{+}$ |
| | (0.013) | (0.010) |
| Early | 0.496$^{**}$ | 0.493$^{**}$ |
| | (0.146) | (0.150) |
| Local Knowledge | 0.149 | 0.147 |
| | (0.106) | (0.105) |
| GVC | -0.311 | -0.254 |
| | (0.227) | (0.236) |
| Early×GVC | -0.483$^{*}$ | -0.485$^{*}$ |
| | (0.242) | (0.240) |
| Local×GVC | 0.296 | 0.242 |
| | (0.195) | (0.203) |
| IPO previous year | -0.018 | -0.007 |
| | (0.085) | (0.084) |
| VC cluster | 0.179$^{*}$ | 0.186$^{*}$ |
| | (0.090) | (0.087) |
| _cons | -0.553 | -0.627 |
| | (0.404) | (0.399) |
| Industry dummies | Yes | Yes |
| pseudo $R^2$ | 0.026 | 0.026 |
| chi2 | 738.107 | 627.022 |
| *N* | 2554 | 2554 |

## Marginal Effect of being Backed by GVCs

| Panel B | (1) Overall | (2) when Early=1 | (3) when Early=0 |
|---|---|---|---|
| 1 vs 0 (GVC vs PVC) | -0.077$^{*}$ | -0.149$^{**}$ | -0.042 |
| | (0.033) | (0.038) | (0.039) |

Table 10

## T-test of Difference of Means

The table illustrates the difference of means of investments which have successful gone public on NEEQ (National Equities Exchange and Quotations) and other stock exchanges. Portfolio companies listed on NEEQ are less likely to backed by GVCs. NEEQ tends to provide a platform for smaller amount (although not statistically significant) and early stage investments. And the VC firms tend to have a better knowledge of the portfolio companies they have invested if the exits are through NEEQ. Difference significant at 1%, 5% and 10% are identified $^{**}$, $^{*}$, and $^{+}$.

| | Listed on NEEQ | Listed on other Exchanges | Difference significance |
|---|---|---|---|
| GVC | 0.236 | 0.125 | ** |
| Amount (USD, m) | 2.887 | 18.954 | |
| Scale (USD, m) | 79.206 | 146.551 | |
| Experience | 20.452 | 15.910 | |
| Industry Experience | 4.350 | 4.091 | |
| Early | 0.274 | 0.189 | * |
| Local Knowledge | 0.579 | 0.327 | ** |
| Industry category | | | |
| Telecommunication | 0.171 | 0.171 | |
| Consumer | 0.064 | 0.107 | |
| Financial | 0 | 0.038 | * |
| Industry & Energy | 0.331 | 0.297 | |
| Internet | 0.191 | 0.127 | * |
| Medical | 0.083 | 0.095 | |
| Other Industries | 0.153 | 0.168 | |
| Observation | 157 | 703 | |

Table 11

## The Impact of GVCs and PVCs on the IPO excluding NEEQ

The sample includes all the first round investments by GVCs and PVCs individually from 1991 to 2010 in the Chinese VC market. Logistic regression is used in the following regressions. We report the coefficients, computed using (Huber-White) heteroscedasticity-robust standard errors (in parenthesis), and clustered by the location of portfolio companies. Values significant at 1%, 5% and 10% are identified by $^{**}$, $^{*}$, and $^{+}$.

| | (1)<br>IPO excluding NEEQ | (2)<br>IPO excluding NEEQ |
|---|---|---|
| Amount | 0.192$^{*}$ | 0.241$^{**}$ |
| | (0.076) | (0.073) |
| Experience | -0.113 | |
| | (0.083) | |
| Experience$^2$ | 0.017 | |
| | (0.019) | |
| Industry Experience | | -0.148 |
| | | (0.105) |
| Industry Experience$^2$ | | 0.076$^{*}$ |
| | | (0.033) |
| Scale | -0.374$^{**}$ | -0.429$^{**}$ |
| | (0.119) | (0.096) |
| Scale$^2$ | 0.022 | 0.021 |
| | (0.016) | (0.014) |
| Early | -1.090$^{**}$ | -1.108$^{**}$ |
| | (0.116) | (0.118) |
| GVC | -0.996$^{**}$ | -1.136$^{**}$ |
| | (0.342) | (0.364) |
| Local Knowledge | -0.327$^{*}$ | -0.340$^{*}$ |
| | (0.163) | (0.163) |
| Early×GVC | 0.296 | 0.357 |
| | (0.404) | (0.419) |
| Local×GVC | 1.041$^{**}$ | 1.132$^{**}$ |
| | (0.394) | (0.280) |
| IPO previous year | -0.173 | -0.164 |
| | (0.138) | (0.137) |
| VC cluster | 0.399$^{**}$ | 0.374$^{**}$ |
| | (0.097) | (0.098) |
| _cons | 0.763 | 0.722 |
| | (0.676) | (0.669) |
| Industry dummies | Yes | Yes |
| pseudo $R^2$ | 0.072 | 0.073 |
| chi2 | 631.088 | 701.222 |
| *N* | 2554 | 2554 |