Crowding-in in Venture Capital in China

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Abstract

By exploiting a unique policy experiment in China and difference-in-differences methodology, I find that government investments crowd in private investments, with a multiplier of 0.88-0.93. The impact is most pronounced in less developed regions and in the earlier stage of developing the VC sector. Using administrative data, I provide micro-level evidence of the crowding-in effects transmitting in a diminishing pattern through network linkages among limited partners and VC firms, indicating that government investments have a signaling role on private investors.

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1 Introduction

Governments worldwide have introduced a range of programs to promote venture capital (VC), believing that an active VC sector is essential for economic growth.[1] However, whether government involvement can neutralize the VC sector is ambiguous. On the one hand, direct subsidies (see Bachas et al. (2021) for small business loans) and indirect signaling effects can lead to private investors responding positively to government investments. On the other hand, if the number of startups seeking VC financing is relatively stable, an increase in the supply of government funding might crowd out private investments (see Demirci et al. (2019), Ru (2018), Huang et al. (2020) for credit markets). Therefore, how private VC investors react to government investments is an empirical question that requires further investigation.

While the existing literature provides evidence of this question in the credit market, we lack knowledge of whether the same effect exists in venture capital, perhaps due to the lack of data. This paper aims to fill in this gap. The venture capital market is very different from the credit market in terms of higher riskiness of the portfolio company (Cochrane (2005), Korteweg and Nagel (2016)), more pronounced information asymmetry between investors and entrepreneurs (Gompers (1995), Kirilenko (2001)) and more severe agency conflicts (Lerner (1995), Casamatta (2003)). Consequently, the findings in credit markets may not apply to the venture capital.

More specifically, I study whether government VC investments *causally* affect private VC investments. Answering this question poses several challenges. First is the endogeneity concern about the correlation between the region's prosperity of entrepreneurship and VC investment opportunities. Second is the data requirements of *all* limited partners in the fund and *all* owners of joint affiliates among VC firms. Access to such data, combined with a natural experiment to address the endogeneity concern, makes China an ideal setting to explore the role of government investments in venture capital. In addition, the Chinese VC sector has recently seen rapid growth,

[1] Examples include: the U.S. SSBCI, Israel's Yozma, European Investment Fund, BipFrance, the U.K. AngelCoFund, Japan's Venture Enterprise Center, and China's InnoFund, etc.

from effectively no VCs in the 1990s to the world's second-largest market. Government investments account for a critical share of the market: 50.65% of portfolio companies have a government VC as the lead according to the sample of this paper.

The ideal solution for the above-mentioned endogeneity concerns requires an unobserved counterfactual of what would happen without government intervention. In the absence of such a counterfactual, I exploit the regional randomness in implementing the InnoFund VC Program (IFVC Program henceforth). The IFVC Program is a central-level government-guided fund that was staggered introduced in local provinces from 2008 to 2013.[2] Policy experimentation is a key feature in many government programs in China's economic reform (Brunnermeier et al. (2017)). While local government programs could be endogenous to local economic conditions, the central government tends to carry out regional experiments with sufficient randomness.[3] Specifically, the policy document of the IFVC Program explicitly states that the central government chooses several provinces as "trial spots."

An effective government program is not one that directly injects a large amount of capital but one that stimulates other investors to make more investments.[4] Instead of directly evaluating the impact of the IFVC Program on its target firms, I exploit the regional randomness when implementing the program to study other investors' responses. In this way, I take into account the spillover effects to non-target firms (Boehmer et al. (2020), Berg et al. (2021)). The estimation captures how local government and private investors adjust their VC investments upon the introduction of the IFVC Program in the target province.

To address the sample selection in policy experiments (Wang and Yang (2021)),

[2]The program is implemented in the following format: the central government directly invests in VC funds as a limited partner and delegates fund management to local VC firms.

[3]M-economy theory explains why the Chinese economy is a good field in which to carry out regional experiments (Maskin et al. (2000), Qian et al. (2006)). While other regions can follow the successful experience in one region, failures do not expand to the whole nation. Giannetti et al. (2015) explore this theory and identify the exogenous variation in the introduction of policies attracting talented emigrants in different provinces.

[4]The IFVC Program itself has merely invested in 170 companies, which is small relative to the sample size of over 9,000 companies.

I use the difference-in-difference method (DID), which allows for a first-difference between treatment and control groups. While cities in the treatment group tend to be less VC active before the IFVC Program, the negative gap between treatment and control groups is not significantly different from zero. More importantly, I show that no *pre-treatment* trend is observed, which supports the validity of the parallel trend assumption for *unobserved* factors. I also do not find correlations between the inclusion of the program and *observed* factors about local economic conditions.

I find that the IFVC program results in more investment from both government and private VCs in terms of fundraising, total deals, and successful deals (those that exit through IPOs). I assign cities in the provinces where the IFVC Program started to the treatment group and others to the control groups. Evidence shows that the difference between the treatment and the control groups enlarges slightly in the year of the policy announcement, followed by a dramatic increase in the first year after the policy announcement. For example, the number of successful deals doubles. As to the interplay between local government and private investors, one important observation is that the responses from both the local government and private VCs are positive. This indicates that the crowding-in effects (private investments augment government investments) dominate the crowding-out effects (government investments replace private investments).

I further explore the heterogeneity of the response to the IFVC Program across regions and development stages of the VC sector. I divide the provinces into groups based on their *ex-ante* similarity in economic and innovation development. Private investors may be more likely to lack the information and confidence in risky assets in less developed regions. Thus, positive signals from the central government could be more important for their investment decisions. Similarly, in the early stage of the development of the VC sector, there is more uncertainty about which direction the sector will take. Government investments can be seen as a positive sign and lead to private investors injecting their money. Consistent with the signaling role of government investments, the response to the IFVC program is most pronounced in less developed regions but very mild in developed areas. Similarly, I find a nega-

tive association between the development stage of the VC sector and the impact of government investments.

To shed more light on the transmission channels, I borrow the network analysis from the social networking literature, where the existing papers show that investors' decisions are affected by others in their network (for instance, Hong et al. (2004), Ouimet and Tate (2020)). In the interplay between government and private investors, government investments can serve as a positive signal that encourages private investors to be more involved in the VC sector. The networking theory predicts that the incremented investments induced by government investments diminish in network distance. This diminishing pattern is because private signals are transmitted imperfectly in the network.

Correspondingly, I present two pieces of micro-level evidence using the network analysis. First, taking advantage of administrative data where we observe *all* LPs in the fund, I show that funds having government LPs attract more private LPs, and this pattern diminishes in the network distance to government LPs. The diminishing pattern of co-investments between private and government LPs suggests that private LPs gain an information advantage by investing with government LPs.[5] To address the reverse causality concern that a fund with more LPs could be more attractive for government LPs, I build an instrumental variable, exploiting the staggered-issued certificates to invest in government programs. Results are robust and stronger when using the IV.

Second, VC firms can also transmit the signal through joint affiliates. To identify joint affiliates, I build a novel dataset of common ownership among VC firms using the administrative data. I find that entering joint affiliates with government VCs is positively associated with more deals and more successful deals for the focal VC. In contrast, we do not observe such a pattern when the affiliate is made with private

[5]I cannot rule out the possibility that private LPs also gain direct subsidies by investing along government LPs. However, such benefits are unlikely to be transmitted through networks. Another concern is that private LPs in China are obedient to governments and therefore invest along with governments. However, using a survey-based experiment, Colonnelli et al. (2022) show that, instead, private investors dislike investors with government ties.

VCs. The difference between government and private VCs suggests that government VCs play an essential role in transmitting signals through connections among VC firms.

This paper is related to the literature on government involvement in venture capital. Theoretical studies, including Keuschnigg and Nielsen (2003), Hellmann and Thiele (2019), discuss how public policies influence the incentives of investors and entrepreneurs. Empirically, cross country comparative studies show that the VC market size is positively correlated with public participation (Leleux and Surlemont (2003)) and supportive public policies (Da Rin et al. (2006), Bai et al. (2022)). I make several contributions to this literature. First, I exploit the policy experimentation in the development of venture capital in a single country, which advances our knowledge from correlations between government and private investments to a causal effect of government investments on private investors. Second, to the best of my knowledge, my paper is the first to show that the crowding-in effects diminish in network distance to government investors, which suggests a signaling role of government investments in explaining the crowding-in effects. Third, taking advantage of the heterogeneity in China, I provide a new and nuanced answer to the debate of crowding-in or crowding-out: it depends on the development stage of the region and the VC market.

Several independent concurrent papers also look at state/government investments in China. Using the administration data, Bai et al. (2020) find a similar network pattern that larger firms are more likely to be related to state equity ownership. However, they do not study venture capital investments, and they do not use regional randomness in policy experimentation to establish causality. Colonnelli et al. (2022) also studies the role of governments in venture capital in China. My paper differs from their paper by showing the bright side of government investments using a larger and less biased sample. Their sample is based on over 600 large VCs, highly likely to be biased against the dark side of governments as indicated by the relation between size and government helping hands in Bai et al. (2020).

This paper also belongs to the broad literature on the role of governments in the financial market, where we have mixed evidence. On one hand, most of the

existing papers on government funding programs for entrepreneurship and innovation find positive impacts, examples including innovation grant programs (Lerner (1996), Howell (2017)) and government small business loan programs (Banerjee and Duflo (2014), Brown and Earle (2017), Bachas et al. (2021)). On the other hand, Babina et al. (2020) find crowding-out effects in funding for university R&Ds. Moreover, evidence shows that government investments and ownership distort the cost of debt (Borisova et al. (2015), Cong et al. (2019)) and crowd out private debt (Demirci et al. (2019), Ru (2018), Huang et al. (2020)) for large companies. I add to this stream of literature by providing novel evidence on the role of governments in venture capital, which extends our knowledge about the relationship between government and private investors in a sector of high riskiness, low liquidity, and pronounced agency conflicts.

2 Institutional Background

Venture capital is a relatively new phenomenon in China. There were fewer than 200 VC-backed companies before the year 2000. In this section, I discuss the most important policy instrument of government intervention in venture capital in China: Government Guided Fund programs. More background information is in Internet Appendix A.

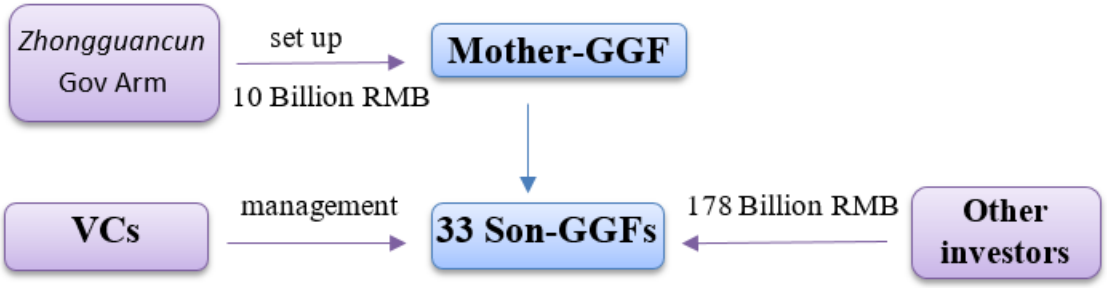


Figure 1: This figure shows the sketch of how the Zhongguancun GGF is structured. The Zhongguancun GGF was the first GGF in China in 2003. The Zhongguancun Government Arm set up the mother-GGF and invested 10 billion RMB in the mother-GGF from 2003 to 2013. The mother-GGF invests in 33 son-GGFs and delegates the fund management to professional VCs. In addition to the money from the mother-GGF, the son-funds receive 178 billion RMB from other private investors.

Government Guided Fund (GGF, henceforth) programs are, in essence, funds where governments are one of the Limited Partners (LP) and hold a certain amount of shares. Figure 1 gives a sketch of how the first GGF program in China, *Zhongguancun GGF*, is structured. A typical GGF program consists of two layers of funds: a "mother fund" (*mu ji jin*) investing in several "son funds" (*zi ji jin*). While the "mother fund" is run by government institutions and financed by government resources,[6] the "son funds" are delegated to professional VCs. In this paper, the term *GGF programs* refers to the whole set of funds, *mother-GGF* to "mother fund" and *son-GGF* to "son fund".[7] Mother-GGFs invest in son-GGPs as an LP, taking 5%-30% of the capital commitment. The rest of the capital commitment is from private LPs.

2.1 The Central Government InnoFund VC Program

In this paper, I exploit the National InnoFund VC (IFVC) Program led by the central government as a quasi-experiment. The InnoFund serves as the mother-GGF and invests in son-GGFs in different provinces in different years.

The IFVC program is likely a quasi-experiment to study the interplay between local government and private VCs for at least three reasons. First, the program intentionally implements regional experiments. The policy document states that the program picks some provinces as "trial spots". Second, the multi-layer-multi-regional organization form of the Chinese economy makes it low cost for the central government to carry out regional experiments: while other regions can learn from the successes in one region, failure in one region does not expand to the whole nation (Maskin et al. (2000), Qian and Roland (1998); Qian et al. (2006)). Third, political factors can play a crucial role in the entry time and weights of the provinces in the program, which implies that the variation in program inclusion is likely to be unrelated to the main driver of the endogeneity concern – the local economic conditions. Figure 2 provides a first look at each province's inclusion from 2008 to

[6] In China, besides tax revenue, returns of state-owned assets, the issuance of government bonds and fees are important government resources.

[7] In the press, perhaps confusingly, both the mother fund and the son funds are referred to as GGFs interchangeably.

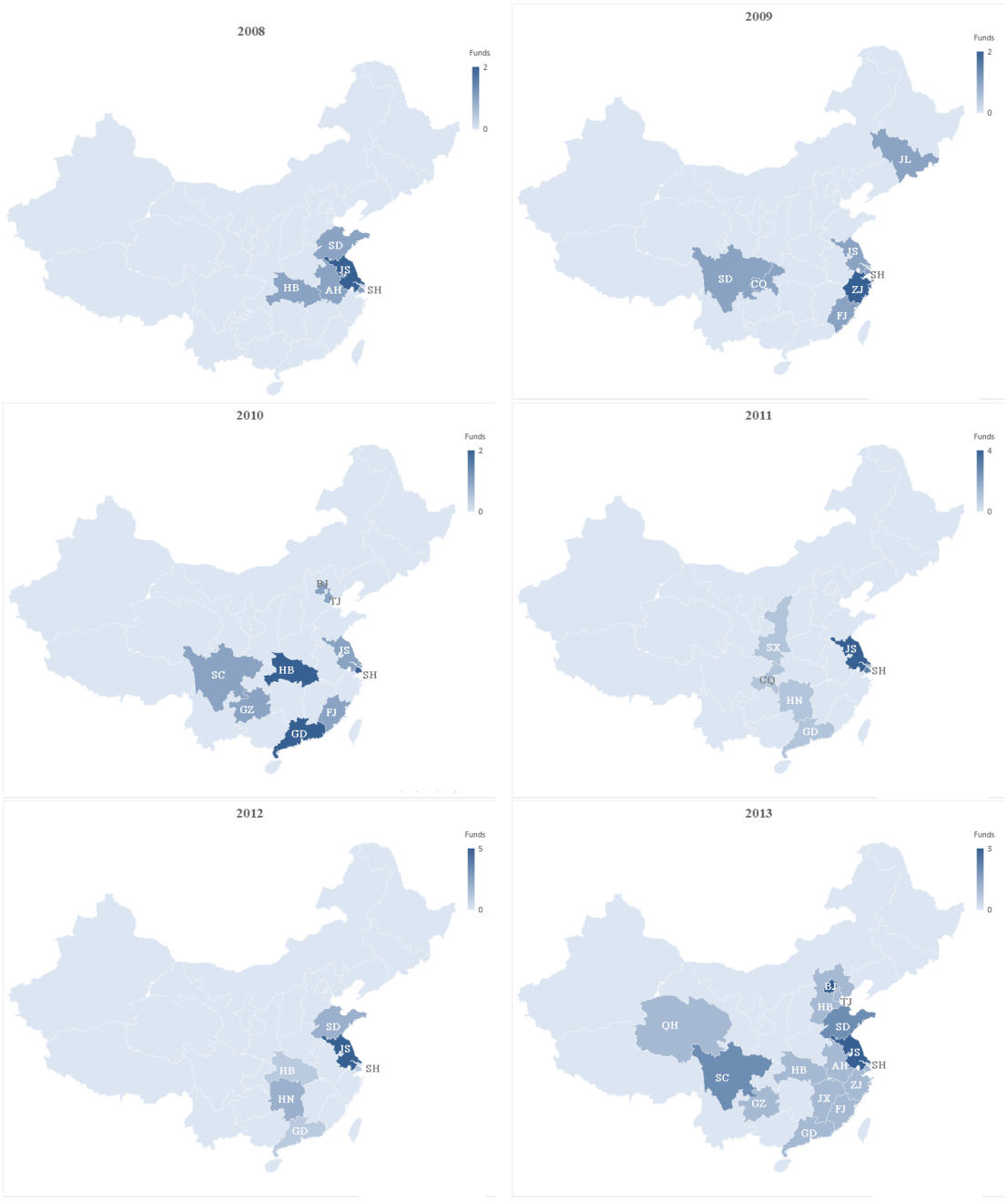


Figure 2: The figure shows the inclusion pattern of the IFVC Program in each province from 2008 to 2013. No son-GGF of the IFVC Program is established that year in the provinces of the lightest blue. The darker the blue is, the more son-GGFs in the province. The largest number is two in 2008, 2009, and 2010 and four, five, and three in 2011, 2012, and 2013 respectively.

2013. We observe a staggered introduction pattern. Internet Appendix Table C1 Panel C reports each province's annual distribution of son-GGFs.

The program itself is of small scale: the direct investment of the program covers a total of 71 funds (1.2% of the whole sample), 55 VC firms (2.08%), and 235 portfolio companies (2.00%) from 2008 to 2013. Therefore, the dramatic growth of the VC sector documented below is not the direct investments by the program itself but responses from local government and private investors. The official starting date of the IFVC Program is the year 2008. I choose 2013 as the end of the experiment period because Prime Minister Li Keqiang proposed a new initiative in 2014. Stopping in 2013 also allows for a moderate time gap between the year of investment and exit.

2.2 Local Government Programs

In addition to the central government program, local governments also launched various GGF programs: more than 120 provincial and city level mother-GGFs between 2001 and 2013 (reported in Internet Appendix-Table C1 Panel B). The geographic variation in local GGF programs is likely endogenous to local economic conditions because local mother-GGFs are financed by local government resources. Therefore, I do not use local GGF programs as a source of exogenous variation but as controls.

2.3 Participant Certification

One important step in the operation of GGF programs is to grant *Participant Certification*s to VCs and private LPs. To limit the potential agency and political frictions, governments do not directly scrutinize son-GGFs but allow for open bidding for managing and investing in son-GGFs. However, to secure the quality of son-GGFs, each son-GGP at least needs to have one VC management firm and/or private LPs that are granted the *Participant Certifications*. The central government grants the certifications on an annual basis. In addition, the issuance procedure of the certifications features a staggered pattern, potentially because it is implemented by the central government as shown in Internet Appendix-Table C1 Panel A. That said, VCs and LPs with certification are more likely to invest alongside government

LPs. However, investment in son-GGFs is not an obligation for certified VCs and LPs: they could choose not to invest in son-GGFs. As discussed below, exploiting the institutional specifics, I build an instrument variable on this GGF Participant Certification.

3 Data and Descriptive Statistics

In China, the VC industry follows the same operational structure as in the U.S. and other countries around the globe. The key entities are VC firms, funds, limited partners (LP), and portfolio companies. In this paper, I collect and assemble a comprehensive dataset on VC activities in China from 1990 to 2013 that covers 6,596 VC affiliates,[8] 6,260 funds, 43,668 LPs, and 9,234 portfolio companies.

In this paper, I use the terminology "government LP", "government-invested fund", and "government VC" in the following way. A government LP is an LP that is a government institution or controlled by a government institution (including those through chains and pyramids). A government-invested fund is a fund in which at least one LP is a government LP. A government VC is a VC firm that manages at least one government-invested fund.[9]

Data sources used in this paper include *Zero2IPO*, *CVsource*, *AMAC*, *NECIPS*, *Ministry of Science and Technology*, *CSMAR* and *WIND*. I construct five data sets using information collected from these sources: a city panel, a fund cross-section, a VC cross-section for fundraising, a VC cross-section for deals and a portfolio company cross-section. In this section, I describe each part and discuss the degree of government involvement.

[8] To be discussed in detail in the following paragraphs, the most granular business unit in real-world operation is VC affiliates which are entities set up by VC firms to manage funds.

[9] An alternative classification between government and private VCs is according to their ownership structure. However, state-controlled VCs (state ownership larger than 50%) account for only 4% in my sample, implying that controlling through firm ownership is not the primary way of government intervention.

3.1 Data

VC Deals: Zero2IPO

Data on VC deals mainly comes from *Zero2IPO*, the most comprehensive commercial database of VC & PE activities in China. The primary information used in the paper is: 1) VC firm investment in portfolio companies (the leading VC firm in Round A, the total number of investors in all rounds, and the summed amount of money a company receives in all rounds); 2) exit status (whether the portfolio company goes to IPO), and 3) portfolio company characteristics (founding date, industry, and headquarter location). I manually double check the duplicates by comparing them with other databases, including *CVSource* and *Wind*. I also use them as supplementary sources for missing values. More information on *Zero2IPO* can be found in Internet Appendix A.

Fundraising: AMAC, Zero2IPO and NECIPS

I collect a sample of 6,260 funds established until 2013 (4,545 funds from *AMAC*, supplemented by 1,715 funds in *Zero2IPO*) and 53,812 LP×fund investment records from *NECIPS*. *AMAC*, the Asset Management Association of China(*gs.amac.org.cn*), provides the official lists of VC and PE funds. However, because *AMAC* does not include liquidated and informal funds, I use *Zero2IPO* as a supplementary data source. *NECIPS*, National Enterprise Credit Information Publicity System (*www.gsxt.gov.cn*) is run by the State Administration for Industry & Commerce and has the most comprehensive coverage of all business entities operating in China, including joint ventures. It provides complete information on all shareholders, which is equivalent to LPs of the fund plus the VC affiliate managing it.

The LP sample consists of 9,589 corporate LPs (based on a unique ID in *NECIPS*) and 34,079 individual LPs (based on a unique ID on a third-party platform using machine learning techniques). To prevent double-counting, I only include ultimate LPs in the fund-of-funds chains in the LP sample. To identify government LPs and measure new entry correctly,[10] I track down the ultimate controlling shareholders of

[10]Because state ownership features chains and pyramids heavily in China, identifying the ultimate

the corporate LPs and group them into 8,489 corporation groups.

VC Firms and Affiliates: NECIPS

Consolidating data from the VC deals and fundraising, the final dataset contains a total of 6,596 VC affiliates. Following La Porta et al. (1999), two VC affiliates are grouped into the same VC firm group if they share the same large ultimate owners (those account for 20% or more of the shares in the company).[11] Using this criterion, 45.65% of the affiliates belong to the same VC firm group. The final sample contains 4,443 VC firms in total.

IFVC Program and GGF Participant Certification: MOST

Information on the IFVC Program is from the Ministry of Science and Technology (*MOST*). We have precise information on the name of the VCs/LPs involved, the targeted provinces, and son-GGFs (name, total size, and share of the InnoFund). Information on the VCs/LPs that obtained the GGF Participant Certifications is publicly available on the InnoFund's website (*innofund.chinatorch.gov.cn*).

Local Government Guided Funds and Other Controls

I merge data on all government funds in *Zero2IPO* and *CVsource* and manually check whether the fund is a mother-GGF based on policy documents collected from local government websites. Specifically, I first exclude all funds that are son-GGFs. Then, I identify the funds as mother-GGFs if the policy documents state that the government fund invests in son-GGFs as an LP. In this way, I identify 93 mother-GGFs with at least 100 million RMB under management. Data on economic conditions and political turnovers is from *CSMAR*. Data on financial market conditions is from *WIND*.

shareholder is indispensable in knowing whether governments control a company. Similarly, we would overestimate the participation of newly entered LPs by counting different companies in the same corporate group as newly entered LPs if not identifying corporation groups.

[11] I group VC affiliates into one VC firm group if they have at least one same ultimate owner among the two largest ones. I also use the information on the chairman, email, website, or telephone for further aggregation.

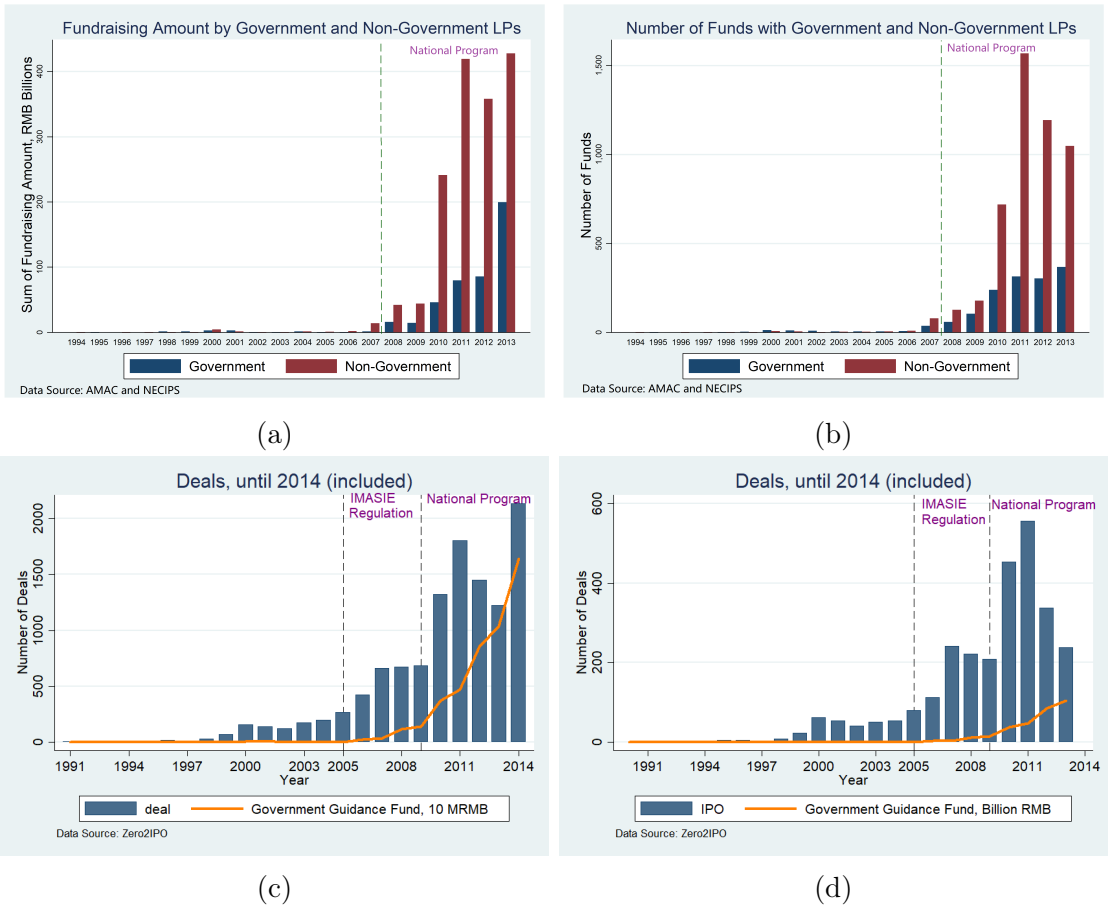


Figure 3: The figure includes plots of VC fundraising from 1990-to 2013 and deals from 1990-to 2014 in China. Plot (a) shows the time trend of the amount of money invested in VC funds from government and non-government LPs. Plot (b) shows the time trend of the number of funds with and without government LPs. Plot (c) shows the time trend of the number of VC-backed companies, and plot (d) shows the time trend of the number of VC-backed IPOed companies. I limit the counting to the first round of VC investments. In each plot, a dashed line is marked at 2008 (2009 for deals to account for a one-year lag) to present the IFVC Program. In plots (c) and (d), another dashed line is marked in 2005 to represent the release of IMASIE regulation. The solid orange line in plots (c) and (d) shows the time trend of the amount of money from local GGFs (units are adjusted to be comparable with the graph).

3.2 Descriptive Statistics

The Chinese VC sector sees rapid growth, from effectively no venture capitalists in the 1990s to the world's second-largest VC market to date. Governments play a crucial role in this process. 25.40% of the VC funds receive money from the government, and government VCs back 50.65% of the portfolio companies as the lead VC in the first round.

Government funding is spread widely. Government LPs only account for 11.73% of the non-individual LPs, but they invest in 25.4% of the funds. In addition, government LPs tend to be state-owned corporations instead of government arms. Among the 1,262 government LPs, only 9.78% are government arms. 58.14% are companies owned by the state directly, and 32.08% are owned through chains or pyramids.

Figure 3 plots venture capital fundraising and investment in portfolio companies from 1990 to 2013. There is a strong correlation between the IFVC Program and VC activities. After the launch of the IFVC Program, capital injection (plot (a)) and funds established (plot (b)) from both government and private LPs increase tremendously. The total size of local mother-GGFs expanded dramatically (solid line in plots (c) and (d)) . Consequently, the number of deals grows rapidly (bars in plot (c)). The number of deals that eventually exit through IPOs also increases greatly (bars in plot (d)).

Table 1 provides summary statistics and data sources of the main variables. Further details on database construction can be found in Internet Appendix B. To the best of my knowledge, the datasets are the most comprehensive data to date on Chinese VCs and their ownership links.

4 A Multiplier Effect of Government Venture Capital Programs

4.1 Impact of the IFVC Program on Local VC Activities

In this section, I present results on the impact of the central-government IFVC Program on local government and private VC activities at the city level.

Table 1: Summary Statistics

Panel A: City× Year Panel, Fundraising and VC Activities

Variable	Obs	Mean	Std. Dev.	Min	Max
Gov Money (10 million RMB)	7450	0.06	1.28	0	86.78
Gov Fund	7450	0.20	1.56	0	44
Private Fund	7450	0.74	9.35	0	285
Gov Deal	7450	0.67	5.39	0	207
Private Deal	7450	0.6	6.10	0	258
Gov IPO	7450	0.11	0.73	0	19
Private IPO	7450	0.1	0.6	0	15
Local Programs	7450	0.13	0.52	0	6
National InnoFund	7450	0.07	0.25	0	1

Panel B: Fund Cross Section

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P75
Number of Corporation LPs	6260	2.48	3.42	0	46	1	3
Number of New Corporation LPs	6260	1.4	2.46	0	35	0	2
Gov1	6260	0.25	0.44	0	1	0	1
Gov2	6260	0.13	0.34	0	1	0	0
Gov3	6260	0.03	0.17	0	1	0	0
IV1	6260	0.08	0.27	0	1	0	0
IV2	6260	0.16	0.37	0	1	0	0
IV3	6260	0.12	0.32	0	1	0	0
Fund Size	6260	0.31	1.28	0	50	0.04	0.21
Fund Life	6260	12.2	7.47	1	50	7	20

Panel C: VC Cross Section, Fundraising

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P75
Number of New Individual LPs (VC)	2218	13.61	41.61	0	966	0	11
Number of Individual LPs (VC)	2218	17.97	53.85	0	1173	1	13
Number of Corporation LPs (VC)	2218	7	20.68	0	366	1	6
Number of New Corporation LPs (VC)	2218	3.97	11.79	0	293	1	4
Gov1 (VC)	2218	0.31	0.46	0	1	0	1
Gov2 (VC)	2218	0.09	0.28	0	1	0	0
Gov3 (VC)	2218	0.02	0.14	0	1	0	0
IV1 (VC)	2218	0.11	0.31	0	1	0	0
IV2 (VC)	2218	0.17	0.38	0	1	0	0
IV3 (VC)	2218	0.09	0.28	0	1	0	0
VC Capital	2218	0.88	3.42	0	59.1	0.06	0.49
VC Age	2218	4.25	3.82	.02	32.69	2.17	4.94

Table 1 Summary Statistics (continued)

Panel D: VC Cross Section, VC Activities

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P75
Num. IPOs	1279	0.50	1.65	0	34	0	0
Num. Deals	1279	5.15	13.39	1	254	1	4
Gov VC	1279	0.25	0.44	0	1	0	1
Leading VC	1279	0.11	0.32	0	1	0	0
Minority VC	1279	0.10	0.30	0	1	0	0
Gov Leading VC	1279	0.07	0.26	0	1	0	0
Private Leading VC	1279	0.04	0.19	0	1	0	0
From Gov Leading VC	1279	0.08	0.27	0	1	0	0
From Private Leading VC	1279	0.06	0.25	0	1	0	0
VC Age	1279	6.72	6.02	-2.78	32.57	2.68	10.1
Geographic Range	1279	1.36	1.01	1	16	1	1

Panel E: Portfolio Company Cross Section

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P75
IPO	9378	0.16	0.37	0	1	0	0
Gov VC	9378	0.49	0.50	0	1	0	1
Experience	9378	0.24	0.23	0	1	0	0.37
Number of Investors	9378	1.98	1.79	1	30	1	2
Investment Amount	9378	0.01	0.1	0	4.13	0	0.01
Round	9378	2.58	1.01	2	8	2	3
Competition	9378	1.10	0.98	0.01	3.53	0.28	1.73
Turnovers	9378	0.64	0.77	0	4	0	1
Portfolio Company Age	8173	5.41	5.69	-16.25	84.06	1.18	8.49

Data Source Summary

Zero2IPO & AMAC & NECIPS	Gov Deal, Private Deal, Gov IPO, Private IPO
AMAC & NECIPS	Gov Money, Gov Fund, Private Fund, Gov VC, Number of Corporation LPs, Number of New Corporation LPs, Gov1, Gov2, Gov3,Fund Size, Fund Life, Number of New Individual LPs (VC), Number of Individual LPs (VC), Number of Corporation LPs (VC), Number of New Corporation LPs (VC), Gov1 (VC), Gov2 (VC), Gov3 (VC), VC Capital, Gov Leading VC, Private Leading VC, From Gov Leading VC, From Private Leading VC
Zero2IPO & CVSource	Local Programs
MOST	National InnoFund, IV1, IV2, IV3, IV1 (VC), IV2 (VC), IV3 (VC)
Zero2IPO	Num. IPOs, Num. Deals, IPO, M&A, Experience, Number of Investors, Investment Amount, Round, Competition
NECIPS	VC Age, Leading VC, Minority VC, Geographic Range

4.1.1 Main Specifications

The empirical specification follows the generalized difference-in-difference (DID) form,[12]

$$y_{i,t} = \alpha_i + \alpha_t + \beta IFVC\ Inclusion_{i,t} + \boldsymbol{\gamma}\mathbf{X}_{i,t} + \mu_{i,t}, \tag{1}$$

where i indexes cities, t indexes years, $y_{i,t}$ is the dependent variable of interest (e.g. *Gov Deal*), α_i and α_t are city and year fixed effects, $IFVC\ Inclusion_{i,t}$ is a dummy that equals one if the province in which city i is located was included in year t in the IFVC Program, $X_{i,t}$ are control variables, and $\mu_{i,t}$ is an error term. The sample covers 298 cities from 1999-to 2013. This methodology controls time-invariant differences between treated and non-treated cities, such as geographic characteristics and historical background, via the city fixed effects and for aggregate fluctuations over time via year fixed effects. Our estimate of the investor's response is β.

City is a geographical unit commonly used in studies on the Chinese economy (Lin (2017), Brunnermeier et al. (2017)). By "city", I refer to the terminology used for the administrative unit one layer below "province". It covers both urban and rural areas. There are 338 cities in China, of which 294 are prefectures, four are large municipalities (Beijing, Shanghai, Tianjin, and Chongqing), and 40 are minority regions. The primary sample comprises 294 prefectures and four large municipalities (298 cities). I exclude the 40 minority regions in the main analysis because they have special policies and a different economic environment.[13]

I study three distinct dimensions of VC activities and outcomes. Based on the specification, the dependent variable $y_{i,t}$ measures 1) fundraising (the number of funds with at least one government LPs (*Gov Fund*) or with no government LPs (*Private Fund*)); or 2) deals (the number of portfolio companies financed by government VCs (*Gov Deal*) or by private VCs (*Private Deal*) as the lead VC in the first round); or 3) successful deals (the number of portfolio companies exiting through

[12]This is a generalized DID model. See Bertrand and Mullainathan (2003) and Atanassov (2013) for example. The key independent variable, $IFVC\,Inclusion_{i,t}$, is equivalent to an interaction term between treatment and post dummies.

[13]See the Ministry of Civil Affairs of China (*xzqh.mca.gov.cn*) on the administrative units.

IPOs that are financed by government VCs (*Gov IPO*) or by private VCs (*Private IPO*) as the lead VC in the first round). All dependent variables are calculated as the number of funds/deals in city i in year t. The key independent variable, $IFVC\ Inclusion_{i,t}$, is measured at the province level because this is economically more adequate (not because of lack of data). I have information on the city where a son-GGF of the IFVC Program is registered. However, the son-GGFs are very likely to invest in companies in different cities in the province, and thus the signaling effect is likely to transmit to other cities. To define the effective year of the inclusion, I use one year after the announcement year. Except for provinces in the first round in 2010, I use 2010 as the effective year. The policy document is released in November or December each year, except in 2010 when there were two rounds: one in July and one in November.

An important control variable is $LocalPrograms_{i,t}$ which is the number of local mother-GGFs with a scale of no less than 100 million RMB exist in the province of city i in year t. Other controls include *Experience Private*, *Experience Gov*, *GDP*, *GDP Growth Rate*, *Tertiary Industry Shares*, *Middle School Proportion*, *High School Proportion*, *College Proportion* and *Number of Special Zones*. The controls are at the province level due to data availability.

4.1.2 Results

Table 2 reports the results. For each outcome variable, the odd column reports the OLS results, and the even column reports the DID results. I find that the IFVC Program has a significant and positive impact on both government and private venture capital investments. For example, after the inclusion in the IFVC program, we observe an increase of 0.89 government funds (Column 2) and 6.03 private funds (Column 4) in the city. Similarly, being included in the IFVC Program results in 2.22 more deals by government VCs (Column 6) and 2.07 more by private VCs (Column 8) in the city. For IPO exit deals, 0.17 more IPO exit companies are financed by government VCs (Column 10) and 0.15 more IPO eixt companies by private VCs (Column 12).

Table 2: Impacts of the IFVC Program on Venture Capital

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	OLS	DID	OLS	DID	OLS	DID	OLS	DID	OLS	DID	OLS
Dependent Variable	Gov Fund		Private Fund		Gov Deal		Private Deal		Gov IPO		Priv
IFVC Inclusion	1.28***	0.89**	6.44**	6.03*	3.22**	2.22**	2.65*	2.07*	0.36***	0.17**	0.24**
	(3.15)	(2.14)	(1.99)	(1.74)	(2.52)	(2.01)	(1.90)	(1.69)	(3.38)	(2.38)	(3.41)
Local Programs	0.52**	0.25	1.73	1.02	1.21***	0.46**	1.07**	0.37**	0.18***	0.07*	0.13**
	(2.56)	(1.51)	(1.64)	(1.03)	(2.94)	(2.32)	(2.42)	(2.22)	(3.42)	(1.75)	(3.48)
Other Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
City FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Observations	4470	4470	4470	4470	4470	4470	4470	4470	4470	4470	4470
Adjusted R^2	0.084	0.355	0.041	0.270	0.041	0.608	0.023	0.502	0.037	0.561	0.026

Note: This table shows the regression results of the impact of the IFVC Program. Columns (1)-(4) are about fundraising, columns (5)-(8) about deals and columns (9)-(12) about IPOed deals. The data is a city×year panel of 298 cities from 1999-to 2013. The key independent variable *IFVC Inclusion* is a dummy that equals one if at least one son fund of the IFVC Program established in the province of the city. *Gov Fund* and *Private Fund* are the number of funds, with and without government LP investments. *Gov Deal* and *Private Deal* are the number of deals by government VCs and private VCs, respectively. *Gov IPO* and *Private IPO* are the number of deals that eventually exit through IPOs, by government VCs and private VCs, respectively. I calculate the dependent variables at the time of the investment and aggregate them at the city level. *Local Programs* is the number of local government guidance funds with a scale larger or equal to 100 million RMB in the province of the city. Other controls include *Experience Private*, *Experience Gov*, *GDP*, *GDP Growth Rate*, *Tertiary Industry Shares*, *Middle School Proportion*, *High School Proportion*, *College Proportion* and *Number of Special Zones* and are at province level. t statistics are in parentheses and standard errors are clustered at city level. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels.

In terms of economic magnitude, the incremented investments are close to the sample mean. Suppose we multiply the increase in IPO exit companies by the number of cities. In that case, the IFVC Program leads to, on average, an *incremented* 100 VC-backed IPO exit companies each year, even larger than the annual average of the *total* number of IPO exit companies (75) before the launch of the IFVC Program. It is important to point out that the IFVC Program itself has only invested in 27 IPO exit companies from 2008-to 2013, which is a tiny number compared with the estimated 500 successful companies that other VCs finance in response to the program. Overall, my findings support that the IFVC Program has a positive impact on the development of the VC sector. A "smart" government program is not one that directly injects a large amount of capital but one that stimulates the investment of other investors in the market.

Do local government investments crowd in or crowd out private investments? My findings show that responses from private VCs are positive and statistically significant at 5% or 10%. In magnitudes, increased capital injection from private investors is close to responses from local government VCs in terms of deals and even more extensive than that from local government VCs in terms of funds. In other words, the coefficients for government and private VCs are of the same sign, supporting the hypothesis of crowding-in effects.

4.1.3 Identification Assumptions

To test the validity of the parallel trends assumption, Figure 4 plots the trends of the volume of VC activities in a city from three years before to three years after the inclusion in the IFVC Program. Each plot shows the estimated coefficients of the dummies that indicate the year gap between the VC activity time and the program inclusion time and the corresponding 95% confidence intervals. There is no apparent increasing pattern before the inclusion in the program. In the announcement year, all outcomes increase slightly. In one year after the inclusion (the effective year of the program), the volume of VC activities increases further. The impacts on fundraising and VC deals (plots a-d) are persistent, but the impact on IPO exit deals (plots e-f)

is less lasting and even becomes negative after two years of the program. The weaker results for IPO exit deals imply that government programs have a limited long-term impact. It could be explained by the "money chasing deal" that the overall probability of success decreases with the expansion of the sector (Gompers and Lerner (2000)).[14]

To strengthen the identification, I test whether there are correlations between local conditions and the inclusion in the IFVC Program by regressing the variables of location conditions in year $t-1$ on a dummy standing for whether the Program includes the province in year t. Table 3 reports the results. I look at four parts: VC Activities, Innovation, Special Industry Zones (Tian and Xu (2022)), and Economic Development. Overall, the correlations are weak. These results support the argument that the IFVC Program does not cover different regions based on economic and innovation conditions.

4.1.4 Robustness

I perform a battery of robustness checks, and the results on reported in Internet Appendix C Table C2. To see whether the geographic coverage drives the results, I do robustness checks by including minority regions (Panel A) and excluding the five western undeveloped provinces (Panel B). To check whether the results are affected by sample periods, I expand the period to 1990-2014 (Panel C) (2014 is the last year I have information on the IFVC Program. As discussed in the previous section, I stop the sample period in 2013 to rule out the impact of another central-government entrepreneurship promotion policy starting in 2014). Finally, I also analyze at the province level as an alternative geographic aggregation unit (Panels D and E). All results are robust to these modifications.

In summary, the findings suggest that both local government and private investors respond positively to the IFVC Program launched by the central government. The crowding-in effects dominate the crowding-out effects in our setting.

[14]The weaker results for IPO exit deals are also possible due to that the time period in my sample is not long enough to observe exits.

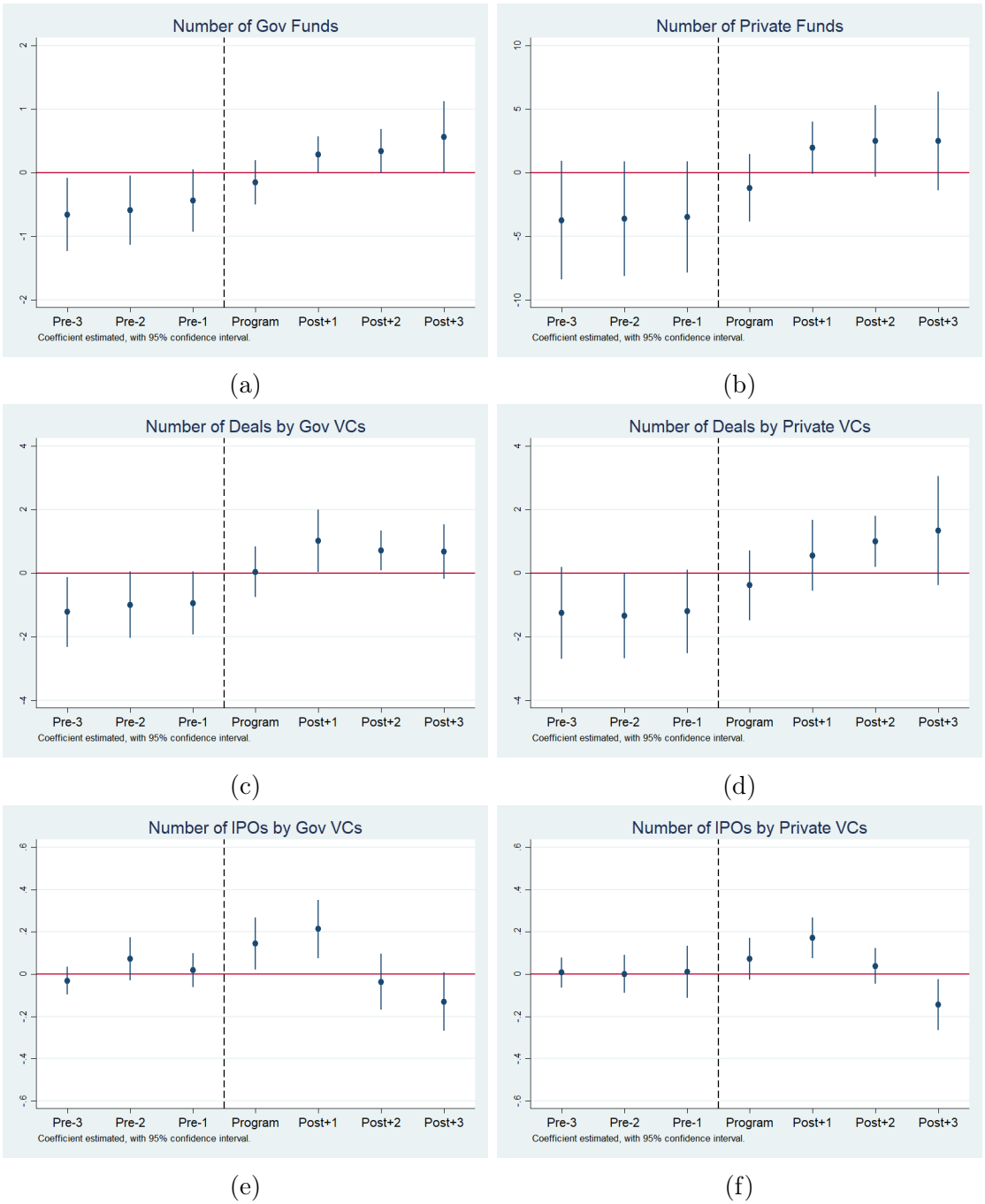


Figure 4: This figure includes plots on trends of VC fundraising and deals in a city from three years before to three years after the inclusion in the IFVC Program. The period is 2005-2013, and the sample covers 298 cities (4 municipalities and 294 prefectures). The *after Program* period is from 2008 to 2010. Each plot shows the estimated coefficients before the year dummies with 95% confidence intervals. i.e., β's in the following regression equation. $y_{i,t} = \beta_1 Before3_{i,t} + \beta_2 Before2_{i,t} + \beta_3 Before1_{i,t} + \beta_4 \text{In Program}_{i,t} + \beta_5 Post1_{i,t} + \beta_6 Post2_{i,t} + \beta_7 Post3_{i,t} + \boldsymbol{\gamma} \mathbf{X}_{i,t} + \alpha_i + \alpha_t + \mu_{i,t}$, where $y_{i,t}$ are the indicators of VC fundraising and deals and $\mathbf{X}_{i,t}$ are controls, α_i are city fixed effects and α_t are year fixed effects.

Table 3: *Ex Ante* Differences Between Treatment Group and Control Group

	β	t-value	$Adj.R^2$
Part I: VC Activities			
N. of Deals	-3.11	-0.07	0.736
N. of Active VCs	-13.46	-0.34	0.832
N. of VCs	-11.12	-0.28	0.908
Part II: Innovation Atmosphere: Grants & Patents			
N. of Grants	-3.48	-0.14	0.841
Amount of Grants, *RMB*	-0.13	-0.27	0.843
N. of Patents (Invention Type)	0.34	0.88	0.857
N. of Patents (Utility Type)	0.37	0.53	0.819
N. of Patents (Design Type)	0.91	0.75	0.732
Part III: Special Industry Zones			
N. of Special Zones	0.35	0.91	0.894
N. of New Special Zones	0.13	0.64	0.491
Output of the Special Zones, *RMB*	-842.99	-0.39	0.802
Export of the Special Zones, *USD*	-43.48	-0.35	0.768
N. of Firms in the Special Zones	-56.38	-0.20	0.976
Part V: Economic Development			
GDP, *RMB*	978.40	1.11	0.974
GDP, Primary Industry, *RMB*	-51.33	-0.41	0.937
GDP, Secondary Industry, *RMB*	-205.18	-0.44	0.954
GDP, Tertiary industry, *RMB*	1408.82	1.46	0.967
GDP, Finance, *RMB*	194.52	0.83	0.965
GDP Growth Rate, Primary Industry	-23.52	-0.33	0.552
GDP Growth Rate, Secondary Industry	-0.47	-0.01	0.635
GDP Growth Rate, Tertiary Industry	-81.59	-1.58	0.437

Note: This table summarizes the regression results of the difference in province characteristics between the treatment and control groups one year before being included in the IFVC Program. The sample is a year×province panel that covers 31 provinces during 2008-to 2013 (186 observations). I control for year- and province-fixed effects. *N. of Patents (Invention Type)*, *N. of Patents (Utility Type)*, *N. of Patents (Design Type)* are adjusted per ten thousand people. The following variables are adjusted in per capita unit: *Amount of Grants*, *Output of the Special Zones*, *Export of the Special Zones*, *GDP Primary Industry*, *GDP Secondary Industry*, *GDP Finance*. GDP growth rates are multiplied by 100. Standard errors are clustered at the province level.

4.2 Heterogeneous Impacts: Less vs. More Developed Regions

In this section, I discuss whether the impact of IFVC Program varies between less and more developed regions. This sheds light on the signaling theory of government investments (discussed in length below). Provinces are classified into "rich", "middle"

and "poor" regions according to their *ex-ante* level of development.[15]

4.2.1 Main Specifications

In section 4.1, I use a dummy variable on *whether* a province is included in the IFVC Program in a given year. In this section, I conduct another DID specification as an extension. Within each of the "rich", "middle" and "poor" regions, provinces are divided into treatment and control groups based on their *relative* inclusion intensity in the IFVC Program. The treatment group consists of provinces whose number of son-GGFs is above the median of their region. In addition, I estimate the *cumulative* impact of the IFVC program in this section (as opposed to the *one-period* impact in the previous section) to address the possibility that the actual impact of the IFVC Program may last longer than the year(s) of the Program. I use the following empirical specification,

$$y_{i,t} = \alpha + \beta_1 Treatment_{i,t} \times Post_{i,t} + \beta_2 Treatment_{i,t} + \beta_3 Post_{i,t} + \boldsymbol{\gamma} \mathbf{X}_{i,t} + \mu_{i,t}, \quad (2)$$

where i indexes cities, t indexes years, and the sample covers 240 cities[16] over 1999-2013. $y_{i,t}$ is the dependent variable of interest (e.g. *Gov Deal*), $Treatment_{i,t}$ is a dummy that equals one if city i is in a province in the treatment group, $Post_{i,t}$ is a dummy that equals one if year t is after the establishment year of the first son-GGF in the province for the treatment group and if year t is after 2008 for the control group, $X_{i,t}$ are control variables, and $\mu_{i,t}$ is an error term. Our estimate of the national program's effect is β_1.

4.2.2 Results

Table 4 reports the results. In "poor" regions, we observe positive impacts of the IFVC Program: treated cities have 1.08 more government-invested funds and 4.10 more private funds. Similarly, for VC deals, treated cities have 2.98 more deals

[15] I divide the 31 provinces into four groups according to their average ranks of the following indicators: *InnoFund grants*, *high-tech industry special zone development*, *patents*, *education*, *GDP*, *GDP growth rate*, *share of the tertiary sector* and *growth rate of the tertiary sector* in 1999-2006. Details in Appendix A.

[16] They the 298 cities in the previous section minus 58 ones in the least developed region. I exclude the least developed region because only one city was in the IFVC Program.

Table 4: Policy Experimentation and Heterogeneous Impacts

Panel A: Number of funds raised						
	(1)	(2)	(3)	(4)	(5)	(6)
	Poor		Middle		Rich	
Dependent Variable	Gov Fund	Private Fund	Gov Fund	Private Fund	Gov Fund	Private Fund
Treatment× Post	1.08**	4.10	-0.71	-6.29	1.61	9.78
	(2.05)	(1.66)	(-1.01)	(-1.34)	(1.07)	(0.87)
Treatment	0.19	0.32	-0.13*	-0.86***	1.05*	5.66
	(1.49)	(1.29)	(-1.81)	(-2.87)	(1.79)	(1.24)
Post	0.22*	0.38	0.74	4.49	0.94	7.32*
	(1.84)	(0.79)	(1.48)	(1.12)	(1.16)	(1.92)
Local Programs	0.02	-0.06	0.23	0.84**	0.23	0.68
	(0.49)	(-1.11)	(1.65)	(2.10)	(0.78)	(0.35)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1200	1200	1230	1230	1170	1170
Adjusted R^2	0.157	0.146	0.147	0.133	0.287	0.231
Panel B: Number of deals						
	(1)	(2)	(3)	(4)	(5)	(6)
	Poor		Middle		Rich	
Dependent Variable	Gov Deal	Private Deal	Gov Deal	Private Deal	Gov Deal	Private Deal
Treatment× Post	2.97**	1.70**	-0.24	0.20	-1.85	-2.60
	(2.21)	(2.17)	(-0.28)	(0.36)	(-0.41)	(-0.47)
Treatment	1.10**	0.64***	-0.09	-0.17	1.71	2.11
	(2.08)	(3.57)	(-0.37)	(-0.86)	(1.14)	(1.22)
Post	0.73*	0.12	0.81*	0.20	5.52**	6.59*
	(1.72)	(0.95)	(1.87)	(0.78)	(2.01)	(1.80)
Local Programs	0.02	0.08	0.13	0.27	0.63	0.22
	(0.37)	(1.04)	(0.90)	(1.47)	(1.05)	(0.31)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1200	1200	1230	1230	1170	1170
Adjusted R^2	0.241	0.220	0.095	0.068	0.472	0.450
Panel C: Number of deals that exit through IPOs						
	(1)	(2)	(3)	(4)	(5)	(6)
	Poor		Middle		Rich	
Dependent Variable	Gov IPO	Private IPO	Gov IPO	Private IPO	Gov IPO	Private IPO
Treatment× Post	0.30**	0.33*	-0.13	0.03	-0.43	-0.50**
	(2.07)	(1.79)	(-1.30)	(0.54)	(-1.52)	(-2.27)
Treatment	0.24***	0.28***	-0.01	-0.04	0.26	0.10
	(2.96)	(2.99)	(-0.31)	(-0.81)	(1.20)	(0.58)
Post	0.01	-0.03	0.11**	0.03	0.44***	0.33***
	(0.26)	(-0.47)	(2.06)	(1.02)	(3.64)	(2.86)
Local Programs	-0.01	0.02	0.03	-0.04*	0.15***	0.10**
	(-0.55)	(0.87)	(1.34)	(-1.92)	(2.77)	(2.55)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1200	1200	1230	1230	1170	1170
Adjusted R^2	0.121	0.111	0.055	0.021	0.304	0.405

Note: The table shows the regression results of the impact of the IFVC Program in "poor", "middle" and "rich" regions. Cities are grouped into "poor" , "middle", and "rich" regions based on a series of *ex ante* economic development and innovation indicators (i.e., during 1999-2006). Treated cities are those located in provinces included intensively in the IFVC Program. $Treatment_{i,t}$ is a dummy that equals one if city i is in a province in the treatment group. $Post_{i,t}$ is a dummy that equals one if year t is after the establishment year of the first son-GGF in the province for the treatment group and if year t is after 2008 for the control group. Dependent variables and controls are the same as in Table 2. t statistics are in parentheses, and standard errors are clustered at the city level. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels.

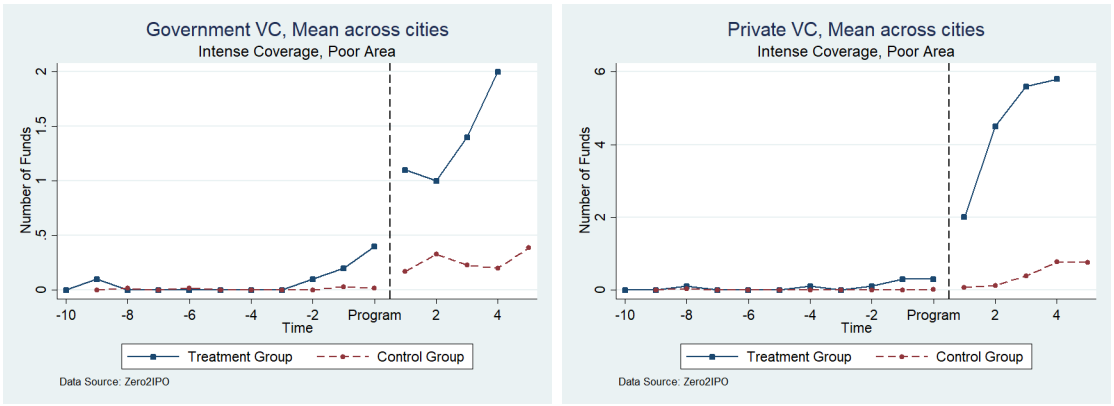
by government VCs and 1.70 more by private VCs, 0.30 more IPO exit deals by government VCs and 0.33 more by private VCs after the launch of the program. These estimates are economically large: the increments are three to five times as large as the sample mean. In "middle" and "rich" regions, results are mixed. The changes are insignificantly different from zero in most outcome variables. This finding suggests that investors in middle and rich regions do not adjust their investment decisions in response to the central government program.

Figure 5 provides a graphic illustration of the time trends of the results described above. For the "poor" regions, we observe a large jump for the treatment group upon the introduction of the national program, and the difference between treatment and control groups widens dramatically afterward (plots a and b). In contrast, we do not observe a discontinued jump for "rich" regions (plots e and f). For the "middle" regions (plots c and d), the patterns are not clear.[17] I present plots on the number of funds here. Figures plotting the number of deals and IPO exit deals are in the Internet Appendix C Figures C2 and C3.

Overall, both the regression results and the figures of time trends show that government programs are most effective in less developed regions. This result is consistent with the signaling theory of government policies that private investors interpret government investments as a signal of commitment. In less developed regions where private investors rely more on the policy commitment of governments, government investments have a more substantial signaling effect in the coordination game. As a result, government investments attract money from private investors that would not be raised otherwise. In more developed regions, private investors make their investment decisions more based on the market condition than government commitment. Consequently, the signaling role of government investments is weaker.

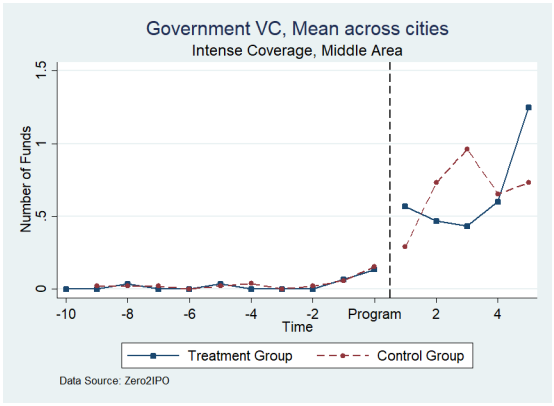
Speaking to the crowding-in or out effects, we still observe crowding-in effects

[17]In all plots, we see another increase in VC activities around three to four years before the start of the IFVC Program. This is related to when VC was formally acknowledged as a legal form of business in China in 2005. However, the increase is less dramatic when compared with the increase upon the introduction of the IFVC Program. Also, the 2005 policy is a policy without regional variation and experimentation elements.



(a)

(b)



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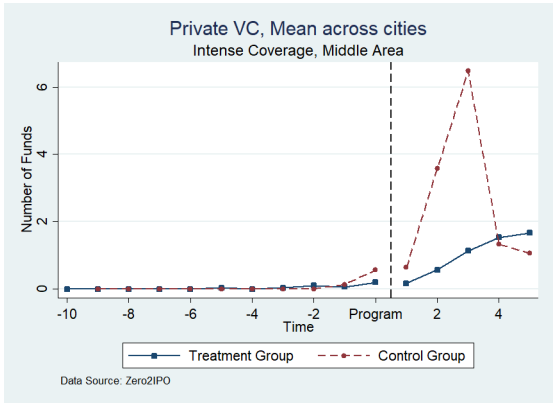

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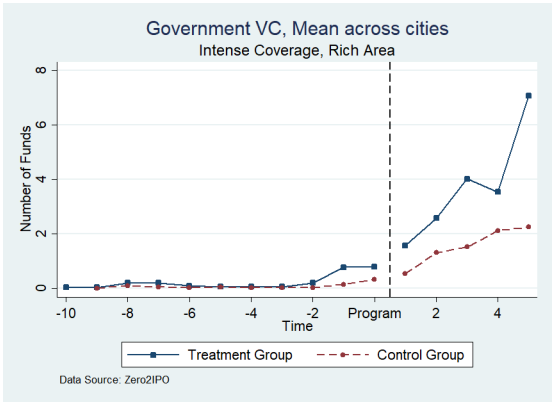
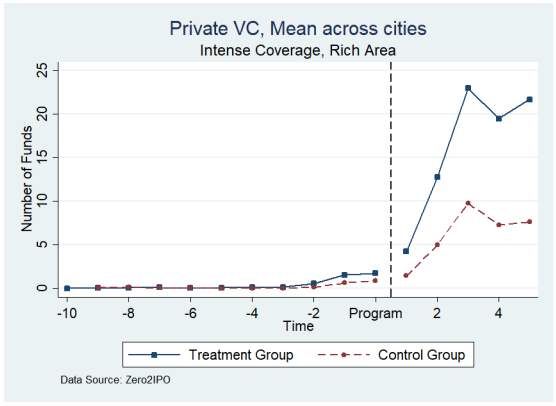


(e)



(f)

Figure 5: This figure includes plots on the number of funds established in "poor", "middle", and "rich" regions from top to bottom. Cities are grouped into "poor" , "middle", and "rich" regions based on a series of *ex ante* economic development and innovation indicators (i.e., during 1999-2006). Treated cities are those located in provinces included intensively in the IFVC Program. Plots on the left are for government-invested funds, and plots on the right are for private funds. In each plot, the dots are the mean value of the number of funds across cities in each group. The solid blue line is for the treatment group, and the red dashed line is for the control group. The vertical dashed line separates the years before and after the policy document announcement year (program year).

for most specifications: the changes in government and private VC activities are of the same sign. However, in some specifications for "middle" and "rich" regions, we have opposite (insignificant) signs, indicating potential crowding-out effects. This finding is consistent with evidence from existing literature showing that government investment crowds out private investment in developed countries.

4.2.3 Identification Assumptions

This extension of the DID models is based on the following identification assumptions. The central government may not select provinces purely randomly. However, the central government likely implements regional experiments by putting differentiated weights for each province. Compared to provinces of similar economic development levels, the *relative* intensity of son-GGFs is likely to reflect this dimension of policy experimentation. Another way is to pick provinces as experiment targets ("trial spots") during the early implementation of the program (section 4.2.4). In addition, the way I define $Post_{i,t}$ allows for the exploiting the staggered introduction of the IFVC Program, similarly to section 4.1.

4.2.4 Robustness

As a robustness check, I define the treatment and control groups based on whether the province is chosen as a "trial spot" in the first two years of the IFVC Program (2008 and 2009) (early trials). Results are robust and reported in Internet Appendix C Table C3. In addition, I also report the results of the entire sample using the relative inclusion intensity and early trials to define the treatment and control groups. Results are in the Internet Appendix C Table C4 and are similar to the findings in the previous section using the inclusion dummy variable.

In summary, the findings suggest that the impact is most significant in less developed regions. For developed regions, the impact is limited and may even be negative. The policy implication is that government intervention is more effective in less developed regions where government programs can lead to investment that otherwise would not occur.

4.3 Non-linear Impact: Early vs. Late Stage of the VC Sector

In this section, I investigate whether the impact of government investment depends on the development stages of the VC sector.

[INSERT Table 5 AROUND HERE]

I conduct two groups of analyses. First, I study the relationship between the level of government investment and VC activities. Table 5 Panel A reports the results. The specifications follow the baseline model in section 4.1 but replace $IFVC\ Inclusion$ with a linear and a quadratic terms of *Gov Money*. *Gov Money* is the amount of money invested by government LPs in VC funds in a city in a given year (a unit of 10 million RMB). We observe an inverted-U shape relationship between the level of government investment and VC activities for both governments VCs and private VCs. When the level of government investments is moderate, the effects are positive. With a further increase in government investments, the impact increases at a diminishing rate and eventually becomes negative.

Second, I study the impact of government investments in different development stages of the VC sector. Specifications are the same as the baseline model in section 4.1, except that $IFVC\ Inclusion$ is replaced by an interaction term of $GovMoney$ and $Stage$. $Stage$ is the years since the first fund was established in the city. Table 5 Panel B reports the results. The negative coefficients before the interaction term between $GovMoney$ and $Stage$ for IPO exit deals indicate that government investments have a diminishing positive impact as the VC sector enters a more mature stage.

In summary, the evidence presented in this section suggests that government investment is most beneficial when the VC sector is at an early stage. When the sector grows, we find a smaller effect of government investments. The policy implication is that governments should step back as the VC sector matures.

Table 5: Non-Linear Impact of Government Investment

Panel A: Inverted-U shape relationship between government money and vc activities					
	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Private Fund	Gov Deal	Private Deal	Gov IPO	Private IPO
Gov Money	9.38***	3.70**	4.14*	0.17***	0.07
	(2.89)	(2.44)	(1.97)	(3.10)	(1.24)
Gov $Money^2$	-0.091**	-0.034**	-0.021	-0.003***	-0.002**
	(-2.55)	(-2.17)	(-0.94)	(-5.01)	(-2.16)
Local Programs	1.06	0.46***	0.27**	0.080**	0.037
	(1.22)	(2.75)	(2.41)	(2.11)	(1.57)
Controls	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	4470	4470	4470	4470	4470
Adjusted R^2	0.543	0.744	0.777	0.588	0.556
Observations	4470	4470	4470	4470	4470
Adjusted R^2	0.546	0.745	0.778	0.589	0.557
Panel B: Decreasing impact of government money as the sector in more mature stage					
	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Private Fund	Gov Deal	Private Deal	Gov IPO	Private IPO
Gov Money	13.77*	3.98	-0.11	0.72**	0.31*
	(1.81)	(1.10)	(-0.03)	(2.57)	(1.66)
Gov Money × Stage	-0.74	-0.20	0.16	-0.05***	-0.02**
	(-1.54)	(-0.85)	(0.73)	(-2.83)	(-2.02)
Stage	2.85**	1.44**	1.38**	0.13***	0.11***
	(2.28)	(2.55)	(2.23)	(2.94)	(2.96)
Local Programs	2.18	0.93***	0.59***	0.13**	0.05
	(1.54)	(3.15)	(2.93)	(2.39)	(1.28)
Controls	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Observations	1300	1300	1300	1300	1300
Adjusted R^2	0.466	0.741	0.790	0.608	0.566

Note: Panel A shows the regression results of the relationship between government money and VC activities. The independent variable *Gov Money* is the amount of the money in VC funds from government LPs in a city in a given year (unit: 10 million RMB). *Gov* $Money^2$ is its quadratic term. Panel B shows the impacts of *Gov Money* at different stages of the development of the VC sector. The independent variable *Stage* is the years since the first fund was established in the city. *GovMoney* × *Stage* is the interaction term of *GovMoney* and *Stage*. Definitions of dependent variables and other control variables are the same as in Table 2. I omit *Gov Fund* as an outcome measurement due to the mechanical link concern to *Gov Money*. t statistics are in parentheses, and standard errors are clustered at the city level. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels.

5 Micro-Level Evidence

In this section, I study the crowding-in effects via the network connections among investors. This provides further support for the signaling effect of government investments. Suppose we observe that the investment behavior of private investors shows a network pattern with respect to connections to government investors. This supports the signaling role of government investments. In particular, I look at two types of investor connections in reality: the LP co-investments networks and VC joint affiliates.

5.1 LP Co-Investment Networks

In the GGF program, the government intervention takes the format of LP investments. In this section, I present evidence on the multiplier effect at the LP level using network analysis. LP networks are likely to serve as a transmitter of information that facilitates the signaling effects of government investments.

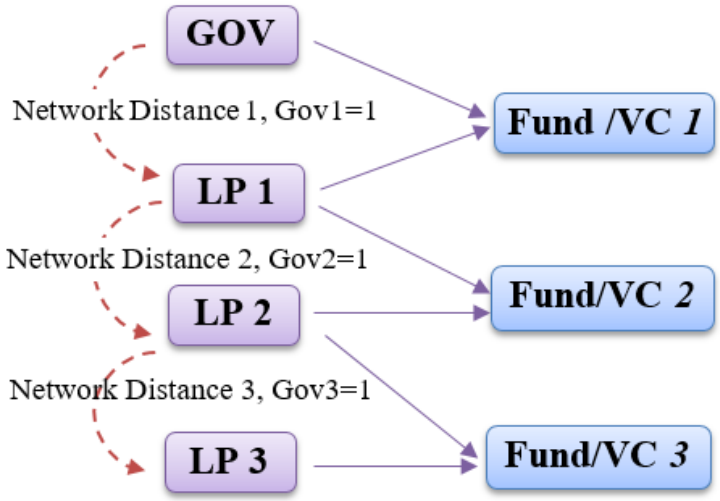
5.1.1 Main Specifications

I use the following empirical specification,

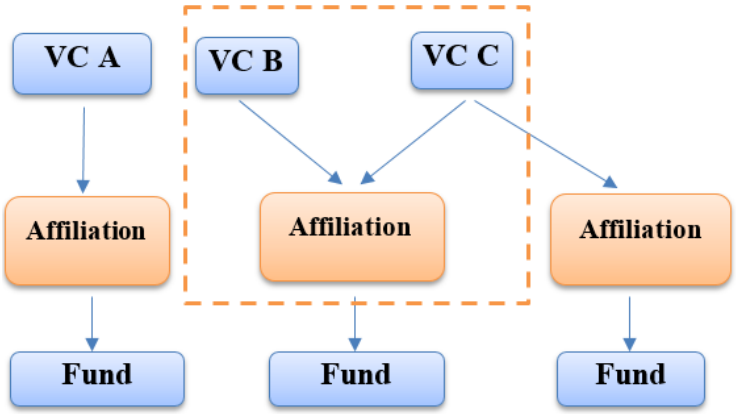
$$y_j = \alpha + \beta_k Gov\text{k}_j + \boldsymbol{\gamma}\mathbf{X}_j + \mu_j, \tag{3}$$

where j indexes fund, $k(= 1...3)$ indexes network distance, y_j is the dependent variables of interest (e.g. *Number of Corporate LPs*), $Gov\text{k}_j$ is a dummy that is equal to one if government LPs (co-LPs if $k > 1$) invest in the fund, X_j are control variables, α is the constant term, and μ_j is an error term. $Gov\text{k}_j$'s are mutually exclusive. The control group is the same for each regression which consists of funds without government LPs and co-LPs at network distance two and three. The sample is a cross-section of funds. Our estimate of the government LP (co-LP if $k > 1$) impact is β_k.

Co-investment networks refer to the linkages among LPs established by investments in the same fund, as shown in Figure 6 Panel (a). Two LPs are called co-LPs of a network distance *one* if they invest in the same fund. For further layers of network



(a)



(b)

Figure 6: This figure shows the network structure in venture capital. Plot (a) shows the LP co-investment networks. I define the network linkages in the following way. LPs are linked if they invest in the same fund (or funds of the same VC). In this example, *LP 1* is an LP linked to a government LP at network distance 1. *LP 2* is an LP linked to a government LP at network distance two, and so forth. Plot (b) shows the networks established by joint VC affiliates. Linkages are formed through being the significant ultimate owners (>20%) of the same affiliate. In this example, *VC A* is not connected with other VCs. *VC B* and *VC C* are connected. However, they can also be the single ultimate owner of another affiliate (e.g., *VC C*).

linkages, two LPs are defined as co-LPs of a network distance *two* if they have a co-LP of a network distance *one* in common, and so on.[18]

Based on the specification, dependent variables are *Number of Corporate LPs*, *Number of New Corporate LPs*, *Number of Individual LPs* and *Number of New Individual LPs*. LPs are classified into corporate LPs (firms) and individual LPs (typically high net-worth individuals). In addition, I distinguish between new and existing LPs. An LP is a new LP if its corporate group (or itself in the case of individual LPs) appears for the first time in the dataset.

Control variables include *Fund Size* (the amount of money raised), *Fund Life* (the registered number of operation years; I assign the average length 20 years to funds with no definite lifetime), a dummy that controls for the registered location and the established year of the fund, *VC Capital* (the sum of money raised by all the funds under the management of the VC), and *VC Age* (the number of days between the founding of the VC and February 1st 2014 divided by 365).

5.1.2 Instrument Variable

We may have the reversal causality that funds with more LPs are more attractive to government LPs and thus more likely to be invested by government LPs. To address this endogeneity concern, I build an instrument variable (IV) using one specific feature in the GGF programs: *Participant Certification*s (discussed in section 2.3). A necessary condition of son-GGFs is that at least one private LP must already be granted the *Participant Certification* (supporting the Relevance Assumption of the IV). More importantly, the *Participant Certification*s have three institutional features that support the validity of the Exclusion Restriction Assumption of the IV. First, certified LPs are not obligated to invest in son-GGFs and could invest in purely private funds. Second, while son-GGFs operate locally, certifications are issued by the central government in a staggered pattern. The central government's decisions contain exogenous variation in the allocation of certifications. Third, the certification

[18] I stop tracing LP co-investment networks at a distance of three because only a tiny number of funds are linked to governments at further distances (around 0.5% of the sample).

is independent of other non-certified LPs and should not directly influence their investment decisions. It should likely be exogenous for LPs in further layers in the networks.[19]

The empirical specification is as follows,

First Stage

$$\hat{Gov}\text{k}_j = \alpha + \delta_k Certification\text{k}_j + \boldsymbol{\lambda}\mathbf{X}_j + \epsilon_j \tag{4}$$

Second Stage

$$y_j = \alpha' + \beta'_k \hat{Gov}\text{k}_j + \boldsymbol{\gamma'}\mathbf{X}_j + \mu'_j, \tag{5}$$

where j indexes fund, $k(= 1...3)$ indexes network distance, y_j is the dependent variables of interest (e.g. *Number of Corporate LPs*), $Certification\text{k}_j$ is a dummy that equals to one if at least one certified LP (co-LPs if $k > 1$) invest in the fund (the IV), $Gov\text{k}_j$ is a dummy indicating investment from government LP(s) (co-LPs if $k > 1$), X_j are control variables, α and α' are the constant term, and ϵ_j and μ_j are error terms. Like $Gov\text{k}_j$, $Certification\text{k}_j$ are defined in a mutually exclusive way. Our estimate of the government LP (co-LP) impact is β_k.

To estimate the impact of government investment (co-investment) precisely, I deal with the timing carefully in a way that the government LPs (co-LPs) only affect funds established *after* the co-investment. Similarly, for the IV dummy variable, only funds established after the certification year are assigned with a value equal to one. In the case of more than one co-LPs/certified LPs, I use the minimum of the co-investment/certification years among them.

[19]To further support the Exclusion Restriction Assumption (i.e., not a certain unobservable quality of the certified LPs attracts other investors), I restrict to a subsample of funds without government LPs (and co-LPs). For the subsample, I do not find a significant positive correlation between the certification and the number of LPs investing in the fund. Results are in Appendix C Table C5.

Table 6: Transmission Through LP Co-Investment Networks (Corporate LPs)

Panel A: First Stage of IV Regression, Fund Level						
Dependent Var.	Gov1		Gov2			Gov3
IV1	0.60***	IV2	0.73***	IV3		0.53***
	(28.81)		(44.38)			(41.37)
Observations	5,260	Observations	4,484	Observations		3,856
IV F-stat	830.2	IV F-stat	1969	IV F-stat		1712

Panel B: OLS and Second Stage of IV Regression, Corp. LPs (All)						
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	IV	OLS	IV	OLS	IV
Dependent Var.	# of Corp. LPs		# of Corp. LPs		# of Corp. LPs	
Gov1	2.94***	4.68***				
	(29.11)	(17.39)				
Gov2			1.99***	2.98***		
			(18.65)	(15.85)		
Gov3					1.36***	2.32***
					(7.28)	(7.15)
Fund Size	0.36***	0.26***	0.28***	0.23***	0.35***	0.32***
	(10.42)	(6.78)	(6.19)	(4.95)	(5.28)	(5.00)
Fund Life	-0.02***	-0.01	-0.01*	-0.01	-0.01	-0.01
	(-3.83)	(-1.44)	(-2.45)	(-1.75)	(-1.51)	(-1.52)
Province×Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5260	5260	4484	4484	3856	3856
Adjusted R^2	0.234	0.189	0.120	0.103	0.064	0.057

Panel C: OLS and Second Stage of IV Regression, Corp. LPs (New)						
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	IV	OLS	IV	OLS	IV
Dependent Var.	# of New Corp. LPs		# of New Corp. LPs		# of New Corp. LPs	
Gov1	1.03***	1.26***				
	(13.20)	(6.19)				
Gov2			0.41***	1.04***		
			(4.84)	(6.99)		
Gov3					0.33*	0.86**
					(2.07)	(3.10)
Fund Size	0.14***	0.13***	0.17***	0.13***	0.22***	0.21***
	(5.31)	(4.52)	(4.68)	(3.70)	(3.91)	(3.75)
Fund Life	-0.01*	-0.01*	-0.01*	-0.01	-0.01	-0.01
	(-2.45)	(-2.02)	(-2.21)	(-1.66)	(-1.62)	(-1.63)
Province×Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5260	5260	4484	4484	3856	3856
Adjusted R^2	0.124	0.123	0.052	0.040	0.042	0.040

Note: The table shows the results of LP co-investment network transmission for corporate LPs. The sample is a fund cross-section. *Gov1*, *Gov2* and *Gov3* are dummies that equal one if government LPs (co-LPs if $k > 1$) invest in the fund. Similarly, *IV1*, *IV2* and *IV3* are dummies that equal one if certified LPs (co-LPs if $k > 1$) invest in the fund. Dependent variables are *# of Corp. LPs* and *# of New Corp. LPs*. Only funds established in and after the same year of the co-investments/certification are counted as affected ones (i.e., dummy equals one). t statistics are in parentheses. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels.

5.1.3 Results

Table 6 reports the results for corporate LPs. Panel A reports the first stage results where I find that $Certification$ positively correlates with government investments. Panel B reports the results for all corporate LPs in the fund. Odd columns show the OLS results, and even columns present the results of the second stage of the IV analysis. In all specifications, the coefficient before government LPs (and co-LPs) is positive and significant at 1%, suggesting that the funds with government LPs (and co-LPs) have more non-government-related corporate LPs. More importantly, the coefficient becomes smaller as the network distance to government LPs increases, implying that the "crowding-in" effect diminishes as the private investors are further away from government LPs (in a network sense). This pattern is consistent with the signaling theory of government investments that private investors take government funding as positive signals for the VC sector. As reported in Panel C, we observe a similar pattern for new corporate LPs.

The positive and significant coefficients before government LPs (and co-LPs) in the IV-based analysis support a causal interpretation of the findings. For example, in Panel B column (2), I find that governments being an LP leads to 4.68 more corporate LPs per fund. This result is economically large considering that the 75% percentile for the sample is three corporate LPs per fund. In addition, the results in the IV regressions are larger than in OLS regressions, consistent with that the IV captures the variation in government investments caused by GGF programs (instead of general government investments in the OLS regressions). One key purpose of the GGF programs is to foster the VC sector with the hope of having more private capital injection. Results on corporate LPs at the VC level are in Appendix C Table C6. We observe that the pattern is similar.

Table 7 reports the results for individual LPs. The analysis is conducted on the VC firm level (instead of the fund level) to avoid the results being driven by the fact that governments usually do not co-invest along with individual LPs. Panels A shows results supporting the validity of the first stage of the IV analysis. Panels B and C present the results of the second stage for all individual LPs and new individual LPs.

Table 7: Transmission Through LP Co-Investment Networks (Individual LPs)

Panel A: First Stage of IV Regression						
Dependent Var.	Gov1 VC		Gov2 VC		Gov3 VC	
IV1	0.63***	IV2	0.77***	IV3	0.49***	
	(21.37)		(31.40)		(19.25)	
Observations	1,983	Observations	1,491	Observations	1,346	
IV F-stat	456.9	IV F-stat	985.8	IV F-stat	370.5	
Panel B: OLS and Second Stage of IV Regression, Individual LPs (All)						
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	IV	OLS	IV	OLS	IV
Dependent Var.	# of Indiv. LPs		# of Indiv. LPs		# of Indiv. LPs	
Gov1 VC	6.68**	26.03***				
	(2.62)	(4.37)				
Gov2 VC			8.72**	10.96**		
			(3.28)	(2.61)		
Gov3 VC					7.24	-4.36
					(1.51)	(-0.42)
VC Age	0.99**	0.49	0.52	0.52	0.37	0.41
	(3.23)	(1.44)	(1.82)	(1.82)	(1.32)	(1.44)
VC Capital	4.03***	3.45***	4.80***	4.64***	7.06***	7.47***
	(11.94)	(9.14)	(5.91)	(5.52)	(6.64)	(6.72)
Observations	1983	1983	1491	1491	1346	1346
Adjusted R^2	0.092	0.066	0.038	0.038	0.037	0.032
Panel C: OLS and Second Stage of IV Regression, Individual LPs (New)						
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	IV	OLS	IV	OLS	IV
Dependent Var.	# of New Indiv. LPs		# of New Indiv. LPs		# of New Indiv. LPs	
Gov1 VC	4.66*	18.99***				
	(2.36)	(4.11)				
Gov2 VC			8.72**	7.37*		
			(3.28)	(2.31)		
Gov3 VC					7.24	-3.30
					(1.51)	(-0.41)
VC Age	0.72**	0.35	0.52	0.40	0.37	0.34
	(3.03)	(1.34)	(1.82)	(1.87)	(1.32)	(1.55)
VC Capital	3.11***	2.68***	4.80***	3.58***	7.06***	5.72***
	(11.84)	(9.13)	(5.91)	(5.60)	(6.64)	(6.62)
Observations	1983	1983	1491	1491	1346	1346
Adjusted R^2	0.089	0.064	0.038	0.037	0.037	0.032

Note: The table shows the results of LP co-investment network transmission for individual LPs. The sample is a VC cross-section. *Gov1*, *Gov2* and *Gov3* are dummies that equal one if at least one of the funds managed by the VC has government LPs (co-LPs if $k > 1$). Similarly, *IV1*, *IV2* and *IV3* are dummies that equal one if at least one of the funds managed by the VC has certified LPs (co-LPs if $k > 1$). Dependent variables are *# of Indiv. LPs* and *# of New Indiv. LPs*. Controls include *VC Age* (the number of days between the found date and February 1st 2014, divided by 365) and *VC Capital* (the amount of money under the management; unit: billion RMB). Only funds established in and after the same year of the co-investments/certification are counted as affected ones (i.e., dummy equals one). t statistics are in parentheses. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels.

We observe a similar pattern for individual LPs as for corporate LPs: government investments lead to more private investments, and the effect decreases with the network distance to the government LPs. For example, based on the IV estimation in Panel C Column (2), government LPs crowd in about 26 more individual LPs per VC. The effect decreases by about 60% in magnitude as the network distance increases from one to two and becomes insignificant with a network distance of three. Also to be noticed is that the OLS regressions here do not show a clear pattern, which shows the importance of doing the IV analysis.

To sum up, in this section, I provide LP-level evidence on the influence of government LPs on non-government LPs. I find that government LPs attract more private LPs into the VC sector and that the effect transmits through LP networks in a diminishing pattern. These findings are consistent with the hypothesis that government investments serve as a signal that can be spread out through networks among investors.

5.2 VC Joint Affiliate

Venture capital businesses frequently operate through joint VC affiliates that two or more VC firms set up to manage deals in collaboration. These joint affiliates can be another type of information transmission vehicle. In this section, I present VC-level evidence on the multiplier effect through this transmission channel.

Figure 6 Panel (b) illustrates the basic idea of information transmission through VC affiliates. A VC firm can be the single ultimate owner having a significant share ($> 20\%$) in an affiliate (e.g., *VC A*). Alternatively, VC firms can form joint affiliates with other VCs by being among the largest ultimate co-owners (e.g., *VC B* and *VC C*). In the following analysis, I focus on each affiliate's five largest ultimate owners. The signaling effects of government investments can be observed empirically as an additional capital injection from private VCs who form the same affiliates with government VCs.

Table 8 reports the regression results. Column (1) shows that VC co-owners of joint affiliates make 7.69 more deals on average. In column (2), I control for *VC Age*,

Table 8: Transmission Through VC Joint Affiliates

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) Probit	(6) Probit
Dependent Variable	#. Deals	#. Deals	#. IPOs	#. IPOs	Co-Owner	Co-Owner
Co-Owner	7.69***	3.43***	1.07***	0.44***		
	(8.04)	(3.36)	(9.11)	(3.61)		
Gov VC					1.21***	0.92***
					(13.33)	(8.85)
VC Age		0.20***		0.04***		0.03***
		(3.21)		(4.93)		(4.37)
Geo. Range		4.04***		0.53***		0.35***
		(10.47)		(11.32)		(6.29)
Head Location	No	Yes	No	Yes	No	Yes
Observations	1279	1278	1279	1278	1279	1258
Adjusted R^2	0.047	0.130	0.060	0.161		
Pseudo R^2					0.153	0.250

Note: This table shows the regression results on transmissions through joint VC affiliates. *Co-Owner* is a dummy that equals one if the VC are co-owners with other VCs in a VC affiliate. *#. Deals* is the number of deals and *#. IPOs* is the number of deals that later exit through IPOs. *Gov VC* is a dummy that equals one if the VC manages at least one government-invested fund. Control variables include *VC Age* (the number of days between the VC's founding date and February 1st, 2014, divided by 365), *Geo. Range* (the number of provinces where the VC has a fund), and *Head Location* (the oldest affiliate of the VC's location). I only look at the five largest ultimate owners of the joint affiliate. t statistics are in parentheses. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels.

Geographic Range, and *Headquarter Location*. The positive relationship becomes smaller but remains significant at the 1% level: VCs that are co-owners invest 3.43 more deals on average. Columns (3) and (4) report the results for IPO exit deals, which also show a positive relationship between joint affiliates and IPO exit deals. For example, in column (4), where we have controls, I find that VCs that are co-owners make 0.44 more IPO exit deals, *ceteris paribus* and the coefficient is at a significance level of 1%. Columns (5) and (6) analyze the determinants of entering joint affiliates. Government VCs are 15% more likely to be co-owners (marginal effect of the Probit model) at a significance level of 1%. Older and more geographically diversified VCs are also more likely to be co-owners of affiliates.

Table 9: Transmission Through VC Joint Affiliates: Lead vs non-Lead Co-Owners

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	#. Deals	#. IPOs	#. Deals	#. IPOs	#. Deals	#. IPOs
Co-Owner (Gov)	4.06***	0.42***				
	(3.16)	(2.68)				
Co-Owner (Private)	-0.89	0.11				
	(-0.65)	(0.69)				
Co-Owner (Gov Lead)			7.14***	0.79***		
			(4.52)	(4.15)		
Co-Owner (Private Lead)			-3.04*	-0.16		
			(-1.71)	(-0.74)		
Co-Owner (Gov Non-Lead)					2.91*	0.34*
					(1.90)	(1.83)
Co-Owner (Private Non-Lead)					-1.61	0.09
					(-0.96)	(0.42)
VC Age	0.20***	0.04***	0.21***	0.04***	0.22***	0.04***
	(3.23)	(4.87)	(3.37)	(5.07)	(3.55)	(5.05)
Geo. Range	4.21***	0.53***	4.20***	0.54***	4.37***	0.56***
	(10.86)	(11.44)	(10.73)	(11.36)	(11.67)	(12.41)
Head Location	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1278	1278	1278	1278	1278	1278
Adjusted R^2	0.129	0.160	0.136	0.164	0.124	0.155

Note: This table shows the regression results on transmissions through joint VC affiliates for all (columns (1) and (2)), lead (columns (3) and (4)), and non-lead (columns (5) and (6)) co-owners. *Co-Owner (Gov)* is a dummy that equals one if the VC is a co-owner of a government VC in at least one affiliate. Similar for *Co-Owner (Private)*. *Co-Owner (Gov Lead)* (*Co-Owner (Gov Non-Lead)*) is a dummy that equals one if the VC is a co-owner of a government lead (non-lead) VC in at least one affiliate. Similar for *Co-Owner (Private Lead)* and *Co-Owner (Private Non-Lead)*. Lead VC is the VC that backs the largest ultimate owner in an affiliate, and non-lead VCs are VCs that back other ultimate owners. Control variables include *VC Age* (the number of days between the VC's founding date and February 1st, 2014, divided by 365), *Geo. Range* (the number of provinces where the VC has a fund), and *Head Location* (the oldest affiliate of the VC's location). I only look at the five largest ultimate owners of the joint affiliate. t statistics are in parentheses. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels.

Table 9 reports the results where I decompose the effect of joint affiliates into the effect of government and private co-owners. The coefficients before *Co-Owner (Gov)* are positive and significant at the 1% level: VCs that join affiliates with government VCs invest 4.06 more deals (and 0.42 more IPO exit deals). In contrast, the coeffi-

cients before *Co-Owner (Private)* are insignificant. This difference suggests that the positive association between VC investments and co-ownership is mainly attributable to government VCs in the affiliates (instead of private VCs). This difference between government and private VCs highlights the importance of government VCs in transmitting the information.

I further distinguish between the lead and the non-lead co-owners.[20] Columns (3) and (4) show that VCs that are joint affiliates with *lead* government VCs undertake 7.14 more deals (and 0.79 more IPO exit deals), and the coefficients are significant at 1%. Similar to results in Table 8, coefficients before private lead co-owners are insignificant. Columns (5) and (6) report the results on *non-lead* co-owners, where we find limited impacts of non-lead co-owners on others in the affiliates. This finding suggests that the transmission is through lead co-owners, further supporting the signaling theory of government investments. If other investors take government investments as signals, it is more likely that we have more substantial effects when government VCs are essential agents in the game (lead ones) than minor agents (non-lead ones).

In summary, in this section, I find several pieces of evidence that support that government investments serve as signals and joint affiliate is a way to transmit such information. First, I find that government VCs are more likely to form joint affiliates with other VCs. Second, VCs that form joint affiliates with others make more deals (and more IPO exit deals), especially when the lead co-owner of the affiliate is a government VC. Third, on the contrary, we do not observe the same positive effect when studying joint affiliates that are formed with the participation of private VCs only.

6 Conclusion

In this paper, I discuss whether and how government investment could help to foster the development of venture capital. Using linked databases on a comprehen-

[20] Lead co-owners have more control rights in affiliates and could have more influence than non-lead co-owners.

sive set of funds, LPs, and VC firm investments in China, I provide evidence that government investment could crowd in more private investment, but the effect is limited to less developed regions and the early development of the VC sector. Existing research focuses more on countries where venture capital has long been developed while there is limited research on the importance of government support in seeding the VC sector.

To address potential endogeneity concerns, I exploit specific policy implementation features in government VC programs in China. First, I exploit a specific program of the central government: the IFVC Program. While local government investment is probably dependent on local economic conditions, the IFVC Program has quasi-natural experiment features. Second, the programs involve a process that allocates certification to VCs and LPs giving them permission to invest alongside the government. This certification is exogenous to other non-certified investors and to that end, I build an instrument variable in order to study whether government investment leads to spillovers to other investors.

This paper provides a picture of government policy as signalling or coordination to explain the crowding-in effects. Government investment can be taken by private investors as a signal for the specific regulatory environment. This provides a rationale for private investors to follow government investors and move into the VC sector. Examples of private information that is transmitted among investors could be tacit knowledge, investment experience, or even communication and attention in general. Although it is difficult to determine the exact elements that crowd in private investors, evidence suggests that there are spillovers of government investment among investors.

Governments play an important role in venture capital development in many countries worldwide, including currently in North America, Europe, UK, Israel, Japan, Australia, and South Africa. The structure of the VC industry in China, with VC firms and closed-end funds, follows the internationally established business model as it has first evolved in the U.S. While China might be a special environment to the extent that it has a rapidly growing VC sector, there is no particular reason

to believe that the insights in this paper might not also apply to other countries.

There are several avenues for future research. First, this paper focuses on the first wave of policies to initiate the VC sector. Brunnermeier, Sockin, and Xiong (2017) argue that private actors may front-run future policy changes when the financial market becomes more mature. It would be interesting to study the following policies and the later stage of development of the sector. Second, this paper estimates the impact of one type of government program that supports the development of venture capital: LP investments in VC funds. Hellmann and Thiele (2019), in an overlap generation model, show that the intergenerational transmission of tacit knowledge of entrepreneurship suggests that VC and start-up based policies have different impacts. It would be interesting to empirically evaluate the impact of different types of policies that aim to promote entrepreneurship and innovation.

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Internet Appendix of "Crowding-in in Venture Capital: Evidence from China"

Appendix A Supplementary Information

General Situation of Venture Capital in China

Venture capital investment is a relatively recent phenomenon in China. While in the U.S., the first venture capital firm, American Research and Development (ARD), was established in 1946 (Gompers and Lerner 2001), venture capital were not started in China until the early 1990s. According to Zero2IPO, the first venture capital investment was the investment in Jiangmen JJJ Battery Co, Ltd. by China KZ High Technology Co., Ltd. (CKZ) in 1991. The less-developed financial market attributes to this late start. In fact, active financial markets do not exist in China until early 1990s. The first boom in venture capital in China is around 2005. 2014-2017 sees another surge.

Government investments started early in venture capital in China. According to Zero2IPO, the first investment by government VC is in 1994, investment in Guangdong Fenghua Advanced Technology (Holding) Co, Ltd. by IDG Capital in Guangdong Province. The other three deals in the same year, one in Guangdong Province and two in Beijing, were also backed by government VC. CKZ who made the first VC investment in 1991 is not a government VC under our definition, but it has a strong state background. CKZ, established in 1989, is one of the earliest venture capital organizations in China and the first Sino-foreign joint venture VC firm with strong state background from China Merchants Group, the State Science and Technology Commission (Currently Ministry of Science and Technology) and the Commission of Science Technology and Industry for National Defense.

Venture Capital Policies in China

There were several important policy changes regarding venture capital in China. The first high level regulation was the *Interim Administrative Measures for Venture Capital Investment Enterprises* released in November 2005 and marks the official recognition of venture capital in China. This policy document is of the highest level and ten ministries[1] were backing it. Relatedly, In August 2006, *The Partnership Business Law* was revised and Limited Partnership becomes a legal form of company for the first time. This marks the starting point of formal venture capital investment in China. In 2007, the first national level policy on government investment in venture capital was released. The *National Innovation Fund Venture Capital Guidance Fund Program for Technology Based Firms* (InnoFund VC Program henceforth, www.innofund.gov.cn) was established in the following year.

There are other policies regarding venture capital. One policy is the tax reduction to venture capital firms. It started in 2007 but was not successful and stopped shortly after. Another policy is direct subsidy to venture capital firms and entrepreneurs. This is still ongoing but could be considered as supplementary to the LP investment policy. The amount is tiny relative to the LP-level investments. The direct subsidy is 0.1-0.7 million RMB per VC firm/small business while the funds established by the national program is of 0.9-3 billion RMB per fund. Even consider that each fund invests in a large number of companies, the size difference between direct subsidy and LP investment is still enormous. Moreover, the existence of direct subsidy and potentially other policies are not in contradictory to my story as long as that policies go in same direction. My main argument is that government investments could have pull in effects on other investors if their actions contain (private) information of investment environment. Both GGF policy and VC direct subsidy policy contains information on government's emphasis in venture capital.

[1] National Development and Reform Commission, Ministry of Science and Technology, Ministry of Finance, Ministry of Commerce, People's Bank of China, State Administration of Taxation, State Administration for Industry and Commerce, China Banking Regulatory Commission, China Securities Regulatory Commission, and State Administration of Foreign Exchange

Grant from the InnoFund Program

The InnoFund contains another subprogram which is mainly in the form of direct subsidy to SMEs. As disccuesd above, subsidy is different from VC investments (which are my current research objects). Table A1 gives the information on types of grants in this subprogram. Data on established, mid-term qualified and terminated grants in 1999-2014 is publicly available on the official website (*innofund.chinatorch.gov.cn*).

Table A1: Grant Type Distribution

Grant Type	N.	N. (%)	Amount (Billion RMB)	Amount (mean, Million RMB)	Start Year
Subsidy[1]	42,538	87.94	27.52	0.65	1999
Loan Interest Reduction	3,259	6.74	2.30	0.71	1999
Subsidy to Portfolio Companies of VCs	1,215	2.51	0.95	0.78	2008
Subsidy to Service Center	779	1.61	0.81	1.05	2014
Subsidy to VCs	579	1.20	0.50	0.86	2008

1 There is a separate category, subsidy to start-ups contained in this category (in 2006 only).

Zero2IPO Database

There are two main big commercial VCPE database companies in China: Zero2IPO and CVsource. In this paper, I use Zero2IPO as the main data source of venture capital investment. It is relatively better known internationally, with John Dean and Danny Lui among the initial investors. The chapter about China in Venture Capital and Private Equity: A Casebook (Lerner and Hardymon, 2008) used it. Stanford GSB has a case study (No. E325) on it. An additional reason for choosing Zero2IPO is the public availability. Although the full list and download function is only available in the paid version, all information could be viewed on the official website (pedata.cn) so that readers could get an idea by surfing and searching the website.

VCPE database (PEData, “simutong”) is one product of Zero2IPO Group, a leading integrated service provider and VCPE investment institution in China founded in 1999. Many lead VC/PE firms, including IDG Capital, CDH investments, Sequoia Capital and KKR, subscribe to it. Data are collected from mainly three sources. First, first hand data is collected from frequent surveys of active VCPE institutions. Second, news and announcements on public and professional information platforms, including government announcements, big news presses, VCPE journals, stock exchanges and regional equity markets, are tracked constantly. Third, original data is obtained through direct interaction with entrepreneurs and VCPE firms in regular forums and conferences.

One weakness of Zero2IPO is that it may contain duplicated or imprecise information. When the content of the news is not accurate, all information is recorded. Besides, announcements in news press sometimes may not imply an actual investment. However, the database is updated constantly if more precise information is available when the company goes public or the VCPE firm/company discloses it. Moreover, it is the same situation for the competing database. I checked a small random sample to compare the two databases Zero2IPO and CVsource. The coverage and investment amounts are similar. The exact investment date and estimated returns are different. But the difference is within a reasonable range.

Province Ranks

I rank provinces based on several indicators. Indicators are based on five categories: InnoFund Grant, Special Zone, Patent, Education and GDP. InnoFund Grant includes total number of grants and total amount of grants. Special Zone includes number of special zones, total number of companies, total output and total exports in special zones. Patent includes number of utility patents and number of invention patents. Education includes high school population and college population. GDP includes GDP, GDP growth rate, share of tertiary sector and tertiary sector growth rate. I first rank provinces based on each indicator. Then I calculate the average of sub indicators in each category and then calculate the mean of each category. We have ranks for each province in each year. I calculate the mean of the ranks in 1999-2006 for each province. The final ranks from high to low for provinces are the following,

Guangdong, Jiangsu, Beijing, Shandong, Zhejiang, Shanghai, Liaoning, Hubei, Hunan, Sichuan, Shaanxi, Hebei, Tianjin, Henan, Fujian, Jilin, Anhui, Heilongjiang, Guangxi, Neimenggu, Shanxi, Chongqing, Jiangxi, Tibet, Guizhou, Xinjiang, Gansu, Yunnan, Hainan, Qinghai, Ningxia

The first three groups, denoted as “rich”, “middle” and “poor”, contain seven provinces each. The last (the least developed) group contains ten provinces and among them only one province was included in the national program before 2013 and therefore excluded from the sample for this section.

Appendix B Data Collection and Cleaning Procedure

1 Fund Information

I focus on VCPE funds established before 2014 (included). As discussed in detail in the following paragraphs, only funds in related categories are included. The starting point is AMAC (Asset Management Association of China). Then I supplemented the dataset with Zero2IPO.

Funds Registered in AMAC

AMAC (Asset Management Association of China, www.amac.org.cn), founded in 6 July 2012, is a national level nonprofit organization under the guidance of China Securities Regulatory Commission and Ministry of Civil Affairs of People's Republic of China. According to Securities Investment Fund Law of People's Republic of China, fund management and custodian companies should register in the association. The official website provides various types of entities, including private offered funds and their management firms, private offered funds by security companies, publicly offered funds and their management firms, asset management funds, asset-back securitization funds and futures funds. I used web crawler technology to get a full list of all private offered funds and their management firms and private offered funds by security companies, updated at 1 January 2018.

I included only venture capital and private equity funds established before January 2014 (included), a total of 4874. January 2014 is chosen as the ending date to accommodate to the policy period I study (one-month lag is allowed for gaps between release and execution of the policy). Within private offered funds, there are several categories, including Venture Capital (11%), Private Equity (42%), Trust Plans (14%), Asset Management Plans by funds (7.5%), Asset Management Plans by security companies & their sub-companies, banks, insurance companies and futures companies (less than 1.5%), Security and Bond Investment (16%) and Others (8%, including real estate & construction, arts, films & television, bank loans etc.) I include the following categories: Venture Capital, Private Equity and Others. Trust plans and asset management plans invest in private equities as well, but usually for late stages. In addition, trust plans and asset management plans are treated differently on legal and regulation issues, they should not be as in the same category as VCPE funds. For example, under current regulation, trust plans and asset management plans should exit before a company goes public. i.e., LPs in those plans are

not considered as shareholders of the company and cannot get the return upon IPO. I exclude all funds in Venture Capital, Private Equity and Others category with a trust plan or an asset management plan name. For the category Venture Capital and the category Private Equity, I use a more tolerant filter as funds in these categories in principle should operate as a VCPE business. I only exclude highly unlikely funds. For the category Others, I use a rather strict criterion. I exclude all funds with descriptions containing other types of business and include only funds with names and descriptions referring to VCPE operation. A detailed process description on what are excluded and what are included for each case are available upon requests.

Funds Registered in Zero2IPO

From Zero2IPO, I collect funds established before January 2014 (included) in the following categories: FOF, Angel, VC, Growth and Buyout, updated at 1st January 2018. This gives us a total of 9,181 funds, composed of 4,936 funds both in Zero2IPO and AMAC (this includes some non VCPE funds in AMAC), 2,036 funds both in Zero2IPO and NECIPS, but not in AMAC and 2,271 funds only in Zero2IPO, not in NECIPS nor in AMAC. When establishment date is not available, I use fundraising date. As for AMAC funds, I exclude all funds with a trust plan or an asset management plan name. I focus on a conservative list of funds by deleting funds with duplicated full names, since funds that are not well identified by different VC firms could have the same full name in the database. Through the matching processes with AMAC and NECIPS, duplicated funds are also deleted. Details of the data cleaning procedure are available upon request. Our final fund sample consists of 4,874 funds from AMAC and supplemented by 4,307 funds from Zero2IPO.

I exclude funds that are VC firms (though there is no clear distinction between the two): companies with names containing "group", companies with names containing "management (*guanli*)" which are not of limited partnership format and companies whose VC firm is the same as the fund company itself with all shareholders individuals.

2 LP information

Shareholder Information in NECIPS

To operate a business as an independent legal entity in mainland China, all companies need to be registered in the National Enterprise Credit Information Publicity System (NECIPS, www.gsxt.gov.cn) by the State Administration for Industry & Commerce of the People's Republic of China (SAIC). The majority of VCPE funds are in the form of Limited Partnership or Corporate (more than 98% according to Zero2IPO), which are independent legal entities and are thus registered in the NECIPS. Other forms of funds that operate semi-VCPE business are trust plans and asset management plans. As explained before, they are quite different from VCPE funds in the normal sense and are excluded from the sample. The majority of the observations are collected from third-party platforms because the original NECIPS website doesn't allow for large amount of data downloads. The fund sample is divided into a registered part, a total of 6,431 (among which 35 funds missing LP share information), and an unregistered part, a total of 2,421. A total of 6,384 (99.8%) funds have complete shareholder information (11 without LP information and 35 without share information).

Identify the GP Firm(s)

To identify GP(s), I apply three criteria by descending order
1) GPs reported in NECIPS ("zhishi" partner" "putong" partner). This is the case for the majority of funds in Limited Partner form (66%);
2) associated VC in AMAC/Zero2IPO if it is a shareholder (18%);
3) based on fund form (limited partner/corporate), shareholder equity, shareholder type (individual/investment company/other company type) for funds without direct GP information. For funds of limited partnership, I identify the shareholder with least shares. If there are more than one GP

identified, the GPs with smallest shares are chosen. For funds of the organization form as corporates, I identify the shareholder with most shares.
The methodology successfully identifies GP(s) for 5,857 funds. In the rest of the funds, 326 are funds with person as all shareholders. Thus, we cannot find a GP firm among the shareholders. A total of 239 (4%) funds are left with LPs might be GP firms.

LP composition

The following analysis relies on the above sample of 6,419 funds with LP information. For the 5,857 funds with identified GP firm, LPs are the shareholders excluding the GPs who own less than 5%. For the unclear 239 funds, I include all shareholders in the LP sample.

Fund-of-Fund (FoF) is a common practice for large VC firms in China. For the original LP× fund sample, 2,114 data points are FoFs. This is about 3.78% of the whole sample and 13.81% of the non-individual LP sample. The deepest layer of FoF goes to six layers. The proportion of FoFs at each layer is rather similar (3%-4% of the whole sample and 10%-15% of non-individual LP sample). (I identify FoF based on their registered names. Details are are available upon request. This could identify well limited partnership format FoFs as the registered names usually inform well the role of the company for this organization format. This method cannot pick up corporate format funds. However, the standard FoFs are not in this format.) To prevent duplicate accounting, only ultimate LPs of the FoF chain are included in the final LP sample. The FoFs themselves are not included. This reduces the final fund sample to 6,260 funds. The deleted funds are funds whose LPs are all FoFs.

The final LP sample constitutes 53,812 LP×fund records for 6,260 funds, 9,589 corporate LPs (based on unique ID in NECIPS) and 34,079 individual LPs (based on person link from a third-party platform using machine learning technics). Based on LP type, LP×fund records could be divided into 1) from wealthy individuals (74.03%), 2) from investment companies (16.00%), 3) from other financial companies (0.59%) and 4) from non-financial companies (banks, insurance company, trusts, security companies) (9.38%). The large proportion of individual LPs is mainly due to the larger number of total LPs for funds dominated by individual LPs compared to funds dominated by corporate LPs. A typical fund dominated by individual LPs consists of 10-30 LPs while a typical dominated by corporate LPs consists of 3-6 LPs. From the perspective of funds, corporate LPs are important. More than 75% of funds have at least one corporate LPs. The main part of study on funds and LPs is focused on corporate LPs as we have precise and meaningful information on them. For individual LPs, less precise information and lack of data on links among them (family/working relationship) will overestimate new entries. The share from traditional financial companies is very small mainly because the regulation separates VCPE funds from other types of funds. However, they could set up investment companies and make investments in VCPE funds.

LP × Fund	
Individual	39,838 (74.03 %)
Investment Companies	8,608 (16.00%)
Other Financial Companies	320 (0.59%)
Non-Financial Companies	5,046 (9.38%)
Total	53,812

I group the 9,589 LPs into 8,489 corporate groups based on a 50% threshold. If company A is the shareholder with more than 50% of the shares in company B, then company B is in the corporate group of company A. Controls rights through chains are considered. Admittedly, this is a very rough way of group classification and results in a number of groups larger than under a more refined way of group classification.

Government LPs are companies that are wholly owned by the state. (in practice, I use a 95% threshold for the convince of data collection. It should give approximately the same sample.) Ownership structure features many pyramids. Among the 1262 government LPs, only 9.78% are direct government institutions. 58.14% are wholly state-owned companies and the rest are companies wholly owned by the state through chains or pyramids. While government LPs are of 14.87% of the whole non-individual LP sample, they make up 18.35% of the non-individual investments.

The majority of the sample consists of LPs that make investments only once in my sample (88% for non-individual LPs and 91% for individual LPs).

	Investments		LP		Funds	
	N.	%	N.	%	N.	%
Government	2,791	19.97%	996	11.73%	1,590	25.40%
Non-Government Corporates	11,183	80.03%	7,493	88.27%	4,670	74.60%

3 GP-VC Link

There are 6,596 GP firms (877 foreign companies) in total, combined from the GPs identified in the fund list and the GPs from the deal list.

First, I pin down the ultimate owners accounting for 20% or more shares in the GP firm based on ownership structure information from NECIPS. The main idea follows La Porta, Lopez-de-Silanes, and Shleifer (1999). I track down all controlling owners in the pyramids. For example, if company C hold more than 50% of the shares in company B, and company B accounts for x% of the shares in company A, we say company C accounts for x% of the shares in company A. When there is no controlling shareholder backing owners at a certain layer, each owner accounts for the corresponding percentage of shares in next layer if the total number of owners doesn't surpass 20. For example, if company E, D, and F accounts for e%, d%, and f% of the shares in company B, but none of them is a controlling shareholder, and company B accounts for x% of the shares in company A, we say company E, D, and F accounts for e%×x%, d%×x%, and f%×x%, of the shares in company A, respectively. If the total number of owners at a certain layer surpass 20, I stop the tracking and classify the company as a widely held corporate. I track down until all owners are of one of the following types: 1) individual; 2) government institution; 3) widely held corporate; 4) listed company with a controlling shareholder; 5) foreign company. Companies situated in layers between the ultimate owners and the GP firm and are controlled by the ultimate owners are called parent companies. For example, if ultimate owner P controls company B, directly or through pyramids, and company B is a shareholder of GP A, then company B is the parent company of GP A.

Then, I aggregate the GP firms to the VC firm level based on the following criteria, in descending order.

1) Group according to chairman or the two ultimate owners with the largest number of shares. i.e. If two GPs have the same chairman, I group them together. Or, if two GPs have a common ultimate owner who accounts for the largest or second largest number of shares, I group them together. If there is a common ultimate owner that is a company or there is a common parent company, then the company is chosen to represent the corporate group. If there is no such company, the oldest GP is chosen.
2) Further group according to corporate email address, official website and telephone number, which are registered in NECIPS. If two GPs have the same website, or same corporate email domain, or same telephone number, they are grouped together. The same procedure is adopted to choose the

company to represent the corporate group.
When there are conflicts, i.e., chairman, ultimate owner and email/website/telephone doesn't point to the same group, I first see if there is an ownership relation (a common owner of more 20% of the shares, one is a large owner of the other). If there is such an ownership relation, then the two corporate groups are grouped together. If no relation is identified, I apply the majority rule. If there is no majority, I classify the corporate group based on chairman information.

This procedure assigns a corporate group to 3,010 GPs. For those GPs, the corresponding VC firm is the corporate group. The rest 3,586 GPs (877 foreign companies) are left with no further corporate group and therefore themselves are considered as a VC firm. We have 4,443 VC firms in total.

4 Local Government Guidance Funds

Information on local GGF is released on corresponding government websites. As the number of local governments is large and past information might be deleted from the official websites, it is impossible to collect data on all local programs from official sources. Instead, I merge information from Zero2IPO and CVsource, and complement the database with manually collected data.

First, I combine the list of government funds (in general sense) in Zero2IPO and CVSource. Then, I exclude all funds that are co-investment by government and professional financial firms as they are, in essence, son-GGFs. Finally, based on the regulation policy documents, I identify the funds as mother-GGFs if it is stated that one operation form is investment as a LP in son-GGFs. In some cases, Zero2IPO provides the policy documents. If not, I search the Internet and used the information on the corresponding local government websites. I identify 126 mother-GGFs, with 29 at province level, 21 at high-tech industry park level, 46 at city level and 30 at county or district level. I focused on the 93 mother-GGFs that are of a scale of more than or equal to 100 million RMB as the disclosure of small scale mother-GGFs might be incomplete and biased towards more open local governments.

Appendix C Supplement Figures and Tables

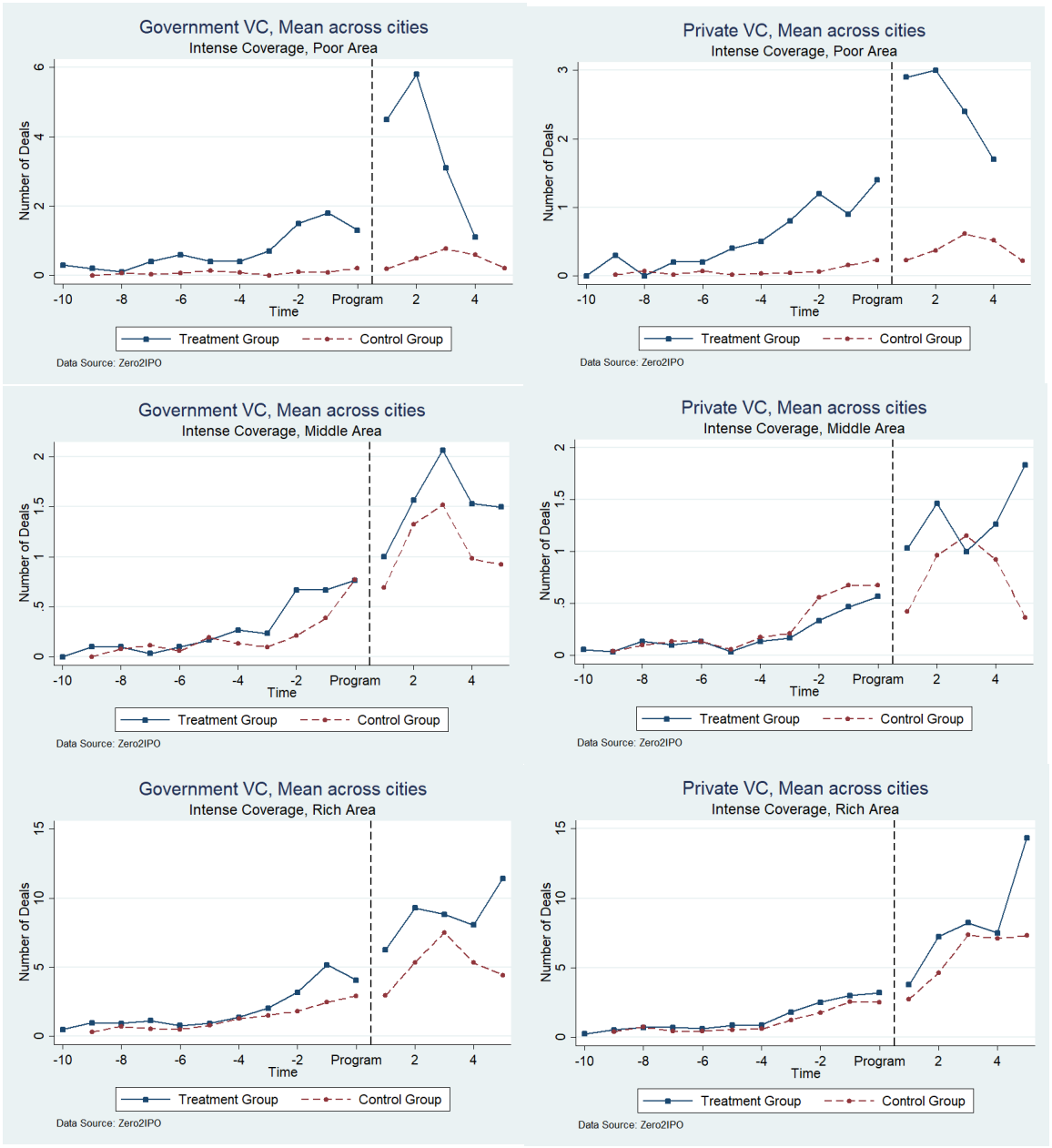

Figure C1: This figure, from top to bottom, includes plots on number of deals invested by VCs in "poor", "middle", and "rich" regions. Cities are grouped into "poor", "middle", and "rich" regions based on a series of indicators on economic development and innovation policies during 1999-2006. Within each group, cities that are located in provinces that are included intensively in the IFVC Program are in the treatment group and other cities are in the control group. Plots on the left are about government VCs and plots on the right are about private VCs. In each plot, the dots are the mean value of the number of deals across cities in each group, with blue solid line for the treatment group and red dashed line for the control group. There is a vertical dashed line between the policy document announcement year (program year) and one year after the program year.

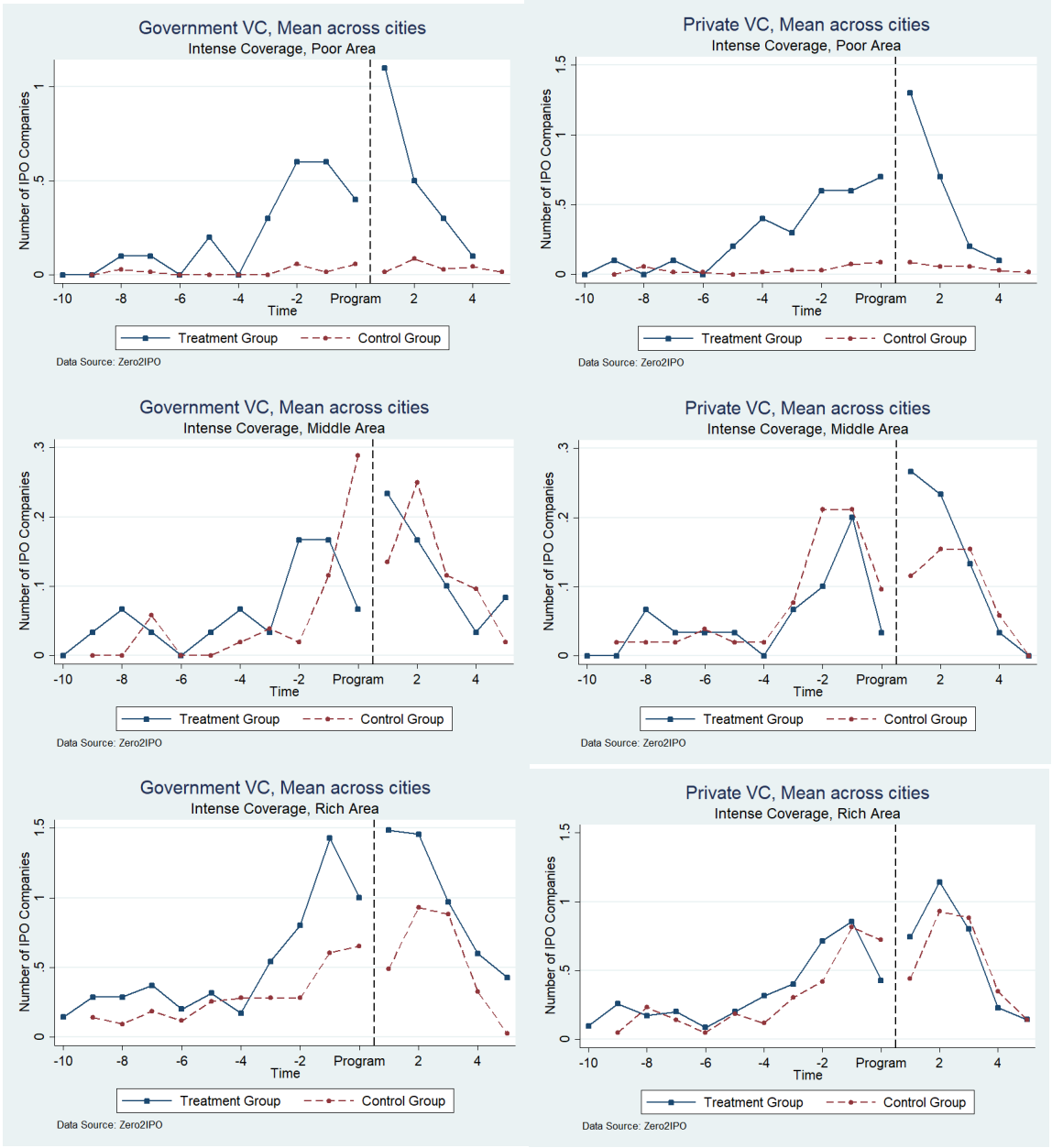

Figure C2: This figure, from top to bottom, includes plots on number of deals invested by VCs that eventually exit through IPOs in "poor", "middle", and "rich" regions. Cities are grouped into "poor", "middle", and "rich" regions based on a series of indicators on economic development and innovation policies during 1999-2006. Within each group, cities that are located in provinces that are included intensively in the IFVC Program are in the treatment group and other cities are in the control group. Plots on the left are about government VCs and plots on the right are about private VCs In each plot, the dots are the mean value of the number of deals that exit through IPOs across cities in each group, with blue solid line for the treatment group and red dashed line for the control group. There is a vertical dashed line between the policy document announcement year (program year) and one year after the program year.

Table C1 Government Guided Fund Programs

This table presents information on government guided fund (GGF) programs during 2001-2013 in China. Panel A summarizes information on the number of GGF participant certifications issued to investors in each province during 2008-2013. Panel B summarizes information on the number of local GGFs (of a 100 million RMB scale or larger) established and the establishment year of the first GGF in each province during 2001-2013. Panel C summarizes information on the number of funds and the number of portfolio companies invested in by the IFVC Program in each province during 2008-2013. Provinces are arranged from north to south and from coast to inner area. The data is consolidated from the *Ministry of Science and Technology*, *Zero2IPO*, and *CVSourc*e.

Panel A: Venture Capital Government Guided Fund Participant Certifications

Province	Number of Certifications					
	2008	2009	2010	2011	2012	2013
Liaoning	3	1		1	1	
Jilin	4					1
Heilongjiang	2			1	1	2
Beijing	18	5	4	3	2	5
Tianjing	6	1	1			2
Hebei	6			1		1
Shandong	5		2	1	6	6
Jiangsu	26	20	20	27	25	26
Zhejiang	9	2	4		8	4
Shanghai	20	3	5	2	6	19
Fujian	2	3		4	2	3
Guangdong	18	3	3	3	5	12
Hainan	1	1	1			
Hubei	16	4	2	4		7
Hunan	2	2	4		1	6
Jiangxi	3					1
Anhui	5		1	1	1	4
Shanxi	2		1			2
Henan	3		1		1	
Neimenggu	2			1		
Shaanxi	3		1	6		2
Yunnan	2	1		1		
Guizhou	1				1	1
Sichuan	6	2	2		2	5
Chongqing	8	1	1	3	1	4
Guangxi						
Gansu	2					
Ningxia			1			1
Qinghai						1
Xinjiang	2	1	1	1	1	
Tibet						
Total	177	50	55	60	64	115

Table C1 (continued)

Panel B: Local Venture Capital Government Guided Funds

Province	First Year	Number of GGFs 2001	2006	2007	2008	2009	2010	2011	2012	2013
Liaoning	2012								2	
Jilin	2010						1			
Heilongjiang	2010						1			
Beijing	2001	1	1		1			2	1	1
Tianjing	2001	1								
Hebei	2009					2				
Shandong	2009					1	1	1	1	
Jiangsu	2006		1	1	1	2	2	5	6	2
Zhejiang	2008				4	2	1	1	1	1
Shanghai	2006		1	1			2	1	1	1
Fujian	2009					1				
Guangdong	2008				1	1	1	2	1	
Hainan	2011							1		
Hubei	2008				2				2	1
Hunan	2010						1		1	
Jiangxi	NA									
Anhui	2009					3		2		1
Shanxi	NA									
Henan	2010						1		1	
Neimenggu	2009					1				
Shaanxi	2008				1			1		1
Yunnan	2009					1		1		
Guizhou	2011							1	2	1
Sichuan	NA									
Chongqing	2008				1	1				
Guangxi	2012								1	1
Gansu	NA									
Ningxia	NA									
Qinghai	NA									
Xinjiang	NA									
Tibet	2012								1	

Table C1 (continued)

Panel C: The National InnoFund Venture Capital (IFVC) Program

Province	Number of Funds						Number of Companies				
	2008	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Liaoning											
Jilin		1							1	5	1
Heilongjiang											
Beijing			1			3			3	1	3
Tianjing			1			1					
Hebei						1					1
Shandong	1				2	2	1	2	3	2	1
Jiangsu	2	1	1	4	5	3	2	5	14	6	4
Zhejiang		2				1	1	4	6	3	1
Shanghai	1	1	2	3	1	1	1	6	7	3	7
Fujian		1	1			1			1	1	1
Guangdong			2	1	1	1		3	4	4	4
Hainan											
Hubei	1		2		1	1	3	7	7	5	1
Hunan				1	2					2	
Jiangxi						1					
Anhui	1					1	1	1	2	1	
Shanxi											
Henan											
Neimenggu											
Shaanxi				1					1	1	
Yunnan											
Guizhou			1			1		1		2	
Sichuan		1	1			2		3	2	1	2
Chongqing		1		1				5	5	5	
Guangxi											
Gansu											
Ningxia											
Qinghai						1					
Xinjiang											
Tibet											

Table C2 Robustness Checks: Impacts of Government Guidance Fund Programs on Venture Capital

Panel A: All 31 provinces, 1999-2013, including minority regions, city level												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID
Dependent Variable	Gov Fund		Private Fund		Gov Deal		Private Deal		Gov IPO		Private IPO	
IFVC Inclusion	1.25***	0.86**	6.23**	5.76*	3.15**	2.13**	2.60*	1.98*	0.35***	0.16**	0.24***	0.13**
	(3.19)	(2.15)	(2.01)	(1.74)	(2.57)	(2.02)	(1.94)	(1.69)	(3.44)	(2.37)	(3.54)	(2.54)
Local Programs	0.52***	0.24	1.75*	0.98	1.21***	0.45**	1.08**	0.35**	0.18***	0.07*	0.13***	0.03
	(2.63)	(1.48)	(1.71)	(1.02)	(3.00)	(2.33)	(2.48)	(2.31)	(3.49)	(1.87)	(3.57)	(1.28)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
City FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	5070	5070	5070	5070	5070	5070	5070	5070	5070	5070	5070	5070
Adjusted R^2	0.084	0.352	0.041	0.266	0.041	0.605	0.023	0.498	0.038	0.561	0.028	0.541
Panel B: 26 provinces (exclude Tibet, Gansu, Niangxia, Qinghai, Xinjiang), 1999-2013, city level												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID
	Gov Fund		Private Fund		Gov Deal		Private Deal		Gov IPO		Private IPO	
IFVC Inclusion	1.28***	0.92**	6.45**	6.54*	3.17**	2.45*	2.61*	2.32*	0.35***	0.20**	0.23***	0.16***
	(3.14)	(2.07)	(1.99)	(1.75)	(2.50)	(1.96)	(1.88)	(1.68)	(3.34)	(2.50)	(3.32)	(2.66)
Local Programs	0.52**	0.31*	1.73	1.16	1.19***	0.57**	1.06**	0.49*	0.17***	0.07*	0.12***	0.04
	(2.55)	(1.71)	(1.63)	(1.08)	(2.93)	(2.27)	(2.42)	(1.95)	(3.39)	(1.97)	(3.45)	(1.51)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
City FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	4035	4035	4035	4035	4035	4035	4035	4035	4035	4035	4035	4035
Adjusted R^2	0.083	0.336	0.041	0.253	0.039	0.592	0.022	0.479	0.035	0.560	0.025	0.541

Table C2 (continued)

Panel C: All 31 provinces, 1990-2014, city level												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID
	Gov Fund		Private Fund		Gov Deal		Private Deal		Gov IPO		Private IPO	
IFVC Inclusion	1.31***	0.95**	6.52**	6.19*	3.35***	2.41*	2.78**	2.12	0.38***	0.20**	0.27***	0.15***
	(3.21)	(2.10)	(2.00)	(1.71)	(2.59)	(1.92)	(1.98)	(1.49)	(3.52)	(2.31)	(3.73)	(2.62)
Local Programs	0.53***	0.38*	1.78*	1.36	1.29***	0.76**	1.15**	0.68*	0.19***	0.10**	0.14***	0.06**
	(2.67)	(1.92)	(1.72)	(1.22)	(3.02)	(2.17)	(2.46)	(1.87)	(3.58)	(2.32)	(3.66)	(2.20)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
City FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	7152	7152	7152	7152	7152	7152	7152	7152	7152	7152	7152	7152
Adjusted R^2	0.092	0.249	0.045	0.174	0.047	0.388	0.027	0.310	0.044	0.383	0.034	0.370
Panel D: 31 provinces, 1999-2013, province level												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID	COR	DID
	Gov Fund		Private Fund		Gov Deal		Private Deal		Gov IPO		Private IPO	
IFVC Inclusion	13.13***	5.90***	58.74***	35.09**	34.11***	13.24***	26.02**	9.29*	9.21***	3.31***	6.76***	2.47**
	(4.93)	(2.89)	(2.77)	(2.38)	(3.85)	(3.54)	(2.66)	(1.97)	(3.88)	(4.35)	(4.00)	(2.54)
Local Programs	6.52***	2.67**	20.31***	10.54	15.22***	5.38***	12.92**	4.07**	4.27***	1.63**	4.27***	1.73***
	(4.11)	(2.05)	(4.72)	(1.61)	(4.54)	(2.91)	(2.74)	(2.23)	(5.96)	(2.42)	(5.37)	(3.09)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
City FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	465	465	465	465	465	465	465	465	465	465	465	465
Adjusted R^2	0.541	0.767	0.383	0.617	0.380	0.819	0.241	0.700	0.400	0.792	0.371	0.735

Table C2 (continued)

Panel E: 26 provinces (exclude Tibet, Gansu, Niangxia, Qinghai, Xinjiang), 1999-2013, province level

	(1) COR	(2) DID	(3) COR	(4) DID	(5) COR	(6) DID	(7) COR	(8) DID	(9) COR	(10) DID	(11) COR	(12) DID
	Gov Fund		Private Fund		Gov Deal		Private Deal		Gov IPO		Private IPO	
IFVCInclusion	13.01***	5.84***	58.62**	35.13**	33.35***	13.04***	25.35**	9.44*	9.00***	3.19***	6.56***	2.52**
	(4.87)	(2.81)	(2.76)	(2.41)	(3.78)	(3.55)	(2.59)	(2.01)	(3.82)	(4.33)	(3.89)	(2.67)
Local Programs	6.52***	2.63**	20.35***	10.68	14.97***	5.17**	12.69**	4.05**	4.20***	1.57**	4.22***	1.67***
	(4.04)	(2.06)	(4.66)	(1.57)	(4.58)	(2.77)	(2.73)	(2.11)	(5.99)	(2.32)	(5.41)	(3.01)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
City FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	390	390	390	390	390	390	390	390	390	390	390	390
Adjusted R^2	0.535	0.763	0.379	0.618	0.368	0.823	0.229	0.701	0.388	0.797	0.360	0.738

Note: The table shows the regression results of impact of government guided fund programs. Columns (1)-(4) are about fundraising, columns (5)-(8) are about VC investments, and column (9)-(12) are about VC investment performance. Panels differ in the sample coverage. Panels A-C is a city × year panel and Panels D, E is a province × year panel. The data in Panel A convers 338 cities during 1999-2013. The 338 cities include the 298 cities in the sample of Table 2 plus the 40 minority regions. The data in Panel B covers 269 cities during 1999-2013. Cities in provinces Tibet, Gansu, Niangxia, Qinghai, Xinjiang are excluded in the sample. The data in Panel C covers 298 cities during 1990-2013. Controls are reduced to *Experience Private*, *Experience Gov*, *GDP* and *GDP Growth Rate* due to data limitation. The data in Panel D covers 26 provinces during 1999-2013. The data in Panel E covers 31 provinces during 1999-2013. Dependent variables, independent variables and other control variables and their definitions are the same as in Table 2. *t* statistics in parentheses and standard errors are clustered at city/province level. ∗, ∗∗ and ∗∗∗ indicate significance at the 0.1, 0.05 and 0.01 levels.

Table C3 Robustness Checks: Policy Experimentation and Heterogeneous Impacts, Define Early Trials as Treatment Groups

	(1)	(2)	(3)	(4)	(5)	(6)
	Poor		Middle		Rich	
	Gov Fund	Private Fund	Gov Fund	Private Fund	Gov Fund	Private Fund
Treatment×Post	0.72***	2.35**	-0.71	-6.29	0.43	2.12
	(2.69)	(2.03)	(-1.01)	(-1.34)	(0.39)	(0.31)
Treatment	0.00	-0.07	-0.13*	-0.86***	1.40***	6.28***
	(0.13)	(-0.92)	(-1.81)	(-2.87)	(4.29)	(4.17)
Post	0.02	-0.18	0.74	4.49	1.10	8.20*
	(0.22)	(-0.45)	(1.48)	(1.12)	(1.41)	(1.93)
Local Programs	-0.12*	-0.57**	0.23	0.84**	0.30	1.41
	(-1.80)	(-2.05)	(1.65)	(2.10)	(1.05)	(0.85)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1200	1200	1230	1230	1170	1170
Adjusted R^2	0.143	0.114	0.147	0.133	0.295	0.228
	(1)	(2)	(3)	(4)	(5)	(6)
	Poor		Middle		Rich	
	Gov Deal	Private Deal	Gov Deal	Private Deal	Gov Deal	Private Deal
Treatment×Post	1.59**	1.09***	-0.24	0.20	-2.53	-5.04
	(2.49)	(3.06)	(-0.28)	(0.36)	(-0.70)	(-0.99)
Treatment	0.13	0.08	-0.09	-0.17	5.59***	6.94***
	(1.02)	(1.61)	(-0.37)	(-0.86)	(3.31)	(3.42)
Post	0.10	-0.26	0.81*	0.20	4.68*	5.94*
	(0.36)	(-1.36)	(1.87)	(0.78)	(1.87)	(1.75)
Local Programs	-0.29*	-0.13	0.13	0.27	0.20	-0.20
	(-1.95)	(-1.27)	(0.90)	(1.47)	(0.48)	(-0.51)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1200	1200	1230	1230	1170	1170
Adjusted R^2	0.145	0.176	0.095	0.068	0.488	0.467
	(1)	(2)	(3)	(4)	(5)	(6)
	Poor		Middle		Rich	
	Gov IPO	Private IPO	Gov IPO	Private IPO	Gov IPO	Private IPO
Treatment×Post	0.18**	0.17*	-0.13	0.03	0.14	-0.04
	(2.44)	(1.79)	(-1.30)	(0.54)	(0.71)	(-0.27)
Treatment	0.05**	0.06**	-0.01	-0.04	0.30	0.41***
	(2.18)	(2.45)	(-0.31)	(-0.81)	(1.18)	(3.01)
Post	-0.08	-0.14*	0.11**	0.03	0.15	0.08
	(-1.23)	(-1.81)	(2.06)	(1.02)	(1.12)	(0.75)
Local Programs	-0.04	-0.01	0.03	-0.04*	0.09	0.02
	(-1.53)	(-0.30)	(1.34)	(-1.92)	(1.26)	(0.45)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1200	1200	1230	1230	1170	1170
Adjusted R^2	0.073	0.068	0.055	0.021	0.305	0.412

Note: The table shows regression results of the impact of government guidance fund programs in "poor", "middle" or "rich" regions, using “early trials” to define the treatment. cities that locate in provinces that are included as early trials in the IFVC Program are in the treatment group and other cities are in the control group. Dependent variables, independent variables and control variables and their definitions are the same as in Table 4. *t* statistics in parentheses and standard errors are clustered at city level. ∗, ∗∗ and ∗∗∗ indicate significance at the 0.1, 0.05 and 0.01 levels.

Table C4 Policy Experimentation, Pooled sample of All Regions

Panel A: Regions intensively included in IFVC as treatments						
	(1) Gov Fund	(2) Private Fund	(3) Gov Deal	(4) Private Deal	(5) Gov IPO	(6) Private IPO
Treatment×Post	0.97*	4.74	2.01*	1.79	0.07	0.06
	(1.90)	(1.31)	(1.77)	(1.31)	(0.78)	(0.82)
Treatment	-0.15	-1.14**	-0.81	-1.08	-0.00	-0.03
	(-1.39)	(-2.04)	(-0.91)	(-1.16)	(-0.03)	(-0.27)
Post	0.33	2.47	0.83	1.09	-0.05	-0.07
	(1.14)	(1.52)	(1.15)	(1.14)	(-0.89)	(-1.56)
Local Programs	0.33	1.22	0.56*	0.30	0.11**	0.06**
	(1.61)	(1.12)	(1.95)	(1.47)	(2.23)	(2.00)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3600	3600	3600	3600	3600	3600
Adjusted R^2	0.186	0.136	0.248	0.232	0.168	0.197
Panel B: Regions included as early trials in IFVC as treatments						
	(1) Gov Fund	(2) Private Fund	(3) Gov Deal	(4) Private Deal	(5) Gov IPO	(6) Private IPO
Treatment×Post	0.79**	3.27	1.86**	1.80*	0.18**	0.19**
	(2.06)	(1.19)	(1.97)	(1.65)	(2.20)	(2.47)
Treatment	-0.19**	-1.25**	-1.19	-1.30*	-0.12	-0.09
	(-2.21)	(-2.33)	(-1.60)	(-1.70)	(-1.11)	(-0.90)
Post	0.24	2.16	0.45	0.64	-0.11*	-0.13**
	(0.88)	(1.33)	(0.75)	(0.79)	(-1.86)	(-2.56)
Local Programs	0.32	1.24	0.57**	0.31	0.11**	0.05*
	(1.54)	(1.12)	(2.02)	(1.57)	(2.22)	(1.81)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3600	3600	3600	3600	3600	3600
Adjusted R^2	0.184	0.133	0.249	0.232	0.171	0.200

Note: The table shows regression results of the impact of government guidance fund programs for a pooled sample of all regions. Panels A and B differ in terms of how the treatment group is defined. For Panel A, cities that are located in provinces that are included intensively in the IFVC Program are in the treatment group and other cities are in the control group. For Panel B, cities that are located in provinces that are included as early trials in the IFVC Program are in the treatment group and other cities are in the control group. Dependent variables, independent variables and control variables and their definitions are the same as in Table 4. *t* statistics in parentheses and standard errors are clustered at city level. ∗, ∗∗ and ∗∗∗ indicate significance at the 0.1, 0.05 and 0.01 levels.

Table C5 Supporting Certification as an IV

	(1) #. of Corporate LPs	(2) #. of Corporate LPs	(3) #. of Corporate LPs	(4) #. of New Corporate LPs	(5) #. of New Corporate LPs	(6) #. of New Corporate LPs
Certification1	-0.27			-0.55*		
	(-0.83)			(-2.51)		
Certification2		0.42			0.05	
		(0.52)			(0.07)	
Certification3			-0.36			-0.14
			(-1.52)			(-0.85)
Fund Size	0.12	-0.05	0.11	0.04	-0.03	0.03
	(1.91)	(-0.31)	(1.57)	(0.94)	(-0.25)	(0.70)
Fund Life	-0.05**	-0.03	-0.04*	-0.03**	-0.03	-0.03
	(-3.13)	(-1.47)	(-2.15)	(-3.10)	(-1.70)	(-1.92)
Province×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1125	215	910	1125	215	910
Adjusted R^2	0.075	0.316	0.063	0.158	0.304	0.160

Note: The table shows the correlation between certification and the number of corporate LPs for funds in which government LP and their co-LP of a corresponding network distance do not invest. Columns (1)-(3) report results of the number of all corporate LPs in the fund and columns (4)-(6) report results of the number of new corporate LPs in the fund. To have a more comparable sample, the sample in all columns is a subsample of a restricted sample of funds: funds in which government LPs' co-LPs of a network distance three or two invest but government LPs do not invest. But for each column, the sample excludes funds co-LPs of a network distance corresponding to that of the certified LP invest. i.e., the sample of column (1) is the restricted sample, the sample of column (2) is the restricted sample, excluding funds in which co-LPs of a network distance of two invest, and the sample of column (3) is the restricted sample, excluding funds in which co-LPs of a network distance of three invest. The same for columns (4)-(6). Variable definitions are the same as in Table 8. *t* statistics in parentheses. ∗, ∗∗ and ∗∗∗ indicate significance at the 0.1, 0.05 and 0.01 levels.

Table C6 Spillovers through LP Co-Investment Networks, Corporate LPs, VC Level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Number of Corporate LPs				Number of New Corporate LPs			
Gov1	7.04***	23.33***			3.02***	11.12***		
	(8.33)	(11.33)			(5.83)	(10.14)		
Gov2	3.69**		7.38***		1.65*		3.51***	
	(2.79)		(10.80)		(2.03)		(8.05)	
Gov3	6.59*			-3.12	5.59***			-4.06
	(2.56)			(-1.00)	(3.54)			(-1.49)
VC Age	0.90***	0.41***	0.20***	0.32***	0.52***	0.24***	0.12***	0.25***
	(9.20)	(3.48)	(4.28)	(3.65)	(8.66)	(3.90)	(4.08)	(3.31)
VC Capital	2.77***	2.36***	0.84***	3.28***	1.26***	1.02***	0.42***	2.58***
	(25.40)	(18.06)	(6.14)	(9.70)	(18.82)	(14.70)	(4.82)	(8.77)
Observations	2218	1983	1491	1346	2218	1983	1491	1346
Adjusted R^2	0.325	0.234	0.140	0.060	0.221	0.169	0.080	0.036

Note: The table shows the results of LP co-investment network transmission about the number of corporate LPs on the VC level. Variable definitions are the same as in Table 8. *t* statistics in parentheses. ∗, ∗∗ and ∗∗∗ indicate significance at the 0.1, 0.05 and 0.01 levels.