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How Do State-Owned and Private-Owned CVC Differ in Nurturing Innovation in China?

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Abstract: We investigate how state-owned corporate venture capital differs from privately owned corporate venture capital in fostering innovation among startups. Based on the data of Chinese A-share listed companies and the startups in their portfolios that they invested in between 2009 and 2018, we find that startups backed by state-owned corporate venture capital are less innovative than startups backed by privately owned corporate venture capital. Using a two-stage least-squares analysis yields the same results. Further, we find evidence consistent with two potential mechanisms: Investors of state-owned corporate venture capital provide weaker technical support and are less tolerant of failure. These results have important implications for stakeholders, management, and policy makers who care about incentivizing young and rapidly growing companies to innovate more effectively.

Keywords: state-owned corporate venture capital; privately owned corporate venture capital; startups; firm innovation; China

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1. Introduction

Corporate venture capital (CVC) is a minority investment in startups by an established non-financial company (Huang and Madhavan 2021; Bae and Lee 2021; Dushnitsky and Yu 2022). Due to the unique knowledge of the corporate parent and the almost unlimited (at least initially unrestricted) life span of the fund, CVC can provide stronger technical support for startups and have a higher tolerance for startup failures. Thus, compared to independent venture capital (IVC), CVC is more effective in nurturing innovation, which is an important engine for firm sustainable development (Khan et al. 2022; Johansson et al. 2021). Using data from developed markets, much empirical research conducted by scholars has supported these views. For example, Chemmanur et al. (2014), Alvarez-Garrido and Dushnitsky (2016), Kim and Park (2017), Park and Bae (2018), Shuwaikh and Dubocage (2022) examined the distinctions between CVC- and IVC-backed startups in the U.S. market and found that CVC performs better in facilitating knowledge transfer between parent and portfolio companies and fostering innovation.

These aforementioned studies have focused on the role of CVC in promoting innovation in developed markets, but in some emerging markets, such as China, the second largest venture capital market in the world, the studies are scarce. In a number of emerging markets, state-owned enterprises (SOEs) are also heavily invested in venture capital. Under the policy directive to enhance innovation, acquire cutting-edge technologies, and expand their markets, SOEs are also very active in venture capital. According to our statistics, nearly half of the listed SOEs in China have made venture capital investments until 2021. Drawing a clearer picture of whether and how state ownership in CVC facilitates or hinders startups' innovating activities may provide better guidance not only for potential investors in later investment stages but also for policy makers who consider innovation to be the ultimate source of sustainable growth of the economy.

In this paper, we examine the differences between state-owned and privately owned CVC in nurturing innovation. Chemmanur et al. (2014) and Wang et al. (2019) proposed two possible underlying economic mechanisms (technical support and tolerance for failure) through which CVC may nurture innovation more effectively than IVC. According to their research, we contend that state-owned CVC (SCVC) and privately owned CVC (PCVC) foster startup innovation differently. First, from the perspective of technical support, startups lack the resources to pursue innovation, so they rely heavily on outside investors to provide innovation resources. SOEs are frequently accused of suffering from a severe agency problem and a lack of incentives to pursue market-driven, efficiency-based innovative activities, resulting in a low level of innovation capacity (Zhou et al. 2017). Hence, we assume that SCVC provides weaker technical support for startups than PCVC does.

Second, from the tolerance for failure perspective, innovation is a complex and risky activity. Thus, the optimal way to motivate innovation is to show tolerance for failure in the short-term and provide rewards for success in the long-term (Manso 2011; Tian and Wang 2014). The loss of state assets is a vital concern for SOE managers, causing them to avoid certain high-risk endeavors. This indicates that SCVC has a lower tolerance for failure than PCVC, which is extremely detrimental to the innovation of portfolio companies. Combining the aforementioned two points, we hypothesize that the role of SCVC in fostering innovation is weaker than that of PCVC.

Based on the data of Chinese A-share listed companies and their startup portfolios from 2009 to 2018, we find that SCVC-backed startups are less innovative than PCVC-backed startups. The findings are consistent with two possible interpretations: the inferior capacity of SCVC to foster innovation (nurturing effect) and to identify and select startups with higher innovation potential (selection effect). To distinguish between these two effects, we employed a two-stage modeling procedure. Our results indicate that SCVC has a significant nurturing effect on startup innovation.

Further, we examine the two possible underlying mechanisms through which SCVC may foster innovation less effectively than PCVC. First, we find that the innovation performance differences between SCVC- and PCVC-backed startups are greater for entrepreneurial firms operating in the same industry as the CVC's parent company. This is consistent with the superior technological expertise of PCVC, which enables firms to better assist the R&D projects of entrepreneurial firms and advise these firms (technical support hypothesis). Second, we find that PCVC firms are more tolerant of failure than SCVC enterprises and that the failure tolerance of CVC investors positively influences the innovation output of portfolio firms. The evidence suggests that greater tolerance for failure is an additional important mechanism that enables PCVC to nurture innovation more effectively than SCVC.

The contributions of this paper are as follows: First, it contributes to the empirical literature on CVC. Studies comparing the differences between CVC and IVC have found that CVC plays a more significant role in promoting innovation in startups (Chemmanur et al. 2014; Alvarez-Garrido and Dushnitsky 2016, Kim and Park 2017; Park and Bae 2018; Shuwaikh and Dubocage 2022). Based on the CVC parent firm's ownership in emerging markets, we divide CVC into PCVC and SCVC and explore the different roles PCVC and SCVC play in fostering innovation. Second, our study extends the existing empirical literature on SOE innovation. Although previous research has found that SOEs perform less well than private firms in terms of innovation (Zhou et al. 2017), our study finds that SOEs are less effective at fostering stakeholder innovation. This suggests that SOEs' shortcomings in innovation will spill over from themselves to their portfolio firms. Third, our study provides evidence for the failure tolerance hypothesis. The failure tolerance hypothesis is a novel theory proposed by Manso (2011) to explain the drivers of firms' long-term innovation. By using the data on failed projects, Tian and Wang (2014) developed a novel method for measuring failure tolerance and provide evidence for this hypothesis. Based on their method, our study on CVC provides additional evidence for this hypothesis.

The rest of this paper is structured as follows. Section 2 lays out the research by constructing a sample of data and a list of variables. Section 3 presents the empirical findings. Section 4 investigates the potential mechanism, followed by Section 5 which concludes the paper.

2. Research Design

2.1. Data and Samples

China is the world's second-largest venture capital market. Large established companies are increasingly entering the venture capital market. Initially, these corporate investors were mostly private companies. Later, the Chinese government recognized the positive role of CVC in fostering innovation and launched a series of policies encouraging SOEs to participate in venture capital. According to the statistics provided by the PEdata database, nearly one-third of China's listed companies had made venture capital investments by the end of 2021, with SOEs and private companies accounting for 36% and 64%, respectively.

Although the venture capital investment and firm innovation data are available up to 2020, we need to set aside at least two years so that companies being funded have sufficient time to apply for patents and obtain grants. As a result, this study examines a sample of first-round startups that received CVC funding between 2009 and 2018. To determine CVC's ownership, we limit CVC's parent to Chinese A-share listed companies. The following are the data collection and filtering procedure: First, we obtain the list of A-share listed companies in 2009–2018 from the CSMAR and screen out all companies in non-financial and non-real estate sectors. Second, we use the PEdata database to identify startups that these companies have invested in. Third, for startups that have received two or more rounds of direct investment from corporate venturers, we keep the first round as our observations. After excluding startups with missing or incorrect data, we obtain the final sample consisting of 896 startups invested by CVC.

2.2. Variables

2.2.1. Firm Innovation

Patents are a common indicator of corporate innovation, particularly for non-publicly traded startups. Patents granted portray innovation better than patent applications submitted because the number of granted patents provides a more valid measure of the novel invention that is externally validated through the patent examination process (Griliches 1994). Thus, following prior research (Wadhwa et al. 2016), we use the number of patents granted within 2 years of receiving CVC investment (year t to $t + 2$) to assess firm innovation. Given the time lag between a patent's application date and its granting, we use the application date to assign granted patents.

2.2.2. Corporate Venture Capital Type

The ownership of the CVC parent company determines whether a company is an SCVC or a PCVC. CSMAR provides the ownership type of all Chinese A-share listed companies. Based on this information, we define CVC whose parent company is an SOE as an SCVC and assign a value of 1, whereas CVC whose parent company is a privately owned enterprise is denoted as PCVC and takes the value of 0.

2.2.3. Controls

Following previous research, we construct the following set of factors that influence firm innovation: (1) CVC reputation is defined as the total number of IPO firms in which CVC has invested over the last five years. (2) We define CVC experience as the total number of firms invested by CVC in the previous five years. (3) We calculate eigenvector centrality to assess CVC status over the last five years. (4) CVC age is defined as the year between the first CVC investment and the focal investment round. (5) If CVC is the syndication's lead investor, CVC lead equals 1, otherwise, it equals 0. (6) The total number of investors in the focal round is used to calculate syndicate size. (7) We define firm age as the year between the firm's inception and the primary investment round. (8) We next define past innovation as the total number of patents held by a company prior to receiving CVC funding. (9) Finally, we use Tian's (2011) method to calculate the geographic distance between a startup and its CVC investor. At the lead VC investor level, we also include industry- and year-fixed effects and cluster standard errors.

Table 1 presents the definitions of all the variables.

Table 1. Definitions of variables.

Variables	Definition
patent	The number of patents granted within two years of receiving CVC investment
SCVC	A CVC whose parent company is an SOE is referred to as an SCVC and this variable is assigned to a value of 1; a CVC whose parent company is a privately owned enterprise is denoted as PCVC and this SCVC dummy takes the value of 0
CVC reputation	The total number of IPO firms in which CVC has invested over the last five years.
CVC experience	The total number of firms invested by CVC over the last five years
CVC status	The eigenvector centrality of CVC over the last five years
CVC age (years)	Time in years from the first CVC investment to the focal investment round
CVC lead	If a CVC is the syndication's lead investor, the value takes 1, and 0 otherwise.
syndicate size	The total number of investors in the focal round
firm age (years)	The time in years from the firm's inception and focal investment round
past innovation	The total number of patents held by a company prior to receiving CVC funding
geographic distance (km)	Following Tian's (2011) method, we calculate the geographic distance between a startup and its CVC investor

2.2.4. Statistical Method and Estimation

Since our dependent variable is a count variable, we use negative binomial regression, which can be defined as follows:

$$P(patent = k|u, \delta) = \frac{\Gamma(\delta + k)}{\Gamma(\delta)\Gamma(k+1)}\left(\frac{\delta}{\delta + u}\right)^{\delta}\left(\frac{u}{u+\delta}\right)^{k}, k = 0,\ 1,\ 2, \ldots \quad (1)$$

We set u in Equation (1) to take the following specification:

$$u = exp(\beta_0 + \beta_1 SCVC + \sum_{i=1} \gamma_i CONTROL_i + INDUSTRY + YEAR + \varepsilon), \quad (2)$$

By using this setup, we can model the probability of having k number of patents obtained by a startup using SCVC participation as a predictor. If we hold the industry and year effect as well as all other controls in Equation (2) unchanged, SCVC jumping from 0 to 1 would increase or reduce an average startup's patent granting rate by e^{β_1}.

3. Empirical Results

3.1. Descriptive Statistics

Table 2 reports descriptive statistics of our base sample. As can be seen from the table, an average startup has about four to six patents, but the variation across different startups is very high. This indicates the importance of identifying a range of possible determinants, including our proposed state ownership of the startup's CVC. Other startup-level variables seem to be much less dispersed in our sample. Turning to CVC characteristics, around 32.7% of startups have SOE participation in funding. Moreover, those CVC firms vary moderately in terms of reputation, experience, status, age, and leadership. Finally, a mean of 550 km distance between an average startup and its CVC soothes our concern, to some extent, about the existence of local bias in venture investment.

Table 2. Summary statistics.

Variables	Mean	Std	Min	Max	N
patent	4.327	9.029	0.000	122.000	954
SCVC	0.327	0.469	0.000	1.000	954
CVC reputation	2.052	5.420	0.000	32.000	954
CVC experience	1.552	5.253	0.000	213.00	954
CVC status	1.632	3.985	0.000	54.542	954
CVC age (years)	0.286	0.452	1.000	22.000	954
CVC lead	0.121	0.326	0.000	1.000	954
syndicate size	2.001	2.547	1.000	18.000	954
firm age (years)	3.476	3.584	1.000	21.000	954
past innovation	5.964	10.134	0.000	214.000	954
geographic distance (km)	552.254	757.324	1.231	3032.941	954

3.2. Regression Analysis

The number of patents is the dependent variable. To avoid a skewed distribution and losing observations with zero patents, we add one to the actual values before calculating the natural logarithm. Subsequently, we use ordinary least squares regression to compare the differences in innovation between SCVC- and PCVC-backed companies, as shown in Table 3. In Model 1, the coefficient for SCVC is negative and significant ($\beta = -0.255$, $p < 0.01$), implying that SCVC-backed firms are less innovative than PCVC-backed ones. This result is consistent with Zhou et al. (2017), who argue that SOEs are less innovative than private firms in China. This result also provides evidence for Yang et al. (2015), who argue that SOEs are not as interested in high-risk projects as private firms.

Table 3. The innovation differences between SCVC-backed and PCVC-backed firms.

Variables	Model 1 (Firm Innovation)
SCVC	−0.255 *** (−3.14)
CVC reputation	0.094 *** (3.85)
CVC experience	0.006 (1.38)
CVC status	0.136 *** (2.88)
CVC age	−0.012 (−1.00)
CVC lead	0.247 ** (2.05)
syndicate size	0.127 * (1.79)
firm age	0.032 (1.41)
past innovation	0.451 *** (4.94)
geographic distance	0.054 *** (2.77)
industry fixed effect	YES
year fixed effect	YES
Adj. R^2	0.14
N (firms)	954

Note: t-statistics in parentheses; ***, **, and * indicate 0.01, 0.05, and 0.1 significance, respectively.

3.3. Two-Stage Least Squares Analysis

Although the preceding difference in innovation between SCVC-backed and PCVC-backed firms appears to be caused by SCVC's ability to promote innovation less effectively, our baseline results could also be attributed to the selection effect, implying that SCVC may have inferior selection abilities to identify entrepreneurial firms with high innovation potential.

To deal with selection effects, we use a two-stage modeling process. In the first stage, we use a Probit model to estimate the likelihood of an SCVC firm selecting a startup at the time of initial investment. First, we change the timing to capture control variables. Rather than using the year following the first round of funding, as we did in the second-stage equation, we take one year before startups raise their first round of funding, because the factors in this year are more influential in whether an SCVC or PCVC should be included. Second, we include an instrument variable in our initial equation. Many studies argued that the availability of CVC funding influences the likelihood of firms obtaining CVC funding, but there is little evidence that the general availability of CVC funding increases a particular venture's post-funding rate of innovation. Therefore, they use the availability of CVC funding as an instrumental variable when comparing the nurturing effects of CVC and IVC (Alvarez-Garrido and Dushnitsky 2016). Following this logic, we introduce the availability of SCVC funding as an instrument variable in the first-stage equation. The total amount of SCVC funding invested in firms in focal industries for a given year, reflecting the supply of SCVC funding at a given time, is defined as the availability of SCVC funding. We believe that the availability of SCVC funding influences the likelihood of firms receiving SCVC funding but has little impact on the firm's post-funding innovation.

In the second stage, we predict post-funding rates of innovation using negative OLS, including all control variables and the first-stage model's Inverse Mill's ratio (λ).

Table 4 summarizes the results of the first stage, estimating the likelihood of receiving SCVC funding. We discover that our instrument is functionary and strong. Moreover, the availability of SCVC funding is both positive and significant (β = 0.341, $p < 0.05$). This result is consistent with the findings of Alvarez-Garrido and Dushnitsky (2016).

Table 4. First-stage Probit model: the likelihood of a firm receiving SCVC funding.

Variables	Model 2 (SCVC)	Model 3 (SCVC)
availability of SCVC funding		0.341 ** (2.33)
CVC reputation	−0.012 * (−1.90)	−0.009 ** (−2.04)
CVC experience	0.112 (1.42)	0.124 (1.45)
CVC status	−0.124 *** (−2.83)	−0.146 *** (−2.90)
CVC age	−0.012 ** (−2.19)	−0.016 ** (−2.22)
CVC lead	−0.300 (−0.99)	−0.321 (−1.21)
syndicate size	−0.009 (−1.01)	−0.024 (−1.28)
firm age	0.109 *** (2.72)	0.106 *** (2.69)
past innovation	0.059 * (−1.89)	−0.101 (−1.44)
geographic distance	0.125 *** (3.21)	0.135 *** (3.14)
industry fixed effect	YES	YES
year fixed effect	YES	YES
Pseudo R^2	0.22	0.23
N (firms)	954	954

Note: z-statistics in parentheses in Model 2; t-statistics in parentheses in Model 3; ***, **, and * indicate 0.01, 0.05, and 0.1 significance, respectively.

Table 5 summarizes the results of the second stage, estimating firm innovation. Model 4 incorporates the estimated Inverse Mill's ratio from the first stage analysis into Model 1. After controlling for this effect, we derive the relationship between SCVC and firm innovation in Model 4 from the nurturing effect of the SCVC investor. The coefficient for the Inverse Mill's ratio is negative but not significant ($\beta = -0.151$, $p > 0.1$), whereas the coefficient for SCVC is negative and significant ($\beta = -0.197$, $p < 0.05$), which means PCVC investors have a superior ability to nurture their portfolio firms' innovation compared to SCVC investors. In terms of control variables, CVC reputation ($\beta = 0.084$, $p < 0.01$), CVC status ($\beta = 0.136$, $p < 0.05$), CVC lead ($\beta = 0.247$, $p < 0.01$), past innovation ($\beta = 0.399$, $p < 0.01$), and geographic distance ($\beta = 0.065$, $p < 0.01$) are positively related to firm innovation. This result is consistent with Zhou et al. (2017) and Yang et al. (2015).

Table 5. Second-stage OLS model: innovation of startups.

Variables	Model 4 (Firm Innovation)
SCVC	−0.197 ** (−2.41)
CVC reputation	0.084 *** (3.02)
CVC experience	0.006 (1.55)
CVC status	0.136 ** (2.41)
CVC age	−0.013 (−1.23)
CVC lead	0.247 *** (2.75)
syndicate size	0.180 (1.49)
firm age	0.101 (1.42)
past innovation	0.399 *** (4.74)
geographic distance	0.065 *** (2.79)
inverse Mill's ratio (λ)	−0.151 (1.23)
industry fixed effect	YES
year fixed effect	YES
Adj. R^2	0.14
N (firms)	954

Note: t-statistics in parentheses; *** and ** indicate 0.01 and 0.05 significance, respectively.

4. Possible Mechanisms

So far, our empirical findings show that SCVC is worse than PCVC at nurturing innovation, but we still do not know what economic mechanisms allow PCVC to perform better. In the preceding section, we proposed two possible mechanisms (technical support and tolerance for failure), which we examine in this section to gain a better understanding of the reasons for the differences between the two types of CVC.

4.1. Technical Support

Because startups lack resources to pursue innovation, they rely heavily on outside technical support for innovation (Fulghieri and Sevilir 2009). The greater the external technical support, the more favorable the environment for firm innovation. Existing research indicates that one important reason why CVC investors are better at fostering innovation than IVC is that CVC can provide firms with greater technical support (Chemmanur et al. 2014;

Alvarez-Garrido and Dushnitsky 2016; Kim and Park 2017; Park and Bae 2018; Shuwaikh and Dubocage 2022).

In contrast to private enterprises, SOEs are frequently accused of having a severe agency problem and a lack of incentives to pursue market-driven, efficiency-based innovative activities, resulting in a low level of innovation capability (Zhou et al. 2017). We argue that because of SOEs' low level of innovation ability, they can only provide weak technical support for firm innovation.

Chemmanur et al. (2014) and Wang et al. (2019) found that entrepreneurial firms that are in close proximity to the CVC parent's technological expertise (technological fit) may benefit more from outside technical support. By extension, if SCVC's shortcomings in fostering innovation are indeed caused by their weak technical support, we predict that the gap between the nurturing effects of SCVC and PCVC will be larger when CVC and portfolio firms are technologically compatible.

This section empirically examines whether technological fit would amplify SCVC's negative impact on firm innovation. Following Chemmanur et al. (2014) and Wang et al. (2019), we define a technological fit dummy that equals one if the CVC parent and portfolio firm are in the same industry and zero otherwise. The PEdata database provides industry classification information.

The results of the interactive effect of CVC type and technological fit are shown in Table 6. Model 5 extends Model 4 by incorporating the interaction between CVC type and technological fit. In Model 5, the coefficient for SCVC is negative and significant ($\beta = -0.185$, $p < 0.05$), whereas the coefficient for SCVC × technological fit is negative and significant ($\beta = -0.278$, $p < 0.05$). Based on the findings, we conclude that the technical support hypothesis can explain the difference in innovation between SCVC portfolio firms and PCVC portfolio firms, which is consistent with the technical support hypothesis proposed by Chemmanur et al. (2014).

Table 6. Test of technical support hypothesis (second-stage OLS model).

Variables	Model 5 (Firm Innovation)
SVC	−0.185 ** (−2.25)
SCVC × technological fit	−0.278 ** (−2.38)
technological fit	0.145 *** (3.24)
Inverse Mill's ratio (λ)	−0.204 (1.33)
control variables	YES
industry fixed effect	YES
year fixed effect	YES
Adj. R^2	0.14
N (firms)	954

Note: t-statistics in parentheses; *** and ** indicate 0.01 and 0.05 significance, respectively.

4.2. Tolerance for Failure

Innovative endeavors require a greater tolerance for failure due to the unpredictability and uniqueness of the innovation process. Manso (2011) found that the optimal contract to motivate innovation is to tolerate failure in the short-term and reward success in the long-term when constructing a mathematical model to derive the innovation incentive problem. Meanwhile, Chemmanur et al. (2014) developed a novel measure of venture capital investors' failure tolerance and empirically found that a high level of failure tolerance is advantageous for firm innovation. According to the empirical findings of Tian and Wang (2014), CVC investors are more tolerant of failure than IVC investors, which is one of the primary reasons why CVC firms foster innovation better than IVC firms. Based on the earlier findings, we hypothesize that if SCVC and PCVC have different tolerance for failure, this will result in differences in how they nurture innovation.

There is a significant reason why SCVC has a lower failure tolerance than PCVC. The agency theory posits that managers in SOEs are unwilling to pursue high-risk activities due to the absence of incentives (fixed salaries and corporate bonuses). As a result, they are content to just fulfill administrative mandates (Freund 2001). If SOE managers engage in a high-risk activity that ultimately fails, they may be accused of contributing to the loss of state assets, which is a serious issue for SOEs. In addition, the managers' salaries could be reduced, their professional reputations could be harmed, and they could even lose their jobs. In contrast, managers of private companies are compensated based on their performance. Although failure would be detrimental to their interests, they are incentivized to increase their tolerance for failure so as to maximize profits. In summary, insufficient incentives make SCVC less tolerant of failures than PCVC.

To test this hypothesis, we examine the failure tolerance of SCVC and PCVC to determine whether the former is truly lower.

Consequently, how can investor failure tolerance be measured? Manso (2011) demonstrated that the degree of tolerance for failure is partially reflected in the principal's choice of project termination time. A principal with a high tolerance for failure will choose a threshold below the ex post optimal level, encouraging agents to innovate. Tian and Wang (2014) expanded on Manso's (2011) research. They found that the duration of VC investment in ultimately failed projects is negatively correlated with the choice of termination threshold and positively correlated with failure tolerance. Hence, they used the 10-year average duration of VC investment in ultimately failed projects to measure CVC's tolerance for failure. We utilized this measurement as well.

Table 7 reports the comparison results of failure tolerance between SCVC and PCVC. In Panel A, the univariate results reveal that the mean and median differences in the failure tolerance measure are negative and statistically significant. In Panel B, we estimate the effect of CVC type on their failure tolerance using regression analysis. We use CVC reputation, CVC experience, CVC status, CVC age, CVC industry expertise (CVC's expertise in certain industries measured by its industry concentration), and CVC stage expertise (CVC's expertise in certain developmental stages of the venture) as controls. The coefficient for SCVC is negative but significant ($\beta = -0.104$, $p < 0.1$), suggesting that SCVC is indeed less failure tolerant than PCVC. Both Chemmanur et al. (2014) and Tian and Wang (2014) found that the failure tolerance of VC investors has a positive effect on firm innovation. Combining their findings with ours, we can conclude that the failure tolerance hypothesis can explain the difference in innovation between SCVC's and PCVC's portfolio companies.

In summary, our tests of potential mechanisms indicate that SCVC has less industry knowledge and is less tolerant of failure, both of which can be used to explain why SCVC is less effective at fostering firm innovation.

Table 7. Test of tolerance for failure hypothesis: second-stage OLS model: innovation of startups.

Panel A: The Difference in Failure Tolerance between SCVC and PCVC (Univariate Analysis)			
	Failure Tolerance of SCVC	**Failure Tolerance of PCVC**	**Difference**
Mean	2.221	2.649	−0.428 ***
Median	2.103	2.377	−0.274 **
Panel B: The Difference in Failure Tolerance between SCVC and PCVC (Regression Analysis)			
Variables		**Model 6 (CVC Failure Tolerance)**	

Table 7. *Cont.*

SCVC	−0.104 ** (2.11)
CVC reputation	0.219 *** (3.02)
CVC experience	0.012 * (1.78)
CVC status	0.013 *** (3.45)
CVC age	−0.143 (−1.37)
CVC industry expertise	−0.154 (−0.49)
CVC stage expertise	0.302 ** (2.40)
industry fixed effect	YES
year fixed effect	YES
Adj. R^2	0.10
N (firms)	684

Note: t-statistics in parentheses; ***, **, and * indicate 0.01, 0.05, and 0.1 significance, respectively.

5. Conclusions and Discussion

5.1. Summary of Findings

We investigate how SCVC differs from PCVC in fostering startup innovation. Based on the data of Chinese A-share listed companies and the portfolio startups they invested in between 2009 and 2018, we find that SCVC-backed startups are less innovative than PCVC-backed startups. These results hold when using two-stage least squares analysis, which suggests that PCVC investors have a superior ability to foster innovation in their portfolio firms compared with SCVC investors. Moreover, we find evidence consistent with two possible mechanisms: SCVC investors provide weaker technical support and are less tolerant of failure. While our work adds to the literature by highlighting the potential adverse effects of government participation—demotivating startups to innovate—the importance of our work can be more realized in the process of designing and implementing schemes for promoting innovation, especially for new business ventures. Innovation lies at the heart of a startup, and our paper suggests policies should be made for SCVC-backed startups to introduce stronger technological support and increase their threshold for utilizing the method of trial and error.

5.2. Implication of the Study

Our findings have some implications for startup managers and policy makers. For managers of startups, when seeking external CVC financing, managers should prioritize PCVC over SCVC. If the PCVC investor has a high tolerance for failure, or if its parent company is in the same industry as the startup, it is even more important to let it make investments. For policy makers, SCVC investors are less effective in fostering innovation due to the low failure tolerance and poor technological capabilities of their parent company. Therefore, policy makers should continue to deepen reforms of SOEs. For example, policy makers should enhance the compensation incentives of SOE managers to improve SOEs' failure tolerance and innovation capabilities.

5.3. Limitations

Concerning the limitations of the present study, we may suffer from sample selection bias and interventions from other factors that drive startups' innovative activities. Due to the relative sparsity of specialized datasets on Chinese CVC deals, we find it difficult to extend our results to a larger sample of investing companies. It is not possible in our sample to further distinguish between the impact of CVC with different objectives, i.e., strategic vs. non-strategic, and the extent to which the corporate investor and the startup are connected at the level of operation. To give an example of potentially omitted influencing factors, most CVC parent firms invest in many startups to maximize the benefit of the so-called portfolio effect. However, this study focuses on the public vs. private identity of the CVC parent and may ignore the effect of portfolio-induced resource distribution on startup innovations.

5.4. Future Research Directions

This paper implies several directions for future research. On the one hand, follow-up studies can conduct an in-depth analysis of technological innovation and value creation in the early stage of invested startups. The reason is that the innovation motive and pattern are distinctive at this stage. There may be hundreds of ideas coming up, but more than 80% of them may not work, while only one or two have practical prospects. Therefore, a very important job in the early stage of a startup is to make a choice among many ideas and innovative inventions, which is crucial for the development of the company thereafter. On the other hand, future research can also compare the flexibility of R&D and patents in small firms to large ones, which are often bound by many constraints when it comes to strategic technology choices and transitions.

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