Article

Do Venture Capital Firms Play as Supportive Mentors or Free-riders? Evidence from China

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ABSTRACT

This paper aims to investigate whether Venture Capital Firms in China play as active investors, who seize to provide the funded entrepreneurial firms monitoring assistance and value-adding service for the performance enhancement, or just act as passive investors, who care little about the growth of the funded firms but the opportunity of freeriding on the IPO process to gain fast and huge economic rents. Utilizing the panel data of listed companies on the Chinese SME Board, this paper employs the PSM methodology and the panel regression models with random effect to control the sample selection bias, and disentangle VC firm's ex-ante screening effect from the ex-post effect. The analysis reveals that Venture Capital firms are able to select the entrepreneurial firms with superior performance before the first round of VC investment, but fail to enhance the development of funded ventures after the involvement. Although the venture backed firms present the performance superiority over the non-venture backed peers overall, this difference is just attributed to VC firm's ex-ante screening effects. VC firms do not demonstrate the ex-post value-adding effect, rather to some extent they even exert hampering effect on the performance of funded firms after the investment was made.

INTRODUCTION

I**N THE ENTREPRENEURIAL** setting, small and medium sized enterprises often face severe financial constraints and find it difficult to raise capital from commercial banks or stock markets. Different from the traditional financial intermediaries, Venture Capital firms mainly make equity investments in the unlisted venture firms with big prospect of furfure success. In this context, VC investments are regarded to be one of important financing channels for the start-ups, which also involve with rather high level of risks under the circumstance of information asymmetry. Regarding the role of VCs in the performance of entrepreneurial firms, a lot of researches based on the mature VC industry of developed economy prove that VC firms usually not only alleviate the financing constraints for funded venture enterprises, but also attach great importance to the post-investment monitoring activities and assistance in developed countries[1, 2]. In such mechanism, the VC investments are considered to greatly help enhance the intrinsic value and foster the professionalization of venture firms. Therefore, nowadays, the corporate venture capital often utilize its advantages of rich managerial expertise, financial resources etc. to provide investee firms with a great variety of value-adding services in aspects of human resources, strategic planning, external market development and social resource network and so on[3-5]. Van den Berghe and Levrau (2002) concludes VC firms' top four of most important roles to be "sounding

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board", "financier", "business advisor" and "mentor/coach" during the life cycle of the funded company[6].

In the mid-1980s, Chinese central government began to initiate VC programs, hoping to spur the commercialization of the innovative technologies. With the stimulation of the favorable policies from the government, along with the rapid development of market economy and continuous improvement of institutions, the VC industry has experienced tremendous changes in China. With the successive operation of the Small and Medium Enterprise (SME, hereafter) Board in 2004 and ChiNext board in 2009, the exit channels of VC investment are broadened. In 2008, the IPO lock-up period for institutional shareholders such VC/PE firms in the stock exchange is reduced from three years to one year (Humphery and Suchard, 2013)[7]. All these favorable policies have greatly stimulated the development of China's VC market. In 2010, the total amount of VC investment in China reached US$5.4 billion, becoming the second largest venture capital market in the world since then (Liu and Chen, 2014)[8]. According to Zero2IPO statistics, from 2002 to 2014, the total amount of venture capital in mainland China increased year by year, with the average annual compound growth rate of 14.4%. In 2014, the total amount of VC investment increases into $ 15.5 billion in 2014.

Whereas, due to the short history of VC industry, and the transitional market mechanism and underdeveloped institutional environment, China's VC industry presents different characteristics from western countries. Unlike the West venture capitalists focusing on investing in innovative high-tech small ventures firms, VC firms in China tend more to invest in entrepreneurial firms at expansion, maturity stages[9]. The weak intellectual property protection and limited legal recourse, lead to that the financing the start-ups with the advantage of high-tech innovation might face higher level of systemic risks than in the western mature markets [10]. The highly administrated Chinese stock market with abnormal high IPO issue price and secondary market price has driven the VC investors to overwhelmingly engage in the short-term Pre-IPO projects, which make Chinese VC investments look more like private equity investments, requiring little efforts in advising and monitoring the portfolio companies. Under such unique circumstance of legal infrastructure and institutional mechanisms, whether the VC investors in the emerging market of China also exert positive impact on the growth of entrepreneurial enterprises like a mentor or just act as a free-rider on the IPO process of investee firms is a pending question. To answer this question, we need to disentangle the impact of VCs' pre-investment screening activities from the incremental impact of VCs' post-investment monitoring and value-adding service. In other words, do VC investors just select firms with better quality and growth potential before the investment was made or offer valuable and supportive service to nurture the development of funded firms after the investment was made?

LITERATURE REVIEW

The academic world has not drawn consistent conclusion on the impact of VC investments on the performance of entrepreneurial firms. Some researchers advocating positive impact of VC investments highlights two important functions of VC firms, namely the pre-investment screening abilities and the post-investment monitoring abilities. Baum (2004) emphasizes that VCs can play roles as pre-investment "scouts" good at identifying promising venture firms, but also roles of post investment "coaches" in providing management expertise and network contacts to the startup in the same direction[11]. During the pre-investment selection process, VC investors are recognized as specialized investors, who are able to utilize information resources to decrease these information asymmetries in the potential investee firms, better than other financial intermediaries[12][13][14]. In the context of high risks and strong information asymmetries, VC investors do not invest in the industry and the venture firm randomly, rather they usually spend a significant amount of time and effort collecting private information during the pre-investment screening process and aim at searching for the most promising industries and best-quality venture firms with superior financial performance, more advanced technology and greater growth potential[15]. In addition, during the post-investment management, VCs often take initiatives to closely monitor their portfolio companies' operation, such as taking membership on the board of directors along with concentrated equity positions, retaining significant ownership and economic rights to control the agency risk and enhance the probability of future success (Barry et al, 1990)[16]. The intensive ex-post monitoring activities of VC investors might also help the respective funded firms use their resources more efficiently[17, 18]. More than that, VCs will also play the "coach" or "mentor" role in providing a variety of professional value-adding services. Being selected by a VC firm usually means the assurance to the financial resources and other value-adding resource such as managerial resources, the network recourse, and VC's social capital[12, 19, 20]. It is because of the screening and monitoring effects, the VC investment conveys the signal of better quality to the capital market, resulting in reducing the IPO underpricing of VC backed firms, which is also known as the "certification" effect of VC investments[12]. The corporate venture capital can be considered as "insider" investor holding more internal

information of the funded enterprise. With involvement in the business management of ventures, they can thus play the third-party certification role of proving the true value of issue, so as to effectively reduce the issuing costs (underwriting fees, IPO underpricing)[12, 13].

However, there are also scholars challenging the "screening and monitoring" hypothesis, and prove the insignificant or negative impacts of VC investment on the performance of entrepreneurial enterprises. Due to the inherent uncertainty of the information asymmetry in the entrepreneurial context of, it will be difficult for the venture capitalists assess accurately entrepreneur's ability, and therefore tend to price the deal based on the average level of enterprises in the market, resulting that less profitable ventures started by less capable entrepreneurs will seek external participation of VC. The severe hazard and adverse selection problems consequently lead to that VC invest in companies in need (frog-kissing) rather than in best performing ventures (cherry-picking), for the best performing ventures will self-select out of the market for VC[21][22]. Besides, the reduction of uncertainty and ambiguity can also leads to substantial transaction costs, which VCs might transfer to their funded firms' post investment. The conflict can arise between the venture capitalist and the entrepreneurial firms during the post-investment period[23]. New ventures might face different organizational goals from VC firms when receiving VC financing, resulting VC's interference in the goals and policies of the entrepreneurial firms, which is likely to produce negative outcomes[22, 24]. The VC investors might be interested in maximizing the overall value of their own in short perspective, and pressure the entrepreneurs to pursue strategies that benefit their own exit-oriented interest, but are not necessarily beneficial for the funded firms[25]. In this regard, a prominent critique comes from Gompers (1996) and known as the grandstanding argument[18], which holds that the reputation is crucial for the fundraising ability and development of VCs, and younger VCs firms may have greater incentives to grandstand and bring IPOs to market earlier at the bigger listing cost, in order to establish a reputation and raise a new fund within a short, predetermined time. VCs take their funded firms to IPOs prematurely to hastily realize the significant exit values even at the cost of higher IPO underpricing and underwriting premium, even through window dressing, which will be harmful for the long-run performance of funded firms. The negative impacts of VC investments are verified by many researchers from the emerging markets. Wang et al. (2003) used the panel data of companies listed on the stock exchange of Singapore (SES) from 1987 to 2001 to verify the certification/monitoring and adverse selection/grandstanding models[26]. The results confirmed the existence of adverse selection and certification effects of VC investment in the Singapore context, for that compared with the non-venture-backed companies, the venture-backed companies listed have lower IPO underpricing rate but exhibit inferior post-IPO operational performance in terms of net income and return on total assets. Lee and Wahal (2004) verified the existence of grandstanding hypothesis, by investigating the role of VC backing in the underpricing of IPOs between 1980 and 2000[27]. After using instruments correlated with this endogenous choice to control for selection bias, the estimations show that VC-backed firms have higher IPO underpricing rates ranging from 5.0% to 10.3% over the entire sample period, compared to non VC-backed IPOs. Supporting the adverse selection hypothesis, Tan et al. (2013) used a matched sample on the companies listed on the Small and Medium-Sized Enterprises Board in China to empirically test the effect of venture capital investment and find out that compared with their non-venture-backed counterparts, venture-backed firms are associated with a greater level of IPO underpricing and inferior operating performance both before and after IPO[10]. He pointed out that under the underdeveloped legal infrastructure and institutional environment, the incentive of VC investments are "encouraged" to invest in mature ventures to avoid the systematic risks and seek the huge returns at the exit of investment in a short time, thus consequently neither add value to their invested firms in the initial public offering (IPO) process nor improve operating performance. The ownership structures of entrepreneurial firms are also found to influence the effectiveness of venture capitalists' monitoring roles, and the severe agency conflict between controlling and minority shareholders hamper the incentive of VCs' monitoring and value-adding activities[28].

From abovementioned, we can see that the impact if VC investment on the performance of entrepreneurial firms is still controversial. Moreover, the role differentiation (ex-ante screening and ex-post monitoring roles) of VC firms in the pre-investment and post-investment phases, have stimulated the debate in the academic world, concerning with the potential endogenetiy problem caused by sample selection bias in the past studies of VCs' effect. Specifically, the outperformance of VC backed entrepreneurial firms could not be explained just by the ex-post impact of VC investment. Due to VC firms' ex-ante screening ability, those venture firms selected by VC firms are with better internal quality in terms of technology, financial performance etc. before the initial VC financing, which will probably continue to present such advantages of development after the entry of VC investment. Whether the superior performance of funded ventures should be attributed to their own inherent better quality, or the post-investment monitoring and supportive efforts by VC firms remains

a question. To tackle reverse causality problems between VC and firm performances Chemmanur (2011) and Croce, Marti and Martinu (2012) committed to further deepening the empirical study of VC investment mechanism and effects, but draw different conclusions. Chemmanur (2011) proved that VC backing present positive impact on the efficiency of private firms in the United States and the efficiency improvement are both because of VCs' screening and monitoring roles, based on financial data of manufacturing firms in the United States[29]. Croce, Marti and Martinu (2013) revealed that unlike VC investors of in the US VC market, European VC firms do not exhibit positive screening effect, but have the imprinting value-adding effect on the productivity growth of entrepreneurial firms[1].

This article aims to resolve the reverse casualty problem from the sample selection bias, concerning VCs' contribution to entrepreneurial firms in China, where the institutional background, legal infrastructure, and capital market structure are different from industrialized economies. Specifically, we aim to find out whether entrepreneurial firms with venture backing demonstrate the advantage of performance, if so whether the performance difference should be attributed to VC firms' ex-ante screening ability or post-investment monitoring and supportive efforts. Namely, we are going to study the following questions: (1) Do VC-backed firms outperform non-VC-backed firms in terms of *profitability*, and *growth ability*? (2) Do VCs exert the significant positive ex-ante project screening effect and select venture firms with better performance, before the investment was made? (3) Do VCs have value-adding effect on the performance of entrepreneurial firms during the ex-post project management phase? (4) To what extent, does the performance difference between the venture-backed firms and non-venture backed firms come from the ex-ante effect or ex-post effect of VC firms?

This paper offers the following three contributions both from a scholarly viewpoint and a policy perspective: First, this study extends the studies of VCs' effect from the emerging market, through the systematic empirical estimation of VCs' roles on the performance of entrepreneurial firms in China based on the panel data of both the pre-investment and post-investment financial statements, where the financial and legal systems are distinctly different from those in western developed countries. Second, this paper is the first study concerning VC's effect in China from the perspective of distinguishing the ex-ante effect and ex-post effects of VC to investigate whether the performance difference between venture firms and non-VC backed counterparts is the result of VC firms' pre-investment screening ability or the post-investment monitoring and coaching function. The empirical results will give us a clear and

accurate understanding of the mechanism and features of the VC investment in China. Third, this paper try to explore the application of the two-stage Heckman with switching regressions to tackle the reverse causality problem, which will enrich the solution of endogenetiy problem in the empirical studies.

RESEARCH DESIGN

PSM

To estimate the treatment effect of VC investments and control for sample selection bias, we need to build up the matched sample groups with the same probability of getting funded by the VC firms. We define the treatment group to include firms with VC backing background, and the control group to include firms with non-VC backing background. Using the propensity score matching (PSM) method developed by Rosenbaum and Rubin (1983)[30], we can obtain propensity scores of each firm, defined as "the conditional probability of receiving a treatment given pre-treatment characteristics" by Rosenbaum and Rubin (1983), which measures the extent of matching of the treatment group and the control group in multi-dimensions. The propensity scores are calculated by the logit model (1):

$$P(X_i) = \Pr(Y_{i=1}|X_i) = \frac{\exp(\beta X_i)}{1+\exp(\beta X_i)} \tag{1}$$

where X_i is the multidimensional vector of independent variables which may affect the propensity of firms to be funded by VC investors, and Y is the indicator variable, which equals 1 if a firm get funded by VC and 0 otherwise, exp(.)/[1+ exp(.)] represents the cumulative distribution function of the logic distribution, β is the vector of coefficients. In this paper, we uses four dimensions parameters of industry, location, firm size and firm age to calculate the propensity scores of each sample firm. Based on the estimation of the propensity scores, this article employs the nearest neighbor matching method to search for the closest control sample, both backwards and forwards, according to the estimated propensity scores of the treatment group. $M(i)$ represents the set of control units matched to the ith treatment unit with an estimated value of the propensity score of p_i. Then, the nearest neighbor matching method can be described as follows,

$$M(i) = min\|p_i - p_i\| \tag{2}$$

DATA

In this article, we utilize the panel data of listed companies on the SME Board in China during between 2001 and 2014. By excluding the ST shares, missing data, unclear property rights of listed companies, we get a total number of 680 listed firms as our research samples. We collect mainly from two authoritative financial databases, named WIND and Zero2IPO. WIND offers the detailed financial data of listed entrepreneur firms, such as *roa, roe*, the annual sales growth rate, the annual profit growth rate, the total asset, tangible assets ratio, total assets turnover, the listing year, and industry etc. Zero2IPO offers the detailed information of VC investments, such as the time, amount of each round of VC investment, the characteristics of related VC firms and funded firms. We refer to *the catalogue of VC/PE firms in China* by Zero2IPO and identify 237 listed firms with VC backing background. In order to observe the performance difference between the VC backed firms and non VC backed firms both of pre-investment and post-investment, we delete the VC backed firms which received the first round of VC financing either before 2002 or after 2014. Additionally, for some VC backed firm with incomplete financial information before the first round of VC financing, we check their disclosed prospectus or send out questioners to their management executives for the missing financial data. If the missing information is still not available, we delete such firms from our treated group. Finally we get 205 VC backed firms, which received the first round of VC financing between 2002 and 2010. Then for these 205 venture backed firms, we employ the propensity score matching (PSM) at matching criteria of firm age, firm size, location and industry, to build the control group of non-VC backed firms at the nearest neighboring matching ratio of 1:1. Then we get 205 venture-backed firms and 205 matched non-venture backed firm as our research samples. All the key financial variables, such as *lnzccapital, lnstaffsalary, zzl, lev, lntotalasset, roe, roa, salesgrowth* and *profitgrowth* are winsorized at the 1t and 99h percentiles to avoid the influence of outliers.

MODELS AND VARIABLES

The random effect models for the estimation of VC's overall effect

Firstly, in order to testify the overall effect of VC investments on the operational performances of entrepreneurial firms, we use the panel random effects regression models as shown in equation (3), with Y_{it} the dependent variable to be *roa, roe, salesgrowth* and *profitgrowth* in model1, model2, model3 and Model4 respectively. In this article, the operational performance is estimated in two dimensions, namely, profitability and growth ability. Profitability is measured by return on assets (*roa*) and return on equity (*roe*) of the firm. Growth ability is measured by the annual sales growth rate of the firm (*salesgrowth*) and the annual profit growth rate of the firm (*profitgrowth*). We use *Vc* dummy, the key explanatory variable to distinguish whether the firm is backed by VC investment. The coefficient δ implies the correlation between VC investment and entrepreneurial enterprises' performances. If δ is significantly positive, it implies that the venture backed firms generally present superior performance than the non-venture backed counterparts and VC firms exert positive overall impact on the entrepreneurial firms' performance. The random effect regression models also include fixed firm and year effects that allow us to precisely control for the heterogeneity by the unobserved characteristics among different firms and statistical years. X_{it} include control variables regarding the firm size, asset structure, ownership, location etc. Such as to control the impact of other observable factors of their own characteristics. In all specifications, *i* indexes firms, *t* indexes years, α_i are firm fixed effects, and β_t are year fixed effects. ξ_{it} is a random error term, independent from all of other explanatory variables,

$$Y_{it} = \alpha_i + \beta_t + \lambda X_{it} + \delta Vc + \xi_{it} \qquad (3)$$

The logit models for the estimation of VC's ex-ante effect

Secondly to further examine the impact of VCs' screening effect, we run the logit regressions in equation (4) to make models 5-8, using the cross-sectional data on the firm's performance in the year before the initial VC investment, to determine whether VCs choose to invest in better performing firms. We introduce the unobservable latent variable Y_{it}^*, which is discretized in equation (5). Y_{it}^* is greater than 0, when the dependent dummy variable Y_{it} is equal to 1, indicating that the sample firm has the venture backing background; otherwise, Y_{it}^* is less than or equal to 0, when the dependent dummy variable Y_{it} equals to 0, representing that the sample firm does not the venture backing background. With the explanatory variable Z_{it} being *roa, roe, salesgrowth* and *profitgrowth* respectively in the models 5-8, the coefficient δ is the main interest, which implies the extent of efficiency of VCs' investment choices. If the coefficient δ is significant positive, it implies that the venture backed firms outperformance the non-venture backed counterparts before the VC investment was made and the VC firms have positive screening effect and demonstrate the capacity to

select ventures with better quality. Otherwise, it means the existence of adverse selection effect between the VC investors and entrepreneurial firms in the VC industry. X_{it} includes control variables regarding the firm size, asset structure, ownership, location etc. such as to control the impact of other observable factors influencing the investment decision of VC firms.

$$Y_{it}^* = \alpha_i + \beta X_{it} + \delta Z_{it} + \xi_{it} \tag{4}$$

$$Y_{it} = \begin{cases} 0(Y_{it}^* > 0) \\ 1(Y_{it}^* \leq 0) \end{cases} \tag{5}$$

$$Pr[Y_{it} = 1] = Pr[Y_{it}^* > 0] = Pr[\alpha_i + \beta X_{it} + \delta Z_{it} + \xi_{it} > 0]$$

$$= 1 - F(-\alpha_i - \beta X_{it} - \delta Z_{it})$$

$$= \frac{e^{\alpha_i + \beta X_{it} + \delta Z_{it} + \xi_{it}}}{1 + e^{\alpha_i + \beta X_{it} + \delta Z_{it} + \xi_{it}}}$$

$$Pr[Y_{it} = 0] = Pr[Y_{it}^* \leq 0] = Pr[\alpha_i + \beta X_{it} + \delta Z_{it} + \xi_{it} \leq 0]$$

$$= F(-\alpha_i - \beta X_{it} - \delta Z_{it})$$

$$= \frac{1}{1 + e^{\alpha_i + \beta X_{it} + \delta Z_{it} + \xi_{it}}}$$

The random effect models for the estimation of VC's ex-post effect

To further examine the ex-post value-adding effect of VC investments, we employ the random effects models as shown in equation (6) and introduce another dummy variable $Vcafter$ as well as its interaction term with the dummy variable Vc. $Vcafter$ is equal to 0 for the period before the investment is made and is equal to 1 for the period after the investment is made, as is also benchmarked against that of non-VC backed firms.

$$Y_{it} = \alpha_i + \beta_t + \lambda X_{it} + \delta_1 Vc + \delta_2 Vcafter + \delta_3 Vc * Vcafter + \xi_{it} \tag{6}$$

Same as in equation (3), Y_{it} will be *roa, roe, salesgrowth* and *profitgrowth* in model 9, model 10, mode 11 and model 12 respectively; α_i represents the fixed firm effect; Vc dummy is equal to 1 if the firm has the venture backing ground and is equal to 0 if otherwise. X_{it} includes control variables regarding the firm size, asset structure, ownership, location etc. such as to control the impact of other observable factors influencing the performance of entrepreneurial firms. Additionally, we also include $Vc*Vcafter$ the interaction term of Vc dummy and $Vcafter$, to estimate difference in difference of the effects of VC investment on the performance of entrepreneurial firms. If the coefficient δ_3 is significantly positive, it will indicate that the performance difference between firms with venture backing than those with non-venture

backing background is increased during the post-investment phase. VC has positive value-adding effect to the funded firms during the post-investment management. However, if the coefficient δ_3 is significantly negative, it will indicate that the performance difference is decreased during the post-investment phase, and the involvement of VC investment reduce the performance advantage of venture backed firms, therefore exert the negative and inhibitory effect on the development of funded firms during the post-investment management process. Table 1 summarizes the variables.

The two-stage Heckman and switching regressions for the estimation of VC's ex-post effect

For the robustness tests of the ex-ante screening and ex-post value-adding effects of VC investments, we use two-stage Heckman combined with switching regressions to conduct the following counterfactual analysis: For the VC backed firm, what would the performance be had it not been backed by VC investors instead? For non-VC backed firms, what would the performance be had it been backed by VC investors instead?

The first-stage Heckman regression model, as shown in equation (1), reflects the matching between the VC investor and the investee firm. The dependent variable I_i indicates the outcome of whether the firm is invested by VC, which results from decisions of both the entrepreneurial firm and the VC investor. The dummy I_i equals one if the firm is venture backed and equals zero, otherwise. Z_i contains variables that might matter the decision-making of VC investors, including factors of the firm-level characteristics, including the R&D investment, firm age, firm size, location, industry, the *salesgrowth* and *roe* in the first year before the initial VC investment.

$$I_i^* = Z_i'\gamma + \varepsilon_i \tag{7}$$

$$y_{1i} = x_i'\beta_1 + u_{1i} \tag{8}$$

$$y_{2i} = x_i'\beta_2 + u_{2i} \tag{9}$$

The latent variable I_i^* is discretized as follows:

$I_i = 1 \ iff \ I_i^* > 0$, and $I_i = 0 \ iff \ I_i^* \leq 0$ (10)

The second-stage Heckman regression model, as shown in equation (7) & (8), are performance measuring models for VC backed firms and non-VC backed firms respectively. The dependent variable y_1 is the dependent variable indicating firms' performance, which can be observed conditionally either for VC backed firms or

Table 1: Variable definitions

Variables	Definition and measurement
roa	profit before interest and tax/average total assets
roe	Net income/average net assets
roe_1	The Net income/average net assets in the first year before the VC financing
salesgrowth	year-on-year growth rate of total operating income
Sales_1	The growth rate of total operating income in the first year before the VC financing
profitgrowth	year-on-year growth rate of operating profit
vc	dummy variable: equals 1 if the listed firm is VC-backed; 0 otherwise
vcafter	dummy variable: equals 1 for the period after the VC investment was made; 0 otherwise
lev	The debt to assets ratio, measured by total debt/total asset
lnzccpital	The logarithm of registered capital
lnstaffsalary	The logarithm of staff's salaryl
ΣNaturedmy	The venture firms are divided into 4 categories by the ownership, here we use 3 dummy variables to represent the private firms, state-owned firms, foreign firms, and other kind of firms
ΣProvincedmy	According to the region ranking, we use 7 dummy variables to represent 8 different locations of VCs' distribution
ΣInddummy	For the research samples cover 15 categories of industries, here we use 14 dummy variables to represent the different industry
lntotalassetend	the logarithm of Initial total assets
zzl	Total asset turnover ratio, measured by the operating income/average net assets
lnrdinvestbe_1	The logarithm of the R&D investment in the first year before the VC financing

for non-VC backed firms. The dependent variable y_{1i} in equation (7) can only observed for venture backed firms and its expectation is discretized as follows:

$$
\begin{aligned}
E[y_{1i}] &= E[y_i|I_i = 1] \\
&= E[y_i|I_i^* \le 0] = E\left[X_i'\beta_1 + u_{1i}\middle|Z_i'\gamma + \varepsilon_i \le 0\right] \\
&= X_i'\beta_1 + E[u_{1i}|\varepsilon_i \le -Z_i'\gamma] \\
&= X_i'\beta_1 + g_1\sigma_{1\varepsilon}\left(\frac{\phi(-z_i'\gamma)}{1-\Phi(-z_i'\gamma)}\right) = X_i'\beta_1 + g_1\sigma_{1\varepsilon}\left(\frac{\phi(z_i'\gamma)}{\Phi(z_i'\gamma)}\right)
\end{aligned}
$$

(11)

Similarly, the dependent variable y_{2i} in equation (8) can only observed for non-venture backed firms and its expectation is discretized as follows:

$$
\begin{aligned}
E[y_{2i}] &= E[y_i|I_i = 0] \\
&= E[y_i|I_i^* > 0] = E\left[X_i'\beta_1 + u_{1i}\middle|Z_i'\gamma + \varepsilon_i > 0\right] \\
&= X_i'\beta_1 + E[u_{1i}|\varepsilon_i > -Z_i'\gamma] \\
&= X_i'\beta_1 + g_2\sigma_{2\varepsilon}\left(\frac{-\phi(-z_i'\gamma)}{1-\Phi(-z_i'\gamma)}\right)
\end{aligned}
$$

(12)

where $\sigma_{1\varepsilon}$ is the covariance between u_1 and ε, $\sigma_{2\varepsilon}$ is the covariance between u_2 and ε, ϕ and Φ are the density and cumulative distribution functions of the normal distribution, respectively. The term $\phi(Z_i'\gamma)/\Phi(Z_i'\gamma)$ is called the inverse Mills ratio, representing the unobserved factors influencing the selection of VC financing. Then we conduct the switch regression to estimate the performance difference between the hypothetical performance and the actual performance both for the VC backed firms and non-VC backed firms.

$$
\underbrace{E[y_{2i}|I_i^* > 0]}_{hypothetical} - \underbrace{y_{1i}}_{actual}
$$

(13)

The hypothetical performance for VC backed firms representing the performance would be achieved if they had not been backed by VC investors, which can be computed by the performance measurement mode in equation (8). And if the difference is significantly positive, which will

imply the performance improvement of venture firms are caused by the involvement of VC investors. If the difference is significantly negative, it will imply that VC investors present hampering effects on the performance of venture firms. In the same way, we can also compute the performance difference between the hypothetical performance and the actual performance for non-VC backed firms using the performance measuring model in equation (7). If the difference is significantly positive, which will imply the VC investors have a negative effect; otherwise, the VC investors have positive effects on the performance of entrepreneurial firms.

$$\underbrace{E[y_{1i}|I_i^* \leq 0]}_{hypothetical} - \underbrace{y_{2i}}_{actual} \qquad (14)$$

ANALYSES AND RESULTS

Descriptive Statistics

In this paper, we classify the companies listed on the SME board according to *The Guidance for Industry Classification of Listed Companies* by CSRC (2012 Revision). From table 2, we can see, the listed companies with VC backing overwhelmingly focus on the industries of manufacturing industry, with the percentage accounting for more than 80%. The percentage of VC investments in the information transmission, software and information technology services is only 5.49%. This reveals that unlike the conventional VC investors driven in investing in the high-tech industries (such as Telecommunication, Media, Technology), Chinese VC investors mainly focus on the traditional manufacturing industry, reflecting Chinese VCs' significant motivation of risk aversion.

Table 3 shows about the duration of VC investment before the IPO year of funded firms, the experience of VC firms by the initial VC investment (measured by the average age of the leading VC firms by the year of the first round of VC financing), and the duration of listed firms before IPO. From table 3, we can see that VC firms have only 5.9 years of experience in China's VC industry by the venture firm receiving the first round of VC financing, which implies that VC institutions are quite young and do not have much experience. On the other hand, the average age of funded entrepreneurial firms by the first round of VC financing to be 7.203 years old, which VC investors mainly invest in the firms at the late stage of development rather than invest in the firms at the early-stage of development. The investment duration period of VC firms before IPO is only 3.367 years on average. According to Naqi and Hettihewa (2007), generally

VC investments should have been toward innovative high-tech firms, and long-term investments, lasting for 5-7 years[31]. The difference in the terms of investments reflects the short perspective of Chinese VC investment strategies. Actually VCs especially the domestic private VCs shifted their investment priority to expansion or mature stage, even the Pre-IPO projects in order to gain the fast and huge returns by *free-riding* the IPO of ventures, which will inevitably cause the weakening of the monitoring and supportive role of VCs on the performance of entrepreneur enterprises[10]. On the other hand, for mature firms at the late stage of development, they also do not appreciate too much interference from the outside investors (Pukthuanthong, K and Walker, T, 2007)[32]. The descriptive statistics of variables are shown in Table 4. As is shown in Table 4 the average level of *roa, roe, salesgrowth*, and the *profitgrowth* rate of is 0.111, 0.173, 0.248 and 0.293, respectively.

Empirical Results

From table 5, we can get the regression results of VC's overall effect to the enterprise's performance, and the dependent variables in models 1-4 are *roe, roa, salesgrowth, profitgrowth* respectively. The coefficients of the *Vc* dummy variable are all positive, with the significance level of 0.05 in model 3 and 0.1 in model 1. The *roa,* and *profitgrowth* of venture backed firms is higher by 0.3% and 4.6%, compared with the matched non-venture backed firms, but the difference is not significant. The *roe and salesgrowth* of VC backed firms prove to be significantly higher than those of non-VC backed peers, by 0.76% and 3.17%. Which means that the venture backed firms outperformed than non-venture backed firms both in *roe* and *salesgrowth*. Next we are going to test whether this advantage of performance should be attributed to the ex-post value adding effect or the ex-ante screening effect of VC firms.

Table 6 shows the regression results of logit models using the cross-sectional data of matched samples in the year prior to the first round of VC investment. For our samples in this article, the first round of VC investments occur in between 2002-2010. With the explanatory performance variable to be *roe, roa, salesgrowth, profitgrowth* respectively in model 5-8, we can see that roe, roa, salesgrowth profitgrowth of the firms are all significantly and positively correlated with VC Dummy, with the significance level to be 5% in model 5, 6 and 8, and 0.2 in model 7. The results suggest that firms are more likely to be backed by VCs if they have higher profitability and growth ability. Specifically, an marginal increase in the *roe, roa, salesgrowth, profitgrowth* of the firm (from its mean) increases its

Table 2: The industry distribution of IPO companies dated from 2004–2014

Industry Name (CSRC Industry 2012)	All samples			VC-backed		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Mining industry	6	0.88	0.88	4	1.69	1.69
Real estate industry	9	1.32	2.2	1	0.42	2.11
Construction industry	24	3.53	5.73	8	3.38	5.49
Transport, storage and postal service industry	7	1.03	6.76	1	0.42	5.91
Financial Industry	4	0.59	7.35	1	1.27	7.18
Scientific research and technical service industry	5	0.74	8.09	1	0.42	7.6
Agriculture, forestry, animal husbandry and fishery	13	1.91	10	4	1.69	9.29
Wholesale and retail industry	19	2.79	12.79	6	2.95	12.24
Water conservancy, environment and public facility management industry	7	1.03	13.82	1	0.84	13.08
Industry of culture, sports and entertainment	3	0.44	14.26	1	0.42	13.5
Industry of information transmission, software and information technology services	30	4.41	18.67	8	5.49	18.99
Manufacturing industry	541	79.56	98.23	168	80.59	99.58
Leasing and commercial service industry	7	1.03	99.26	1	0.42	100
Industry of electric power, heat, gas and water production and supply	4	0.59	99.85			
Accommodation and catering industry	1	0.15	100			
Total	680	100	100	205	100	100

Note: The industry classification is according to The Guidance for Industry Classification of Listed Companies by CSRC (2012 Revision)

Table 3: VC's age and the investment term before IPO

	Obs.	Mean	Max	Min	Std.
The leading VC firms' age	205	5.983	0	17	4.843
The VC investment duration before IPO	205	3.367	1	9	2.16
The age of venture firms	205	7.203	0	15	4.162

Note: The VC investment duration is counted by the duration since the first round of VC financing to the date of IPO of the portfolio company. The age of venture firms refers to the age of funded firms at the first round of VC financing

probability of being selected by 0.2451747, 0.8207199, 0.0626101, 0.0242389 respectively. This also means that by due diligence, VC firms have the capacity to screen the firms with better quality. By implementing a set of strict standards during the projects assessments procedures, VCs usually devote as much effort to the ex-ante project selection as possible. The financial performance and technological improvements of entrepreneurial projects are especially valued as the importance key factors when selecting the potential investee firms. The venture backed firms show superior performance in terms of *roe, roa, salesgrowth, profitgrowth* than

Table 4: Summary Statistics of Variables

Variable	Mean	Std.	Min	Max	Obs.
roa	0.120	0.0864	-0.0654	0.446	1717
roe	0.194	0.159	-0.181	0.795	1729
salesgrowth	0.273	0.344	-0.435	1.783	1529
profitgrowth	0.362	1.246	-5.073	6.803	1529
lnzccapital	19.93	0.698	18.58	21.75	2646
lev	0.455	0.206	0.0503	0.914	1737
zzl	0.934	0.533	0.0876	2.818	1730
lntotalasset	20.46877	1.070351	18.09103	23.56322	1737

Table 5: VC's overall effect to the enterprise's performance

	Model 1	Model 2	Model 3	Model 4
	roe	roa	salesgrowth	profitgrowth
lnzccapital	0.0220***	0.0138***	0.0887***	0.214***
	(6.04)	(6.65)	(9.40)	(5.87)
lnstaffsalary	0.00204	0.00134*	-0.0140***	-0.0265*
	(1.19)	(1.38)	(-3.16)	(-1.55)
lntotalasset	-0.0313***	-0.0174***	-0.0243***	-0.146***
	(-8.54)	(-8.31)	(-2.53)	(-3.95)
zzl	0.0832***	0.0534***	0.0856***	0.248***
	(17.77)	(20.12)	(7.03)	(5.27)
lev	0.0818***	-0.113***	0.185***	0.569***
	(6.39)	(-15.48)	(5.52)	(4.37)
vc	0.00761**	0.00303	0.0317***	0.0460
	(1.78)	(1.25)	(2.91)	(1.09)
Fixed firm & year effects	Y	Y	Y	Y
ΣInddummy	Y	Y	Y	Y
ΣProvincedmy	Y	Y	Y	Y
ΣNaturedmy	Y	Y	Y	Y
_cons	0.417***	0.282***	-0.779***	-0.335
	(5.27)	(6.28)	(-3.90)	(-0.43)
N	3798	3777	3448	3448
p	0	0	1.44e-144	6.20e-63

*Note: Standard errors in parentheses * $p < 0.2$, ** $p < 0.1$, *** $p < 0.05$*

peer even before they are detected by the VC "scouts". Together with the result from models 1-4, we can conclude that the outperformance of venture backed firms is partly because of the ex-ante screening effect of VC firms.

The results from above have confirmed that VC-backed firms outperform on-VC-backed firms, and the outperformance partly comes from VC's selection efforts. In this subsection, we examine whether VC firms have devoted the post-investment monitoring and supportive efforts of so as to add value to their portfolio companies. Specifically, we focus on the difference-in-difference estimates of performance of the VC-backed and non-VC-backed firms. As shown in table 6, VCs select and fund firms with better financial performances. To capture the difference-indifference effects, we add *Vc* dummy (wherher it is venture-backed), and the interaction term of *Vc* dummy and *Vcafter* (whether it is before or after the investment) into our models. The coefficient of the interaction term *Vc* vcafter*, is our major interest as we aim to the estimate the difference-in-difference effects of venture investment on performance of the firm. A significantly positive coefficient of *Vc* vcafter* indicates that the difference in difference effect is positive and the performance gap between the venture-backed companies and the non-venture backed companies is enlarged after the involvement of VC. And VC firms have exerted positive value-adding effect on the performance of entrepreneurial firms during the post-investment management process.

Table 7 shows that all dependent variables *roe*, roa, *salesgrowth*, *profitgrowth* are significantly negatively correlated with the interaction term *Vc* vcafter*, indicating that the treatment effect of venture investment on the profitability of the firm is inhibited after the investment is made. The treatment effect is decreased by 3.13% for *roe*, 1.38% for *roa, 10.2% for salesgrowth, and 62.1% for profitgrowth* after the investment is made, respectively. The above estimates suggest that VC-backed firms outperform non-VC-backed firms in terms of profitability and growth ability. However, the performance difference in terms of *roe, roa, salesgrowth, and profitgrowth* between VC-backed and non-VC backed firms are significantly decreased after the venture capital investment is made. To some extent, VC firms exert significant negative effects on the performance of entrepreneurial firms after the investment was made. No evidence demonstrates that VCs add significant value in terms of sales growth and profit growth of the firm. The conclusion is quite the opposite from traditional literatures from western markets such as the US market, and it might because of different characteristics in the regulatory system, capital market structure, cultural and institutional backgrounds.

ROBUSTNESS TEST

In order to test the reliability of the results of the regression models above, we use the two-stage Heckman and switching regressions to control for endogeneity of VC's screening effect. In the first stage regression as shown in table 8 part1, and VC dummy has positive correlation with the variable, which implies that VC investors choose the firms with better performance in roe and sales growth before the VC financing. In the second stage regression, the inverse mills ratios are significantly correlated with the dependent variable *roe*, which implies there exist unobserved factors influencing the matching of VC investors and entrepreneurial firms, which also affect the outcome performance. Controlling the endogeneity of VC screening effects, the results shown in panel B show that: for venture backed firms, the hypothecial performance is higher than the actual performance by 2.77%; and for the non-venture backed firms, the hypothecial performance is significantly lower than the actual performance by 1.89%. The VC investors play hampering effect on the performance of entrepreneurial firms.

DISCUSSION AND CONCLUSIONS

This article studies the contribution of venture capital investment to the performance of entrepreneurial firms in China based on the panel data of listed companies on the Chinese SME Board dated from 2001 to 2014. We use the PSM methodology to build the matched sample groups and employ the logit models, the panel random effect regression models including the interaction term of *Vc* dummy and *Vcafter* dummy and Heckman two stage with switch regression modes to distinguish the effects of the ex-ante screening from the ex-post monitoring/support efforts of VC firms. The analysis results prove that the venture backed firms have performance superiority in terms of *roe, roa, salesgrowth* and *profitgrowth* before the VC financing, but this performance difference is lessened significantly after the involvement of VC firms. Which suggests that the involvement of VC firms exerts inhibitory effects on the financial performance of the funded ventures after the investment was made. VC firms only exert the positive screening effect before the investment was made, by selecting the venture firms with better quality in terms of *roe, roa, salesgrowth* and *profitgrowth*, compared with the non-venture backed firms.

Table 6: VC's screening effect to the enterprise's performance

	Model 5	Model 6	Model 7	Model 8
	vc	vc	vc	vc
roe	1.092***			
	(2.30)			
roa		3.631***		
		(3.58)		
salesgrowth			0.337*	
			(1.40)	
profitgrowth				0.131***
				(2.05)
lnzccapital	0.131	0.133	0.288*	0.285*
	(0.98)	(0.99)	(1.63)	(1.62)
lntotalasset	-1.083***	-1.098***	-1.417***	-1.415***
	(-8.66)	(-8.68)	(-7.88)	(-7.91)
zzl	-0.629***	-0.719***	-0.610***	-0.582***
	(-3.77)	(-4.20)	(-2.86)	(-2.72)
lev	4.247***	5.103***	5.576***	5.408***
	(7.82)	(8.74)	(6.94)	(6.70)
Fixed firm & year effects	Y	Y	Y	Y
ΣInddummy	Y	Y	Y	Y
ΣProvincedmy	Y	Y	Y	Y
ΣNaturedmy	Y	Y	Y	Y
_cons	2.722	2.059	6.886	6.877
	0	0	-0.01	-0.01
N	962	953	661	661
p	6.05E-42	2.01E-43	5.17E-31	1.93E-31

*Note: Standard errors in parentheses * p < 0.2, ** p < 0.1, *** p < 0.05*

Table 7: The Value-adding Effect of VC firms to Enterprise's Performance

	Model 9	Model 10	Model 11	Model 12
	roe	roa	salesgrowth	profitgrowth
vc	0.0310***	0.0134***	0.123***	0.577***
	(4.08)	(3.14)	(5.35)	(6.67)
Vc* vcafter	-0.0313***	-0.0138***	-0.102***	-0.621***
	(-3.99)	(-3.12)	(-4.37)	(-7.06)
lnzccapital	0.0234***	0.0149***	0.0808***	0.191***
	(6.88)	(7.77)	(9.07)	(5.70)
lnstaffsalary	0.00369***	0.00238***	-0.0152***	-0.0152
	(2.31)	(2.65)	(-3.64)	(-0.97)
lntotalasset	-0.0299***	-0.0169***	-0.00752	-0.0922***
	(-8.79)	(-8.79)	(-0.84)	(-2.73)
zzl	0.0806***	0.0522***	0.0964***	0.231***
	(18.33)	(21.11)	(8.33)	(5.30)
lev	0.0764***	-0.116***	0.111***	0.387***
	(6.29)	(-16.90)	(3.47)	(3.20)
Fixed firm & year effects	Y	Y	Y	Y
ΣInddummy	Y	Y	Y	Y
ΣProvincedmy	Y	Y	Y	Y
ΣNaturedmy	Y	Y	Y	Y
_cons	0.349***	0.245***	-1.056***	-1.410***
	(4.88)	(6.11)	(-5.77)	(-2.05)
N	4425	4377	4038	4038
p	0	0	1.46e-167	6.55e-80

*Note: Standard errors in parentheses * p < 0.2, ** p < 0.1, *** p < 0.05*

For entrepreneurial firms, VC firms function more like a free-rider of IPO rather than a mentor, who can provide efficient monitoring and value-adding services. Our conclusions are not consistent with prior studies supporting the monitoring hypothesis based on the data from the mature VC industry. We conjecture that the absence of monitoring effect is caused by the fact that under the underdeveloped economic and institutional environment with deficiencies in the legal system, Chinese venture capitalists have greater incentives to speculate in late stage or pre-IPO investments, seeking for the huge gains in the IPO market as soon as possible. When investees are developed to the late stage of development or a stage of going public, what concerns venture capitalists is no longer the firm's growth potential but the likelihood of a successful public offering. The need for close monitoring and value-adding assistance in this condition is also limited. Besides, the conflicts of goals and strategy policies might also cause negative effects on the performance of entrepreneurs, such as the hasty IPO process urged by VC investors will cause higher level of underpricing and underwriting premium undertaken by the issue firm, which will inevitably be harmful for the long term performance of entrepreneurial firms. Moreover, in the

Table 8: The two-stage Heckman and switching regressions results

Part A: The two-stage Heckman regression				
First stage regression		**Second stage regression**		
Independent Variable: VC dummy		**Independent Variable: roe**		
			VC-backed	**non VC-backed**
Firmage	0.00393	lnstaffsalary	0.002	0.00817***
	-0.48		-0.66	-2.76
lnzccapital	-0.191***	lntotalassetendbc	-0.0540***	-0.0351***
	-0.191***		(-9.64)	(-8.24)
_cons	-5.266	zzl	0.152***	0.112***
	(-0.32)		-14.5	-12.73
Sales_1	1.053***	lev	0.0855***	0.145***
	-5.75		-3.84	-6.74
Roe_1	0.461***	_cons	1.205***	0.676***
	-6.69		-11.18	-7.94
lnrdinvestbe_1	0.0354*	mills	-0.179***	0.0971***
	(1.41)		(-6.36)	-5.29
ΣProvincedmy	Y	ΣProvincedmy	Y	Y
ΣNaturedmy	Y	ΣNaturedmy	Y	Y
ΣInddummy	Y	ΣInddummy	Y	Y
Wald chi2(15)	715.13			
Prob > chi2	0.0000			

Part B: The difference between the hypothetical performance and actual performance			
	The actual roe of VC backed firms	The hypothetical roe of VC backed firms if had not received VC investments	difference
mean	0.209	0.212	0.0027738 (-0.6050)
	The actual roe of non-VC backed firms	The hypothetical roe of non-VC backed firms if had received VC investments	difference
mean	0.183	0.164	-0.0189495***
			(4.2698)

*Note: Standard errors in parentheses * p < 0.2, ** p < 0.1, *** p < 0.05*

lack of expertise and experience in the related industry[9], the undue interference of young VCs might also exert negative influence on the efficacy of decision making of the administrative level of entrepreneurial firms, which consequently produce negative effects on the performance of entrepreneurial firms.

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