Research on Driving Factors of Venture Capital in China -- Evidence from Provincial Panel Data from 2001 to 2019

Xiaoxiao Zhou, Zhou Zhou, Yilin Li

School of Finance, Anhui University of Finance and Economics, Bengbu 233030, China

Abstract. Venture capital is an important factor to promote technological innovation and economic growth. Exploring the influencing factors of venture capital is of great significance to promoting regional high-quality development and enhancing regional comprehensive competitiveness. This paper takes the panel data of various regions in my country from 2001 to 2019 as the research object, and uses the econometric model to study the driving influence factors of venture capital in China. The results show that the level of technological investment, education and government intervention have a significant role in promoting regional venture capital, and environmental regulations have a certain inhibitory effect. Finally, based on the above research conclusions, corresponding suggestions are put forward from the government's perspective.

Keywords: Venture Capital; Ordinary Panel Model; Spatial Panel Model; Multiple Matrix.

1. Introduction

The report of the 19th National Congress of the Communist Party of China clearly stated that innovation is the first driving force for development and the strategic support for the construction of a modern economic system. The innovation process often requires the support of a large amount of funds and is often accompanied by huge risks. Therefore, venture capital is highly risky. The nature of income not only makes it an important source of funds for innovation activities, but also introduces many non-capitalized value-added services for it. In 2020, the scale of China's venture capital investment reached 991.012 billion yuan, and its compound growth rate in the past ten years was as high as 14.07%, demonstrating the strong vitality of the venture capital market. At the same time, 2021, as the first year of China's 14th Five-Year Plan, is an important year for accelerating the transformation of the economy to connotative growth. Venture capital is because it is improving the level of total factor productivity, promoting the advancement of the industrial structure, and improving the supply of ecological technology. The positive role of this aspect has gradually become one of the important engines for the high-quality development of China's economy. Therefore, exploring the driving influence factors of venture capital is of great significance for promoting the high-quality development of the region and enhancing the comprehensive competitiveness of the region.

2. Literature Review and Research Methods

2.1 Literature Review

With the continuous expansion of the scale of venture capital in various countries around the world, many scholars have attracted many scholars to study venture capital, especially in the research on the driving factors of venture capital. A typical example is Masako (2011) who studied the US manufacturing industry and found that innovation can increase The conclusion of venture capital; research shows that government intervention can broaden the sources of venture capital, thereby enhancing innovation capabilities; but László Kállay (2020) through the study of the impact of state intervention on venture capital portfolios, concluded that government intervention in the Hungarian venture capital market caused crowding The conclusion of the effect, which is contrary to the research of Lerner (2010); MOHAMMAD MUSTAFA (2020) and others take the emerging economy India as the research object, and use the vector error correction method to draw a good economic prospect can attract more venture capital. And global liquidity has played a role as a catalyst in this type of

investment; Pezeshkan (2020) and others used fuzzy set qualitative comparisons and combined institutional complementarity and substitution theories to arrive at strong public governance, advanced product markets, and openness to competition. It is a key factor in attracting international venture capital; Fang Jiawen (2017) takes China's urban agglomerations as the research object, and concludes that factors such as the level of economic development have a promoting effect on venture capital; Zhang Yilin (2018) combines environmental support theory, from inductive factors and Compulsory factors build a model from two aspects, and conclude that the more regional innovation resources, the easier it is to form a spatial agglomeration of venture capital; Sun Xiangxiang (2019) and others have established a spatial autoregressive model to study that factors such as government investment in science and technology have contributed to venture capital investment in Guangdong Province Both have a promoting effect; Qiao Qin (2021) and others have found that factors such as the number of national high-tech zones have a promoting effect on regional venture capital, while environmental pollution has an inhibiting effect.

Compared with the existing literature, the contribution of this article is mainly reflected in the following three aspects. First, this article uses panel data from 30 provinces in China from 2001 to 2019 as the research object to conduct a dynamic study on risk investment driving factors; second, this article uses the ratio of industrial wastewater treatment facility operating costs to industrial wastewater discharge and industrial waste gas treatment The three types of data including the ratio of facility operating costs to industrial waste gas emissions and the comprehensive utilization rate of industrial solid waste are calculated by entropy weight method to obtain the intensity of environmental regulation, which effectively extends the depth of measurement. Third, this article innovatively uses three types of spatial weight matrices to construct the corresponding spatial measurement model to strengthen the reliability of the model results.

2.2 Research Methods

2.2.1 Measurement Model Building

From the literature review, it can be seen that venture capital may have spatial autocorrelation characteristics, ordinary panel model cannot measure the lag effect, which is easy to lead to estimation bias. Therefore, this paper constructs ordinary panel model and spatial panel model respectively to obtain different estimation effects.

First, construct formula of the ordinary panel model, as shown in (1).

$$VC_{it} = \beta_0 + \sum_{\varphi=1}^{n} \alpha_\varphi X_{\varphi,it} + \varepsilon_{it} \tag{1}$$

Among them, i represents the region, t represents the year. VC_{it} represents the scale of venture capital in i region in t year. β_0 represents the constant term, $X_{\varphi,it}$ represents the φth influencing factor in i region in t year, and α_φ represents the regression coefficient of the φth influencing factor, ε_{it} is a random interference term.

Then, construct a spatial panel model to analyze the influence of spatial autocorrelation characteristics on venture capital, and respectively construct spatial autoregressive model (SAR), spatial error model (SEM) and spatial Durbin model (SDM).

First, spatial autoregressive model.

$$VC_{it} = \beta_0 + \sum_{\varphi=1}^{n} \beta_\varphi X_{\varphi,it} + \tau w_{ij} * VC_{it} + \varepsilon_{it} \tag{2}$$

Among them, w_{ij} is the spatial weight matrix, $w_{ij} * VC_{it}$ is the spatial lag variable of the dependent variable, and τ is the spatial regression coefficient, which reflects the direction and degree

of the influence of the observable value in the adjacent region of i region on the venture capital in this region.

Second, spatial error model.

$$VC_{it} = \beta_0 + \sum_{\varphi=1}^{n} \beta_\varphi X_{\varphi,it} + \tau w_{ij} * \varepsilon_{it} + \varphi_{it} \quad (3)$$

Among them, w_{ij} is the spatial weight matrix, $w_{ij} * \varepsilon_{it}$ is the spatial lag error term, and τ is the spatial regression coefficient, which reflects the direction and degree of the unobservable influence factors or random shocks in the adjacent region of i region on the venture capital in this region.

Third, spatial Durbin model.

$$VC_{it} = \beta_0 + \sum_{\varphi=1}^{n} \beta_\varphi X_{\varphi,it} + \tau w_{ij} * VC_{it} + \mu w_{ij} * \sum_{\varphi=1}^{n} X_{\varphi,it} + \varepsilon_{it} \quad (4)$$

Among them, w_{ij} is the spatial weight matrix, $w_{ij} * VC_{it}$ is the spatial lag variable of the dependent variable, $w_{ij} * X_{it}$ is the spatial lag variable of the explanatory variable, and the spatial Durbin model also examines the impact of venture capital in adjacent region on the region and the impact of factors or random shocks in adjacent region on venture capital in this region.

2.2.2 Spatial Weight Matrix

Spatial weight matrix is the premise of spatial econometric analysis. In order to prevent a prior error caused by the construction of spatial weight matrix, this paper constructs and analyzes the empirical results of three kinds of spatial weight matrix, namely 0-1 matrix (WG_{ij}), geographic distance matrix (WD_{ij}) and economic matrix (WE_{ij}). The specific calculation formulas of each matrix are as follows:

(1) 0-1 spatial weight matrix WG. If the two regions are geographically adjacent, it is recorded as 1; if they are not adjacent, it is recorded as 0. d_0 is the threshold of different radius, reflecting the significance of the spatial spillover effect within different radius.

$$WG_{ij} = \begin{cases} W = \dfrac{1}{d_{ij}}, d_{ij} \le d_0 \\ W = 0, d_{ij} > d_0 \end{cases}$$

(2) Geographic distance matrix WD. d_{ij} is the geographic distance between provinces i and j, measured by the shortest railway mileage between the corresponding provincial capitals.

$$WD_{ij} = (1/d_{ij}) \Big/ \left[\sum_{j=1}^{N} (1/d_{ij})\right]$$

(3) Economic matrix WE. $\overline{pgrp_j}$ is the average value of the economic development level of region i during the sample period.

$$WE_{ij} = (1/|\overline{pgrp_i} - \overline{pgrp_j}|) \Big/ \left[\sum_{j=1}^{N} (1/|\overline{pgrp_i} - \overline{pgrp_j}|)\right]$$

In this paper, spatial autocorrelation analysis will use WG matrix, spatial measurement model will use WD matrix, and robustness test will use the WG and WE matrix.

3. Research on Influencing Factors

3.1 Variable Selection and Descriptive Statistics

3.1.1 Interpreted Variable

In previous studies, venture capital (VC) is generally measured by the amount of investment funds at the beginning of the period, the number and amount of venture capital projects. With reference to the research of Yao Li (2018), based on the availability and accuracy of data, the ratio of the amount of venture capital in each region (100 million yuan) to the GDP (100 million yuan) in each region during the same period is used as the measurement. index.

3.1.2 Explanatory Variables

The selection of explanatory variables should include variables that can affect venture capital through a certain path. Refer to the research of Lin Xiao (2019) and others to select the level of technology investment, the level of opening, the level of education, the level of government intervention, and the Five control variables including environmental regulations. Among them, given that R&D activities are the core of technological innovation and have a strong guiding role in technological innovation, this article uses the ratio of regional R&D expenditures (100 million yuan) to GDP (100 million yuan) to measure the level of technology investment (RD); The level of openness (OPEN) mainly includes two parts: foreign direct investment and international trade. It has a positive impact on regional innovation through external effects such as potential "learning by doing" and technology diffusion, using foreign direct investment (100 million yuan) and total import and export trade The ratio of (100 million yuan) to GDP (100 million yuan) in the same period is used as a measure of the level of opening to the outside world; education level (EDU) determines the situation of talent knowledge reserves and has a positive and positive impact on technological innovation. The number of years is used as a measure; government intervention (GOV) reflects the government's dominance of the economy. The local government competition system under the "Chinese-style decentralization" will inevitably have an important impact on the direction and development of technological innovation. Measured as the proportion of GDP (100 million yuan) in the same period. Environmental regulation (EI) reflects the intensity of government supervision of enterprises, which forces enterprises to carry out environmental protection investment, technological innovation and other activities. The measurement indicators have been mentioned above.

3.1.3 Descriptive Statistics

This article uses data from 30 regions in China (considering the availability of data, except Tibet, Hong Kong, Macao and Taiwan) from 2001 to 2019 as the research object to analyze the temporal and spatial distribution of China's venture capital and its influencing factors. The data comes from the "China Statistical Yearbook", Wind data terminal and authoritative data published in various regions, descriptive statistical analysis of each variable in the model, see Table 1.

Table 1. Descriptive Statistics of Variables

Variable	Abbrew	Obs	Mean	Std. Dev.	Min	Max
risk investment	VC	570	0.006	0.023	0.000	0.234
Level of investment in technology	RD	570	0.011	0.010	0.000	0.060
Level of opening to the outside world	OPEN	570	0.319	0.433	0.003	1.931
educational level	EDU	570	9.013	1.596	6.040	15.451
Level of government intervention	GOV	570	0.212	0.097	0.030	0.628
Environmental regulation	EI	570	8.031	5.315	0.909	54.793

3.2 Measurement Model

The Hausman test results of the scale regression of venture capital show that the P-values* are all significant at the 1% level. The assumption of no difference between fixed effects and random effects estimates is rejected. At the same time, the fixed effects model has the best effect. Therefore, this

paper uses the fixed effects model to compare the econometric model. Build. It can be seen from Table 2 that the degree of fit of the venture capital scale estimated by OLS is 0.287, which has passed the significance test at the 1% level. In order to further analyze the spatial effects of regional venture capital, a lag term is introduced to construct a spatial econometric model for analysis. The results show that the fitting degrees of the venture capital scales estimated by SAR, SEM, and SDM are 0.298, 0.203, and 0.247, respectively. By comparing the three models Log-L, etc., it is concluded that the SDM model has a better fitting effect. At the same time, the rho values of SAR, SEM, and SDM are all significantly negative, indicating that venture capital has a strong spatial dependence, that is, the scale of venture capital in the region will be affected by the siphon effect of the scale of venture capital in the surrounding area, causing the outflow of venture capital in this region.

Table 2. Regression Results of Panel Model

Variables	OLS	SAR	SEM	SDM
RD	0.715*** (0.000)	0.297*** (0.006)	0.318*** (0.004)	0.256** (0.017)
OPEN	-0.002 (0.193)	-0.024 (0.412)	-0.046 (0.130)	-0.006 (0.859)
EDU	0.007*** (0.000)	0.013*** (0.000)	0.012*** (0.000)	0.014*** (0.000)
GOV	0.020** (0.021)	0.041*** (0.000)	0.044*** (0.000)	0.046*** (0.000)
EI	-0.001*** (0.000)	-0.000 (0.247)	-0.000 (0.296)	0.000 (0.984)
$w_{ij} * \mathrm{RD}$				-1.433** (0.016)
$w_{ij} * \mathrm{OPEN}$				-0.051 (0.837)
$w_{ij} * \mathrm{EDU}$				-0.006 (0.380)
$w_{ij} * \mathrm{GOV}$				-0.073 (0.154)
$w_{ij} * \mathrm{EI}$				0.004*** (0.000)
Constant	-0.058*** (0.000)			
Lambda			-0.477*** (0.002)	
rho		-0.734*** (0.000)		-0.544*** (0.000)
sigma2_e		0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Observations	570	570	570	570
R-squared	0.287	0.298	0.203	0.247
F-test	45.446			
Prob > F	0.000			
Log-likelihood		1491.7272	1482.8076	1509.4336

Remarks: *** p<.01, ** p<.05, * p<.1

It can be seen from Table 2 that the coefficient of technology investment level (RD) to venture capital (VC) is different, but both are significantly positive at the 1% level, indicating that the level of technology investment has a significant role in promoting venture capital in the region. However, it is found from the SDM model that the level of technology investment in neighboring regions has a significant squeezing effect on venture capital in the region, which inhibits the development of venture capital in the region to a certain extent; the level of opening to the outside world (OPEN) is only included in the SEM model in the regression results Significant, and the coefficient is negative,

indicating that the level of opening to the outside world has a negative effect on venture capital. The possible reason is that the higher the level of regional openness, the more intense the competition of venture capital institutions and the weaker the attraction of venture capital; the level of education (EDU) for venture capital The influence coefficients of (VC) are all significantly positive at 1%, that is, the higher the level of regional education, the higher the promotion of venture capital, which means that all regions can formulate active talent introduction and training policies to increase the level of venture capital; The influence coefficient of government intervention level (GOV) on venture capital (VC) is significantly positive at the 5% level, indicating that government guidance funds have a significant role in promoting venture capital in the region, and the results of the SDM model show that government intervention in neighboring regions has a risk to the region Investment has a negative effect, indicating that China's current risk investment is strongly affected by the level of government intervention; environmental regulations (EI) in the regression results are only significantly negative in the OLS model, indicating that the current level of China's environmental regulations has a greater impact on venture capital weak.

4. Summary

From the above analysis, the following conclusions can be drawn: The spatial measurement results show that the level of technology investment, education level, and government intervention level all have a significant positive effect on the scale of venture capital, and the level of opening is returning due to its possible threshold effect. China has a negative impact on the scale of venture capital. In addition, environmental regulations have a certain inhibitory effect on venture capital. As the concept of carbon peaks has received widespread attention, regions need to pay attention to the impact of green technology innovation on venture capital.

According to the conclusion, the decision-making recommendations from the government's perspective are as follows: First, continue to expand the scale and main body of venture capital. The central government can reasonably formulate corresponding policies and guidelines to guide the rational flow of venture capital, eliminate the blindness of venture capital to a certain extent, and prevent venture capital from overheating investment in a certain industry or a certain region, leading to waste of manpower and material resources. Second, increase the level of technology investment. At present, China’s internal expenditure on research and experimental development accounts for an average of less than 2% of GDP, which is quite different from developed countries. Therefore, it is necessary to continue to increase the scale of technology investment, support the development of strategic high-tech industries, and release industrial dividends in advance. Independent ability of technological innovation, further accelerate the process of industrial ecologicalization, and reserve more reserve technologies.

Acknowledgments

This work is supported by 2018 National Natural Science Foundation of China Youth Science Fund Project: Research on the Effect of Energy and Environment-biased Technological Progress of Environmental Regulation and Structural Upgrade from a Matching Perspective, Project number: 71804001.

References

[1] Hirukawa, Masayuki, and Masako Ueda. "Venture capital and innovation: which is first?" Pacific Economic Review 16.4 (2011): 421-465.

[2] Kállay L, Jáki E. The impact of state intervention on the Hungarian venture capital market[J]. Economic research-Ekonomska istraživanja, 2020, 33(1): 0-0.

[3] Lerner J. The future of public efforts to boost entrepreneurship and venture capital[J]. Small Business Economics, 2010, 35(3): 255-264.

[4] Mustafa M, Mazhar S S. Determinants of Venture Capital Investment in India: A Time Series Analysis[J]. The Review of Finance and Banking, 2020, 12(1).

[5] Pezeshkan A, Smith A, Fainshmidt S, et al. A neo-configurational institutional analysis of international venture capital attractiveness and performance: insights for Asia-Pacific[J]. Asia Pacific Journal of Management, 2020: 1-29.

[6] Fang Jiawen, Liu Haimeng. Temporal and spatial distribution characteristics and influence mechanism of venture capital in Beijing-Tianjin-Hebei urban agglomeration[J]. Advances in Geographical Sciences, 2017, 36(01): 68-77.

[7] Zhang Yilin. An Empirical Analysis of the Spatial Distribution and Influencing Factors of Venture Capital in my country [D]. Zhejiang University, 2018.

[8] Sun Xiangxiang, Zhou Xiaoliang. Regional differences in venture capital and its influencing factors: Taking Guangdong Province as an example[J]. Journal of Beijing University of Posts and Telecommunications (Social Science Edition), 2019, 21(03): 25-32. DOI: 10.19722/j.cnki.1008-7729. 2019. 0042.

[9] Qiao Qin, Fan Jie, Sun Yong, Liu Baoyin, Liu Hanchu. Research on the Spatial and Temporal Distribution and Influencing Factors of Venture Capital in the Areas along the "One Belt and One Road" in my country [J]. Science and Technology Progress and Policy, 2021, 38(18): 37-45.

[10] Yao Li. Venture capital, regional technological innovation level and spatial effects--An empirical study based on inter-provincial panel data[J]. Contemporary Economic Management, 2018, 40(06): 7-12.