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Research on the Influence of Venture Capital on the Technological Innovation Ability of High-Tech Enterprises: Based on the Perspective of Industry Difference

HU Zhiyun[a],*

[a]School of Business Administration, South China University of Technology, Guangzhou, China.
*Corresponding author.

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Abstract
There are differences in the impact of venture capital on technological innovation in various industries because they have different characteristics in technological innovation. By analyzing the impact of venture capital on high and new technology enterprises in different industries, this paper provides a reference for the venture capital to better promote the technological innovation ability of Chinese high and new technology enterprises.

Key words: Venture capital; Technological innovation; High and new technology enterprises; Industry differences

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INTRODUCTION

As a high - yield, high - risk, highly skilled enterprise, the traditional financing method can not meet the financing needs of the high-tech enterprises. As for this, venture capital is undoubtedly an important source for high and new technology enterprises. As a high-tech enterprise gathering place, the GEM provides a platform for high and new technology enterprises to introduce venture capital. The purpose of this paper is to study the subdivision of high and new technology enterprises. According to the results of the analysis, the corresponding policy recommendations are put forward to provide reference for the introduction of venture investment in different industries.

1. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

1.1 Venture Capital and Technology Innovation Investment

Keuschning (2004) believed that an active venture capital industry should have a large number of experienced investors, which can greatly improve the success rate of the venture. Generally speaking, as for the shareholders with a venture capital background, the higher the shareholding ratio they hold, the stronger the control power they have the enterprise. At the same time, the characteristics of the venture capital's profitability also encourage it to explore projects that have more bright profit prospects. Also funds for projects can be released autonomy. From the long-term effect of technological innovation, shareholders with venture capital background will be able to get more rent from technological innovation in the future capital exiting process since we see form the cultivation of venture capital. Therefore, the shareholders with such a background are more motivated to support and promote the technological innovation activities in high and new technology enterprises indeed. Also, they can invest more resources in technological innovation by using the control right of the enterprise. Based on the above analysis, combined with the characteristics of Chinese GEM listed companies, the following assumptions are put forward.

Hypothesis 1: The higher the investment intensity of the venture capital is, the more technological innovation investment of high and new technology enterprises will be.

1.2 Venture Capital and Technological Innovation Output

The impact of venture capital on the technological innovation ability of high and new technology enterprises is mainly reflected in two aspects: First, the intervention of venture capital can help the high-tech enterprises to solve the problem of lack of funds, which allows patents to be converted to products and profits; second, the involvement of venture capital can reduce or eliminate the financial concerns of high and new technology enterprises. And the initiative to carry out scientific research has been promoted for the continuous development of new technologies and the accumulation and integration of technology. Thus, the hypothesis 2 is put forward:

Hypothesis 2: The higher the investment intensity of venture capital is, the more technological innovation output of high and new technology enterprises will be.

2. RESEARCH AND DESIGN

2.1 Research Samples and Data Sources

In order to test the impact of venture investment on the technological innovation level of high and new technology enterprises, the high-tech enterprises in the GEM market are chosen as the studying samples in this paper. By the end of December 31, 2016, before markets opened, there were 570 GEM listed companies in China, of which 438 were high and new technology enterprises. The samples of this study are distributed in 10 industries. As the number of samples in many industries is very small, considering the requirements of statistical testing, we distribute the samples of the key research in 3 industries: the electronic communications industry, the computer industry and the pharmaceutical and biological industry. The distribution of samples in each industry is shown in Table 1. In this study, the data about research and development, equity, financial and other aspects are mainly obtained through the public announcement and the prospectus issued in IPO by the listed company. And the rest of the few additional data comes from the related financial securities websites.

Table 1
Sample Distribution in Different Industries

Electronic communications	Computer	Pharmaceutical biological	Others
110	101	80	147

2.2 Research Variable Definition

The meaning and measurement of the variables are shown in Table 2.

Table 2
Research Variables Definitions

Explained variables	Innovation input	R&D input intensity	R&D	The average value of R&D expenses in the proportion of operating income for the first three years
		R&D personnel ratio	R&DP	Number of technical R & D personnel / total number of employees
	Innovation output	patent right	PATENT	Number of patents owned before listed + number of patents being applied
Explanatory variable	Risk investment participation	Having venture capital or not	VCNO	Dummy Variables, enterprise with venture capital participation is set to 1, otherwise it is set to 0
		Shareholding ratio of venture capital	VCstake	The share proportion sum of the venture capital institutions among the top ten major shareholders
controlled variable	Company scale	SIZE	Total assets at the time when raise capital by floating shares	
	Financial leverage	LEV	Asset liability ratio when raise capital by floating shares	
	Company location	LOCATION	The provinces located in Beijing, Shanghai, Guangdong, Jiangsu and Zhejiangis 1, otherwise is 0.	

2.3 Empirical Model

In order to test the impact of risk-free investment on technological innovation, the following regression Model 1 is established in this paper.

INNOVATION=+VCNO+SIZE+LEV+LOCATION+

Among them, INNOVATION is an explanatory variable, which represents the technological innovation ability before IPO. This paper uses three indexes, the ratio of technology R&D personnel, the intensity of R&D input, and the patent right, to measure it. VCNO is an explanatory variable, indicating whether there is a risk investment participation.

In order to the further analyze the impact of the share proportion of venture capital on the technological innovation ability, Model 2 is also constructed in this paper.

INNOVATION=+VCstake+SIZE+LEV+LOCATION+

On the basis of Model 1, companies with venture capital backgrounds are examined in accordance with the share ratio of venture capital in Model 2. VCstake is an explanatory variable, which represents the proportion of the risk investment.

3. EMPIRICAL RESEARCH AND RESULT ANALYSIS

3.1 Regression Results of Venture Capital's Impact on the Technological Innovation of Electronic Communications Enterprises

Table 3
The Regression Results of the Electronic Communications Industry

Dependent variable	R&D		R&DP		PATENT	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
VCNO	0.802 0.763		-0.632 -0.105		-3.328 -0.208	
VCstake		0.035 1.034		-0.012 -0.063		-0.260 -0.510
LEV	-0.039 -0.981	-0.042 -1.068	-0.614 -2.695**	-0.612 -2.696**	0.587 0.967	0.600 0.995
SIZE	-1.757 -0.776	-1.892 -0.837	8.496 0.656	8.474 0.652	-45.906 -1.331	-44.342 -1.284
LOCATION	1.298 1.074	1.115 0.995	-8.427 -1.219	-8.207 -1.273	28.571 1.553	28.745 1.679

Note. The value of the estimated coefficient is *t* value. ** indicated that at a significant level of 5%.

It can be seen from Table 3 that the absolute value coefficient of R&D and R&DP have little difference whether there is a risk capital in the background or a different proportion in venture capital. Therefore, it can be considered that the participation degree of venture capital has a positive impact on the technological innovation investment in the electronic communications industry. From PATENT, it can be seen that the participation degree of venture capital has a negative impact on the output of technology innovation, so Hypothesis 2 is refused.

3.2 Regression Results of Venture Capital's Impact on the Technological Innovation of Computer Enterprises

Table 4
The Regression Results of the Computer Industry

Dependent variable	R&D		R&DP		PATENT	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
VCNO	0.143 0.102		4.705 0.802		-26.710 -1.427	
VCstake		0.058 0.743		0.193 0.591		-1.479 -1.418
LEV	-0.099 -2.004**	-0.098 -2.008**	-0.053 -0.257	-0.053 -0.255	-0.981 -1.492	-0.985 -1.497
SIZE	0.863 0260	0.451 0.137	16.963 1.220	17.644 1.268	101.591 2.289**	100.912 2.278**
LOCATION	-0.156 -0.091	-0.291 -0.169	6.158 0.855	5.707 0.786	10.704 0.465	14.150 0.612

Note. The value of the estimated coefficient is *t* value. ** indicated that at a significant level of 5%.

It is known from Table 4 that the investment intensity of venture capital has a positive impact on the investment of technology innovation, which is consistent with hypothesis 1. It has a negative impact on the output of technological innovation, assuming that 2 is not supported.

Because of short development cycle, many patent achievements, high innovation efficiency and broad prospects for development, as well as large the growth space, the electronic communication industry is very popular within venture capital in recent years. The future prospects of high value-added and high returns in the computer industry are attracting venture capital institutions to make strategic investments. But why does the venture capital's entry has failed to promote the innovative output in these two industries? On the one hand, the electronic communications industry has been growing at a high speed in the past 20 years. Since 2009, the growth of the sales revenue in the electronic communications industry has been increasing by more than 10%. However, the small scale and the backward technology of the domestic electronic communications enterprises in the world are indisputable situation. In this global economic era, entrepreneurial hi-tech enterprises have greater market risk, profit risk and as well as competitive risk, which has led to the lack of more energy and confidence for the enterprise itself. On the other hand, for the sake of evading and controlling risks, venture capital institutions will shorten investment time as much as possible, and focus on the listed packaging of venture enterprises. They want to be able to exit as their willing after listing, so they have always taken a short view on the investment behavior.

3.3 Regression Results of Venture Capital's Impact on the Technological Innovation of Pharmaceutical Biological Enterprises

Table 5
The Regression Results of the Pharmaceutical Biological Industry

Dependent variable	R&D		R&DP		PATENT	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
VCNO	5.329 2.297		0.828 0.239		17.968 1.167	
VCstake		0.064 0.700		0.021 0.166		0.163 0.288
SIZE	-1.114 -0.205	-2.311 -0.384	-4..284 -0.528	-4.320 -0.527	36.761 1.019	32.001 0.855
LEV	-0.007 -0.095	0.009 0.125	-0.042 -0.412	-0.039 -0.380	0.042 0.091	0.092 0.196
LOCATION	2.910 1.242	3.054 1.151	6.395 1.829	6.497 1.799	14.204 0.913	14.307 0.868

As can be seen from Table 5, the regression results of Model 1 and Model 2 show that the investment intensity of venture capital has a positive impact on the technological innovation ability of pharmaceutical and biological enterprises. This is in accordance with hypothesis 1 and hypothesis 2.

In recent years, the pharmaceutical manufacturing industry has become the main concern of venture capital. Some venture capital institutions have even set up medical funds for the development of the pharmaceutical industry. However, the research and development of the pharmaceutical and biological industry has the characteristics of long period, high investment and high risk, Chinese pharmaceutical companies, generally in the pursuit of current profits, are reluctant to spend so much money and such a long cycle to support the research and development of new drugs. Likely, investment institutions are not willing to wait for such a long time for continuous investment. Therefore, venture capital has no significant effect on technological innovation.

CONCLUSION

Risk investment participation situation and the proportion of venture capital are used to study their impact on technological innovation input (R&D investment and R&D personnel ratio) and technological innovation output (patent right) of high-tech enterprises in this paper. Here are the detailed analysis results of the three kinds of high and new technology enterprises: as for the electronic communications industry, the investment intensity of venture capital has a positive impact on the innovation investment, but has a negative impact on the innovation output, which is partly consistent with the hypothesis; as for computer industry, the investment intensity of venture capital has a positive impact on the innovation input, but has a negative effect on the innovation output, which is partly consistent with the hypothesis; as for the pharmaceutical and biological industry, the investment intensity of venture investment has a positive impact on the innovation input and innovation output, which is consistent with the hypothesis also.

It can be seen that the characteristics of R&D activities in different industries have a significant impact on the role of venture capital in various companies. Such different reasons are related to the characteristics of the industry itself. As a result, government can carry out the targeted system construction according to the special characteristics of different industries, so as to better promote the risk capital for a positive impact on the technological innovation of high-tech enterprises.

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