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The Impact of Venture Capital on Technological Innovation Performance

-- Heterogeneity based on Venture Capital

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Abstract: In the context of increasingly fierce global trade competition, vigorously developing innovation and accelerating the construction of an innovative country is the key to an invincible competitive position. This paper takes the companies listed on GEM from 2010 to 2017 as samples. After eliminating the problem of sample self-selection by combining propensity score matching method, this paper adopts differential model to study the impact of venture capital heterogeneity on technological innovation performance. The results show that: the participation of venture capital promotes the improvement of technological innovation performance, and the performance is better; The equity nature, investment term and investment mode of venture capital have positive effects on technological innovation performance. In addition, the further research proves that the impact of venture capital on innovation performance is persistent, and there is a pre-investment screening mechanism of venture capital. This paper is not only expected to enrich the literature of venture capital on enterprise technological innovation, but also to provide a basis for the government to stabilize the stability of the venture capital market and play the role of venture capital in promoting enterprise technological innovation, which has great practical significance.

Keywords: Venture Capital; Heterogeneity; Technological Innovation Performance; Propensity Score Matching.

1. Introduction

The report to the 19th National Congress of the Communist Party of China clearly stated that innovation is the primary driving force for development and the strategic support for building a modern economic system. As an active group and backbone of China's technological innovation, the improvement of enterprises' innovation ability is of strategic significance for China's in-depth implementation of the innovation-driven development strategy and the realization of economic quality and efficiency improvement. Therefore, technological progress is the driving force and source to ensure a country's sustained economic growth. Due to the high market risk, it is difficult to obtain enough funds needed for development through traditional financing channels, and the innovative development of enterprises is difficult. However, venture capital institutions have the knowledge and skills that traditional financing intermediaries lack in screening, identifying, supervising and counseling high-risk enterprises. As an important channel for enterprises to obtain funds and management knowledge, venture capital is an important force driving and supporting enterprise innovation. Through equity investment, venture capital institutions, on the one hand, finance innovation activities of enterprises. Increase the level of R&D investment of enterprises; On the other hand, it gives full play to its market certification and supervision functions, uses its professional knowledge and unique resources to provide planning and guidance for enterprises' innovation activities, reduces the risks of enterprises' innovation activities, improves the enthusiasm of enterprises' independent research and development, and thus improves the performance of enterprises' technological innovation. However, at present, there are disputes among the academic circles about the research results on the impact of venture capital on the technological innovation performance of enterprises. The main reason is that due to the different environment of the data source and the differences between different industries, the effectiveness of venture capital is different, which brings different degrees of impact on technological innovation. So, does venture capital really play a role in promoting innovation? Does it drive the social effects of technological progress? This problem is particularly important in the current economic environment, which is exactly the position of this paper.

2. Literature Review

2.1. The Impact of Venture Capital on Enterprises

Over the past few decades, venture capital has boomed across the globe. According to the National Venture Capital Association, more than 7,750 startups received a total of $69.1 billion in venture capital funding in the United States in 2016 alone. The rise and rapid growth of venture capital markets in Europe and Asia should not be underestimated. Since the emergence of the first venture capital institution in China in the mid-1980s, China's venture capital industry has experienced more than 30 years of rapid development, and has become the world's second largest venture capital market by the end of 2012 (Ernst and Young, 2012). According to the calculation of the Research Institute, in 2017, the investment amount of China's venture capital institutions /PE market reached 1072.2 billion yuan. With the increasing role of innovation and entrepreneurship in China's economic development, the role of venture capital institutions in promoting the development of new ventures and scientific and technological innovation has also been paid more and more attention.

At present, venture capital has become an important financing intermediary in the financial market, providing key funds for enterprises that have difficulty in obtaining financing from traditional financial institutions (Gompers and Lerner, 2001). From the perspective of the investment process between venture capital institutions and enterprises, a complete venture capital cycle starts with the raising of investment funds, followed by in-depth review of investment projects and business concepts through business plans, follow-up surveys, etc., to ensure the selection of objects with innovative potential to the maximum extent, so as to ensure the successful realization of technological innovation performance. And further implement specific investment, including supervision and value-added services for the invested enterprises, in order to exit from successful investment transactions, win investment returns for investors, and finally return to the new fund-raising link. Therefore, some literatures have studied the impact of venture capital institutions on the IPO timing and market performance of invested companies. For example, Lerner (1994) found that there was timing effect in the listing of invested enterprises, and then chose to list financing when the equity valuation was high, and private financing when the valuation was low. Brav and Gompers (1997) examined the market performance of IPO companies after listing and found that IPO companies with the participation of venture capital institutions performed better. Sørensen (2007) tested the impact of the experience of venture capital institutions on the listing of investee enterprises, and the results showed that the more experience of venture capital institutions, the higher the probability of successful listing of investee enterprises. In China, due to the relatively late start of research on venture capital institutions, the difficulty of obtaining data on venture capital institutions, and the high cost of information collection, the existing research results are limited. In these few studies, some studies combined with China's institutional background, focusing on the background of venture capital institutions and the nature of ownership on the impact of the invested enterprises. For example, Zhang Xueyong and Liao Li (2011) investigated the performance of the invested enterprises in the stock market and found that venture capital institutions with foreign capital background often adopt more cautious investment strategies, make more reasonable arrangements for the corporate governance structure after investment, and the invested enterprises have better profitability. In the end, the IPO underpricing rate of enterprises backed by foreign-funded venture capital institutions is lower than that of enterprises backed by domestic venture capital institutions, and the stock return rate is higher. Yu Yan et al. (2014) further studied venture capital institutions with state-owned background, and found that state-owned venture capital institutions did not reflect their original policy intention in investment behavior, nor did they play a significant role in promoting innovation. In terms of investment effectiveness, after the reform of non-tradable share structure, state-owned venture capital institutions have higher investment efficiency, which is manifested as shorter investment period, higher investment return and lower cost.

2.2. The Impact of Venture Capital on Technological Innovation

Looking at the successful venture capital cases at home and abroad, the take-off of Apple, Baidu and Alibaba are all supported by venture capital, and venture capital has become an important part of the technological innovation process. Driven by the dual role of theoretical development and practical demand, scholars have carried out a large number of theoretical analysis and empirical research on the relationship between venture capital and technological innovation, and achieved diversified research results.

However, the academic debate on whether venture capital promotes technological innovation is still ongoing. Some scholars believe that venture capital has a high promotion effect on technological innovation performance. The first scholars to systematically verify the relationship between venture capital and technological innovation are Kortum and Lerner (2000), who took the relevant data from 1965 to 1992 in the United States as samples. This paper empirically analyzes the impact of venture capital on patented inventions in the past 30 years. The results show that venture capital has a promoting effect on patent application at industry level, and the effect is 3.1 times that of R&D investment. At the same time, the two scholars also studied 530 enterprises in Massachusetts Middlesex from the enterprise level. Through a comparative analysis of 122 venture-backed enterprises and 408 non-venture-backed enterprises, they found that venture-backed companies had more patents; At the same time, domestic scholar Liang Kai (2016) found in the study of venture capital and high-tech industry in China from 1992 to 2013 that venture capital has a significant positive impact on the acceptance of patent applications in high-tech industry, and will not significantly inhibit the increase of export value of high-tech industry. Chen Zhi and Zhang Suodi (2010), Yang Ye and Shao Tongyao (2012), using patent data as a measure of technological innovation, also confirmed that venture capital plays a positive role in regional innovation in China. Another group of scholars believe that the involvement of venture capital cannot promote the improvement of technological innovation performance, and even inhibit the technological innovation of enterprises. Zucker et al. (1998) found that the historical scale of venture capital market has a negative effect on the ratio of bio-high-tech start-ups, controlling for the existence of local star scientists. In addition, the negative impact of the volatility of venture capital market on enterprise innovation activities has also been verified in China. Shan Yuqing and Mai Yiyuan (2006) theoretically analyzed that venture capital in the boom period is relatively stable, and its impact on technological innovation has not increased. In the empirical analysis, Deng Junrong and Long Rongrong (2013) found that the coefficient of the effect of venture capital on technological innovation is negative, and most of China's technological innovation is generated by R&D investment. Some other scholars are in the middle, arguing that there is no significant relationship between venture capital and technological innovation performance. Only Yu Yan et al. (2014) used the R&D expenditure of enterprises three years before listing as a proxy variable for innovation activities to investigate the relationship between venture capital background and innovation of invested enterprises, but the authors did not find significant results.

To sum up, there are big differences on the impact of venture capital on technological innovation performance at home and abroad. The main reason is that due to the different environment of data source and the differences between different industries, venture capital exerts different effects and thus brings different degrees of impact on technological innovation. Previous studies DID not fully consider the endogeneity problem between venture capital and

technological innovation performance, which could not effectively eliminate the bias in sample selection and overcome endogeneity. Therefore, this paper, by referring to the research methods of previous scholars, adopts the method of combining PSM (propensity matching score method) and multi-time point DID (dual-difference method). To overcome the endogeneity problem by eliminating time effect and industry individual differences, this paper discusses the impact of venture capital heterogeneity on technological innovation performance.

3. Theoretical Analysis and Research Hypothesis

3.1. Problems Existing in the Process of Technological Innovation Activities

Can venture Capital promote technological innovation performance? The key to solving this proposition is to correctly grasp the nature and characteristics of technological innovation activities, combine the advantages brought by venture capital institutions, and observe whether venture capital can adapt to the characteristics of technological innovation activities and realize the organic combination of the two, so as to improve the performance of technological innovation. The characteristics of technological innovation activities are as follows:

1. Positive externalities. The most critical goal of technological innovation is to acquire new knowledge and use it as a guide to provide innovative and even subversive products and services for enterprises. However, as an intangible public product, it has positive externality and spillover effect on public environmental benefits. This means that enterprises that invest a lot of money in research and development cannot exclusively enjoy the new knowledge, new ideas, and economic benefits obtained from technological innovation activities. Therefore, the positive externality of technological innovation activities will seriously affect the investment of enterprises in scientific and technological innovation, resulting in insufficient investment in research and development, and thus unable to meet the capital demand of technological innovation from new ideas to new projects, and the financing gap will immediately appear.

2. Information asymmetry. The core difficulty faced by new startups is that it is difficult to use clear financial indicators to reflect the value of innovation and make the outside world fully trust the quality of information disclosed. For venture investors who focus on a specific business field for a long time, they can identify investment objects with great development prospects through long-term accumulated experience. In addition, it can accurately evaluate the feasibility of technological innovation projects, but only a very small number of such investors. For most potential external investors, due to the lack of sufficient information to distinguish high-quality projects from low-quality projects, they can only carry out financing according to the average market price, which will lead to the actual financing cost of high-quality projects being higher than the reasonable financing cost. The problem of information asymmetry greatly increases the frictional cost of the market, and then damages the efficiency of enterprises to carry out innovative activities.

3. Financing constraints. For new startups, due to their small scale, tangible assets account for a low proportion of total assets, in this case, it is difficult for new startups to obtain sufficient external financing. In addition, most of the final products of technological innovation activities of new ventures are mainly intangible assets, which makes it difficult for banks, investment banks and other financial institutions to provide financial support for such projects that lack the collateral property of tangible assets. Moreover, the existence of information asymmetry makes it difficult for external investors to conduct reasonable evaluation of technological innovation projects of new ventures. It further increases the financing constraints of enterprises, which leads to the reduction of R&D investment and the reduction of technological innovation performance of enterprises.

3.2. The Impact of Venture Capital Participation on Technological Innovation Performance

Based on the signal theory, the most important problem faced by new enterprises is the financing difficulties caused by information asymmetry. However, as long as venture capital institutions make investments, as reputable intermediaries, venture capital can endorse enterprises, release favorable signals to the third parties concerned, and eliminate the negative effects of information asymmetry on enterprises. Increasing the possibility for new enterprises to carry out strategic cooperation and find complementary resources indirectly improves the innovation efficiency of enterprises to a large extent (Hsu, 2006; Chemmanur et al., 2011). In addition, if the start-up invested by venture capital successfully exits in the form of IPO, the listing event will serve as a more powerful signal, strengthen the endorsement effect, and further improve the innovation efficiency of enterprises (Hochberg et al., 2007). On the contrary, the operation mechanism of venture capital institutions is that after the enterprise value is increased, they can withdraw through listing, acquisition and merger or other equity transfer methods to earn excess investment returns. Therefore, the improvement of technological innovation efficiency of new ventures has greatly improved the technological innovation performance of enterprises, which is an indicator of the core competitiveness of new ventures. It is also the interest of venture capital institutions.

However, from the perspective of resource theory, venture capital, as a special equity financing channel, not only provides financial support to start-ups with broad development prospects and large capital demand to make up the financing gap, but also directly provides post-investment management services to new start-ups. Venture capital transfers resources and knowledge to new start-ups in the form of contacts and industry information. Make up for resource gaps and knowledge gaps in their innovative activities (Colombo et al., 2006). Therefore, by providing high-quality and highly matched resources to new enterprises, venture capital institutions not only make up for the problem of information asymmetry in the technological innovation activities of enterprises, but also further improve the technological innovation performance of enterprises.

To sum up, the following hypothesis is proposed in this paper.

Hypothesis 1: Enterprises with venture capital investment have better performance in technological innovation performance than enterprises without venture capital investment.

3.3. The Impact of Heterogeneity of Venture Capital on Technological Innovation Performance

Different characteristics of venture capital may have different impacts on the innovation performance of the invested enterprises, and different types of venture capital have different objectives and characteristics. Independent venture capital (IVC) is committed to maximizing returns and may internalize its innovation results to increase investors' financial returns, while corporate venture capital (CVC) often pursues strategic objectives. Pay more attention to long-term benefits, increase the number of patent applications, improve the quality of patents and the subsequent commercialization level of new project results (Tykvova, 2000; Dushnitsky and Lenox, 2005). Therefore, with reference to the existing literature, the impact of the heterogeneity of venture capital institutions on technological innovation performance is further classified and explored.

4. Research Design

4.1. Sample Screening and Data Processing

In this paper, we selected the enterprises of chinext that were initially publicly issued in Shenzhen and Shanghai from 2010 to 2017 as samples. The study period of the project began on January 1, 2010 and ended on December 31, 2017. The reasons for the selection of sample intervals in this paper are as follows: On the one hand, the official listing date of chinEXT is October 30, 2009, so as to avoid the impact of the gaps and omissions caused by too few sample enterprises in 2009 on the overall distribution of data; On the other hand, China's patent law stipulates that the invention patent that passes the preliminary examination shall be disclosed 18 months after the filing date. For utility model and design patents, they need to be examined and authorized before being disclosed. In practice, the process from application to disclosure generally takes 2 to 3 years, while the average time from application to authorization for invention patents is nearly 4 years (LiegsalzandWagner, 2013). Therefore, if the patent data of recent years is used, a considerable part of the patents applied by enterprises have not been published or authorized, resulting in incomplete data on technological innovation performance indicators. Therefore, 2017 is taken as the cut-off time for sample selection in this study.

4.2. Model Design

In order to examine the impact of venture capital participation on the innovation activities of the investee firms, we use a multistage Difference-in-Differences Model (DID) to investigate. The reason for choosing multi-stage DID is that in economics, we usually want to evaluate the effect after the implementation of a certain public policy, by constructing "treatment groups" and "control groups" to evaluate the treatment effect. However, due to the difference in the time of venture capital participation in enterprises, our data are usually from non-random observation studies, and the initial conditions of the treatment group and the control group are not exactly the same, so there is the problem of selection bias. The existence of this selectivity bias makes it impossible to observe the net effect of venture capital participation on technological innovation performance. If the multi-stage DID method is not adopted, and the enterprises with venture capital entry and those without venture capital entry are simply compared, then we cannot rule out whether there are differences between the two types of enterprises before the participation of venture capital, and it is not venturing capital that promotes innovation. However, if we make a simple vertical comparison and compare the differences between enterprises with venture capital investment before and after venture capital investment, then the change of their innovation trend may come from other factors in the external environment that change over time, rather than the role of venture capital. Therefore, only by using the multi-phase DID method to control the differences between time and industry at the same time, can interfering factors be better eliminated and the impact of venture capital on enterprise innovation be more reliably separated. Learn from previous methods (Chen Si, 2017; Yu Minggui, 2016) established the following model:

$$IP\ it = \beta 0 + \beta 1 VCit + \Sigma\ Control\ it + Ii + Y\ t + \varepsilon\ it \quad (1)$$

$$IP\ it = \beta 0 + \beta 1 VCTraitit + \Sigma\ Control\ it + Ii + Y\ t + \varepsilon\ it \quad (2)$$

Where, VC represents whether venture capital institutions participate in the enterprise, and this variable is the key variable in this study. When the i th company has venture capital participation in year t, the value of this variable is 1; otherwise, it is 0. I represent the industry dummy variable, which is used to control the industry effect that does not change over time and is not observable. Y represents a year dummy variable that controls unobservable year effects over time. Control represents the dummy variable and ε represents the random disturbance term.

4.3. Variable Definition

1. Explained variable: technological innovation performance. According to the Patent Law of the People's Republic of China, invention-creation refers to inventions, utility models and designs. Invention refers to a new technical solution to a product, method or improvement thereof; Utility model means a new technical scheme which is suitable for use in relation to the shape, structure or combination of the product; Appearance design refers to the overall or local shape, pattern or its combination, as well as the combination of color and shape, pattern to make a new design rich in beauty and suitable for industrial applications, and invention patents have the highest requirements for technology, innovation is the most difficult. Therefore, drawing on the experience of predecessors, in addition to selecting the total number of enterprise patent applications (lnapply) as the explained variable, the number of invention patent applications (lniapply) is further added. Since the number of patent applications of some enterprises in an individual year may be 0, this paper first adds 1 to the patent application data and then takes the logarithm.

2. Explanatory variable: heterogeneity of venture capital. The heterogeneity of venture capital institutions is measured according to the data of the top ten shareholders of GEM listed companies. (1) Government-backed venture capital (govern). Since state-backed venture capital institutions are mainly funded by the national government, it is bound to exert a significant influence on the governance and decision-making of venture capital companies. Therefore, this paper takes state-backed venture capital as the proxy variable of government-backed venture capital. To measure the impact of venture capital on technological innovation performance in the context of government; (2) Joint venture capital (lncorvcn). In this paper, the logarithm is taken according to the number of venture capital participation of the enterprise in the current year after adding 1, so as to avoid missing

values in the calculation process. Using this method for measurement, not only can the background of joint venture capital participation be measured, but also the joint degree of venture capital can be further quantified. (3) The sustainability of venture capital. As an important indicator in this study, this paper first screened out enterprises with venture capital participation and launched in the sample year, and then assigned a value according to the number of patent applications delayed by one period in the panel data, so as to measure whether the withdrawal of venture capital in the middle will have a sustained impact on technological innovation performance. (4) Investment term. As mentioned in the literature review, the longer the duration of venture capital in the enterprise, the higher the tolerance of enterprise innovation failure. Therefore, based on the method of former Chen Si and combined with the characteristics of this study, the number of years of venture capital participation to the current year is converted into quarters by adding 1, and the logarithm of the structure is performed to measure the tolerance of venture capital.

3. Control variables: By referring to previous literatures, this paper adds enterprise size (lnasset), asset-liability ratio (DAR), profitability (ROA) and tangibleasset_ratio to the multiple regression model.

5. Empirical Results and Analysis

5.1. Descriptive Statistics

Table 1 presents the descriptive statistical structure of the main variables included in the study. As can be seen from the table, the median number of patent applications is 2.303, which is lower than the average of 2.374, indicating that the number of GEM enterprises' patent applications is lower than the average level, and the standard deviation of this variable is 1.015, indicating a large gap in the technological innovation performance of enterprises in different industries. In terms of the heterogeneity of venture capital, the average values of foreign and government investment variables are 0.095 and 0.105 respectively, indicating that only a small number of venture capital institutions with foreign capital or government background participate in GEM enterprises.

Table 1. Descriptive statistics of variables

Variable name	Sample number	Mean	median	standard deviation
lnapply	2524	2.374	2.303	1.015
lniapply	2524	1.666	1.609	1.023
vc	2524	0.724	1	0.447
foreign	2524	0.0950	0	0.294
lncorvcn	2524	0.783	0.693	0.589
govern	2524	0.105	0	0.307
length	2524	1.637	1.386	1.173
consistency	538	2.350	2.303	1.032
lnasset	2524	21.10	20.99	0.735
ROA	2524	0.0550	0.0540	0.0430
DAR	2524	0.263	0.236	0.159
tangible asset	2524	0.912	0.953	0.104

5.2. Regression Analysis

Table 2 (1) reports the OLS multiple regression results of the impact of venture capital participation on technological innovation performance. As can be seen from the table, when the explained variable is the annual number of patent applications (lnapply), the coefficient of vc, which measures the entry of venture capital into enterprises, is 0.121, and is significant at the level of 1%. Therefore, it can be preliminarily believed that the entry of venture capital institutions can indeed use their own knowledge and resource advantages to promote the vitality of technological innovation of enterprises. In addition, it can be seen from the table that the regression coefficients of the operation scale, profitability and tangible assets ratio of the enterprise are 0.393, 1.041 and 1.280, respectively, and are all significant at the level of 10% or above. In other words, the larger the enterprise scale and the better its profitability, the more patent applications will be filed. This is consistent with the reality, because technological innovation activities usually need a large and continuous supply of capital, large scale, better profitability of the enterprise cash flow is more abundant, can invest more funds in R & D activities, the performance of technological innovation of the enterprise is better. Therefore, hypothesis 1 is basically supported by empirical evidence, which can confirm that the entry of venture capital is conducive to promoting the technological innovation performance of invested enterprises. Columns (2) - (6) in Table 2 report the impact of venture capital heterogeneity on technological innovation performance. Under the same explanatory variables, the regression coefficient of the explanatory variable foreign background is 0.282, which is significant at the 1% level. The regression coefficient of variable co-investment degree (lncorvcn) is 0.082, which is significant at 5% level. The regression coefficient of government background is 0.241, which is significant at the 1% level. The regression coefficient of risk investment tolerance (length) is 0.058, which is significant at 1% level. The regression coefficient of consistency of venture capital is 0.664, and the significance level is 1%.

Combined with the above regression results, it can be shown that venture capital institutions with foreign background can provide innovative "Western thinking" when enterprises carry out technological innovation activities by virtue of their advanced management capabilities and rich market experience, which increases the number of patent applications of enterprises, thus supporting hypothesis 2. When the enterprise is invested by multiple venture capital institutions, the enterprise can draw more heterogeneous resources, so that the enterprise can improve the ability of technological innovation from multiple dimensions, so that hypothesis 3 is supported. The entry of government-backed venture capital into enterprises can not only provide sufficient financial support for enterprises, but also provide policy orientation and market orientation for enterprises in advance, and make use of asymmetric information advantages to improve the efficiency of technological innovation of enterprises. Therefore, hypothesis 4 is supported. In addition, the longer the duration of venture capital in enterprises, it means that venture capital institutions pay more attention to the cultivation of enterprises' innovation ability and long-term benefits, so the tolerance of enterprises' innovation failure will be higher, thus promoting the improvement of enterprises' technological innovation performance. Similarly, even if the venture capital withdraws from enterprises in the middle, The institutional influence and resource penetration of venture capital institutions on enterprises will still have a positive impact on the subsequent patent applications of enterprises, thus ensuring the growth of technological innovation performance. Therefore, hypothesis 5 and hypothesis 6 are both supported by empirical evidence.

Table 2. Influence of venture capital heterogeneity on technological innovation performance

variable	(1)	(2)	(3)	(4)	(5)	(6)
vc	0.121***					
	(2.77)					
foreign		0.282***				
		(4.17)				
lncorvcn			0.082**			
			(2.39)			
govern				0.241***		
				(3.82)		
length					0.058***	
					(3.29)	
consistency						0.664***
						(34.17)
lnasset	0.393***	0.385***	0.395***	0.387***	0.376***	0.140***
	(11.23)	(11.01)	(11.32)	(11.11)	(10.50)	(4.56)
ROA	1.041**	0.936*	1.038**	1.112**	1.213**	1.005**
	(2.08)	(1.89)	(2.08)	(2.21)	(2.40)	(2.44)
DAR	-0.187	-0.145	-0.192	-0.167	-0.166	-0.106
	(-1.17)	(-0.90)	(-1.19)	(-1.05)	(-1.03)	(-0.72)
tangibleasset	1.280***	1.313***	1.271***	1.217***	1.308***	0.363*
	(5.80)	(5.95)	(5.75)	(5.50)	(5.95)	(1.96)
constant	-8.106***	-7.898***	-8.123***	-7.871***	-7.764***	-2.525***
	(-9.81)	(-9.58)	(-9.83)	(-9.57)	(-9.26)	(-3.52)
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Observed value	2524.000	2524.000	2524.000	2524.000	2524.000	1738.000
R^2	0.092	0.096	0.092	0.095	0.093	0.481

6. Conclusion

6.1. Research Conclusion and Enlightenment

This paper studies the impact of venture capital participation and its heterogeneity on technological innovation performance. By adopting the propensity score matching method, the endogeneity problem caused by sample selection bias is effectively alleviated, and a relatively reliable conclusion is drawn. The results show that enterprises with venture capital investment have a better performance in technological innovation performance than those without venture capital investment, which is reflected in the increase of patent applications. Moreover, through the analysis and summary of the heterogeneity of venture capital, the following conclusions are drawn: compared with domestic venture capital, foreign venture capital institutions can provide enterprises with more advanced management schemes and high-quality resources, thus making enterprises' technological innovation performance better; Compared with venture capital institutions that invest alone, enterprises invested by joint venture capital have more diversified resource reserves, which can improve the technological innovation performance of enterprises from multiple dimensions. Compared with venture capital without government background, venture capital institutions with government background can provide enterprises with sustained and stable financial support and advantages in information acquisition, which enables enterprises to have more insight in technological innovation activities and effectively improve their technological innovation performance. In the case of a longer duration, venture capital institutions can overcome the deviation of strategic guidance caused by the tighter exit time to a certain extent, which increases the tolerance of venture capital to technological innovation failure, so that the invested enterprises have better technological innovation performance. Although venture capital institutions withdraw from enterprises in the middle of the process, the past resource penetration can still have a lasting impact on the technological innovation performance of enterprises. In addition, by comparing the technological innovation performance of enterprises before and without venture capital participation, it is found that the former has better technological innovation performance, so it is highly attractive to venture capital institutions. Therefore, the difference in technological innovation performance of enterprises is also affected by the pre-investment choice of venture capital to some extent.

From the perspective of theoretical significance and practical significance, this paper has the following contributions:

First of all, by reviewing the existing literature on venture capital's effect on technological innovation performance, this paper clarifies the relationship between venture capital and enterprise's technological innovation performance, the mechanism of action and the degree of influence of venture capital on technological innovation, and focuses on the historical orientation and future research direction of this research. Based on the heterogeneity of venture capital companies, the impact of venture capital on technological innovation performance of enterprises is analyzed. Further research finds that venture capital has a continuous impact on technological innovation performance. The existence of the impact of venture capital on technological innovation performance is analyzed from a static perspective, and the continuity of the impact of venture capital on technological innovation performance is demonstrated from a dynamic perspective. It has enriched the literature on the impact of venture capital on enterprise technological innovation.

Secondly, by studying the factors that constitute the continuous influence of venture capital on enterprise technological innovation, it is not only conducive to providing useful reference for the two-way choice between venture capital enterprises and start-ups, but also provides a basis for the government to stabilize the stability of venture capital market and make relevant policies to play the role of

venture capital in promoting enterprise technological innovation, which has great practical significance.

6.2. Policy Suggestion

In the current era of fierce competition in global trade, trade barriers and trade conflicts also continue to occur, if you want to stand in the invincible position in global trade competition, the hard power is scientific and technological innovation. In order to earnestly implement the major decision and deployment of the Party Central Committee on strengthening the construction of strategic scientific and technological forces and "reinforcing weaknesses, building advantages, and strengthening capabilities", and improve the technological innovation system with enterprises as the main body and deep integration of industry, university and research, the government can more actively participate in the top-level design of venture capital, under the guidance of national policies, Ensure the sustainability, insight and practicality of technological innovation. In view of the impact of venture capital heterogeneity on technological innovation performance in this study, centralized venture capital organizations can be set up in various places to combine the individual differences of enterprises with the heterogeneity of members of risk institutions, so as to achieve "precise drip irrigation" of venture capital and technological innovation of enterprises and improve investment efficiency. The system and mechanism to promote the value-added of enterprises and the transformation and industrialization of scientific and technological achievements will provide strong support and guarantee for the construction of a modern economic system. In addition, according to the perspective of resource theory, diversified resources have a significant role in promoting technological innovation performance, so the integration of technological innovation forces among various regions and fields should be further optimized, and the distribution of innovation resources for technological innovation projects should be as much as possible to draw a blueprint to the end, so as to further narrow the uneven distribution of technological innovation performance among regions and industries. Promote the open sharing of innovation resources among enterprises.

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