Research on the Heterogeneous Impact of Pilot Free Trade Zones on Enterprise Innovation

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Abstract

In order to conform to the new trend of global economic and political development and make domestic economic development compatible with the globalization system, China has established free trade zones in various pilot sites since 2013. The setting of the free trade zone has a certain positive effect on enterprise innovation with its negative list management, government function transformation and other institutional innovation advantages and the facilitation of investment and trade environment, but under the conditions of enterprise ownership, the life cycle stage of the enterprise, and the industry in which the enterprise is located, there is heterogeneity in the impact of the pilot free trade zone on enterprise innovation, this paper uses the data of China's Shanghai and Shenzhen A-share listed companies and provincial panels from 2010 to 2020 from the perspective of micro enterprises themselves to carry out quasi-natural experiments. The double difference model is used to empirically investigate the impact effect and mechanism of the establishment of the pilot free trade zone on enterprise innovation, and the causal relationship between the establishment of the pilot free trade zone and the innovation behavior of micro enterprises is systematically explored and fully demonstrated.

Keywords

Pilot Free Trade Zone; Corporate Innovation; Multi-period Double Differential.

1. Introduction

In order to conform to the new trend of global economic and political development and make domestic economic development compatible with the globalization system, China has established free trade zones in various pilot sites since 2013. As of December 2020, China's free trade zones have undergone six expansions, with a total of 21, forming a basic pattern of east, west, south, north, and south, coastal and inland connections. The Outline of the 14th Five-Year Plan and the Long-Range Goals for 2035 points out that innovation should be adhered to the core position in the overall situation of China's modernization, and enterprises should play a vital role in the process of running through the innovation-driven development strategy. On July 9, 2021, General Secretary Xi Jinping stressed at the 20th meeting of the Central Committee for Comprehensively Deepening Reform that greater efforts should be made to plan and promote the high-quality development of pilot free trade zones. Studies have shown that the FTZ, with its special advantages of negative list management and transformation of government functions, provides an important institutional environment for the innovation and transformation of enterprises in the zone. At the same time, the establishment of free trade zones has improved the trade environment, and has a significant positive effect on foreign direct investment (FDI), while the increase in FDI will promote enterprise innovation from R&D funds and human capital, providing new solutions to alleviate the financing constraints often faced by enterprises in innovation. Therefore, under the macroeconomic background of the

"Belt and Road" initiative, innovation-driven development strategy and the development trend of digital economy, Chinese enterprises in the free trade zone should make use of their location advantages and their own endowment advantages to improve their independent innovation capabilities and promote the high-quality development of the regional economy.

Academics generally believe that industrial agglomeration, technology spillover, enterprise scale, enterprise productivity, regional cooperation, international inter-enterprise cooperation, international capital flow and patent protection system have a positive effect on enterprise innovation, and the establishment of free trade zones has significantly promoted the growth of urban total factor productivity and contributed to the upgrading of industrial structure in various regions. It is further found that factor allocation efficiency, infrastructure connectivity, financial development, enterprise internationalization level, and service industry agglomeration have significant positive intermediary effects. So does the establishment of the free trade zone promote the independent innovation of enterprises? What is the mechanism of its influence? Is there heterogeneity? From these perspectives, we can explore the innovation drivers of micro-enterprises in the pilot free trade zone, which is very useful for our goal of building an innovative country, and China has the advantage of domestic super-large market scale, which is very beneficial to China becoming an innovative country.

This paper systematically explores and fully demonstrates the causal relationship between the establishment of pilot free trade zones and the innovation behavior of micro-enterprises, and further investigates the intrinsic influence mechanism of pilot free trade zones on the innovation behavior of micro-enterprises. Starting from the micro-enterprises themselves, this paper uses the data of Shanghai and Shenzhen A-share listed companies and provincial panels in four regions of Shanghai, Guangdong, Fujian and Tianjin, China, conducts quasi-natural experiments, and uses the double difference model to empirically investigate the impact effect and mechanism of innovation policy pilot on enterprise innovation in the pilot free trade zone.

2. Literature Review

2.1. Research on the Effect of Policies Set by the Free Trade Zone

In recent years, with the increase in the number of various free trade zones around the world, many scholars at home and abroad have carried out a lot of research on the issues related to the free trade zone, especially the impact effect after the establishment of the free trade zone. From the perspective of economic growth, Liu Bingyu and Lv Cheng (2018) analyzed the difference indicators and found that the establishment of the free trade zone has a significant effect on improving regional innovation capacity [1]. Wang Aijian and Fang Yunlong et al. (2015) took institutional innovation and reform as the starting point to analyze the mechanism of the construction of free trade zones on regional economic growth under the background of dual circulation [2]. From the perspective of industrial structure, Liang Shuanglu et al. (2020) analyzed and examined five regional free trade zones in North America, Europe, ASEAN, China-ASEAN and South America, conducted empirical evidence through synthetic control methods, and tested five paths, and concluded that the establishment of free trade zones can promote industrial transformation through multiple paths [3]. In addition, as an optimistic representative of the transformation of the free trade zone to industrial results, Hirshman and others believe that the establishment of the free trade zone can reduce trade costs, mainly because the free trade zone breaks down trade barriers to promote the free flow of production factors, commodities and capital, so that the industries in the zone can be more flexible in their choice of structural upgrading and location [4]. In terms of asset allocation, the establishment of the free trade zone will help the company gradually open up the asset market, further effectively optimize the asset allocation of enterprises, and promote the high-quality, rapid and healthy development of the market economy. First of all, the establishment of the FTZ will

increase the use of RMB by multinational companies, so that companies and individual corporate citizens in the zone can use their local currencies more flexibly and diversely to achieve cross-border investment transactions, and further enhance the effect of corporate capital utilization. Secondly, the establishment of the free trade zone will complement the company's market-oriented transformation, jointly build a revenue composition system determined by the supply and demand relationship of the asset securities market, further enhance the sensitivity of capital prices, and then make the asset securities market play a decisive role in the company's asset allocation; Third, the establishment of the free trade zone will further broaden the company's domestic and foreign investment channels by promoting the reform of the company's foreign currency system, thereby promoting the company's two markets at home and abroad, and further improving the economic benefits of the company's fixed asset allocation; Finally, the establishment of the Shanghai Free Trade Zone promotes the two-way liberalization of the capital market and improves the efficiency of capital allocation and reallocation by exploring the investment and financing fund exchange facilitation system. (Wei Rongrong et al., 2020[5]).

2.2. The Driving Force of Enterprise Innovation

The drivers of enterprise innovation have been studied by many scholars. First, government policy support. Chen Yuanyan et al. (2017) pointed out that a series of preferential tax policies issued by the Zhongguancun National Independent Innovation Demonstration Zone are encouraging enterprise R&D investment, and the promotion effect is significant [6]; Yan Yanyang and Yan Jin (2019) point out that a series of "policy effects" and "agglomeration effects" can stimulate enterprises to carry out innovation activities through the implementation of national independent innovation demonstration zones [7]. Zheng Wei et al. (2021) empirically tested the panel data of industrial enterprises at the industry level in China for more than 10 years, and concluded that improving the efficiency of enterprise innovation-driven development can be promoted through fiscal science and technology policies, but its promotion role is different in different industries [8]. Second, external environment support. The external market of enterprises is the environment for the survival and development of enterprises, and one of the important factors for the smooth progress of technological innovation is the property rights protection system, and China's property rights protection system is still slightly imperfect. A good property rights protection system can create a good external environment for enterprise technological innovation, can effectively solve the exogenous problems of enterprise innovation, and properly protect the innovation achievements of enterprises. The degree of market competition can also have a huge impact on enterprise R&D investment, which is due to the concentration of high-tech talents and high-quality enterprises, which will intensify the degree of competition of enterprises in the region, in order to occupy market share, enterprises tend to invest in innovation and research and development in order to obtain excellent innovation results (Xia Qinghua et al., 2019 [9]). Third, adequate sources of funding. High innovation capacity is often accompanied by high capital investment, and when financing can be relatively low, enterprises may allocate funds from ordinary productive investment to R&D project investment, promoting corporate innovation activities [10].

2.3. The Impact of Free Trade Zones on the Level of Innovation

Many scholars have studied and demonstrated the role of the establishment of the free trade zone on the overall innovation ability of the region, such as Liu Bingyu, Wang Yue (2018[11]), Gao Zeng'an, Li Xiaomeng (2019[12]) and other research results have confirmed that the establishment of the free trade zone promotes the improvement of regional innovation level. Ye Linli (2021[13]) believes that the construction of the free trade zone has significantly promoted the level of regional technological innovation, mainly through three channels: trade facilitation, investment facilitation and industrial agglomeration effect. Xu Jiexiang et al.

(2020[14]) took innovation quality as the research starting point, and refined the indicators to measure regional innovation ability into invention patents, utility model patents and design patents with different technical content, and investigated the impact of the free trade zone on innovation quality. It has been found that the establishment of the free trade zone promotes the high-quality innovation output of enterprises and reduces the low-quality innovation output.

3. Theoretical Analysis

Through financial reform and institutional innovation, the pilot free trade zone will improve the business environment and allow enterprises to "go global" under the conditions of trade facilitation. The institutional innovation of the free trade zone is reflected in the innovation of the trade system of trade facilitation, the innovation of the financial system of the capital market, and the innovation of the regulatory system of government functions. In addition, the FTZ has also implemented management system innovation with the "negative list" as the core, the "negative list" has been slimmed down after the establishment of the free trade zone, and the international trade of the "single window" has been promoted in many places [15]. Compared with enterprises that are not in the free trade zone, enterprises in the free trade zone tend to increase innovation input and innovation output due to better market competition and more reasonable transaction costs.

(1) Market competition mechanism. Enterprises will determine the R & D output of funds due to market competition, the free trade zone brings together a large number of high-tech talents and high-quality enterprises, forced by the pressure of competition, enterprises will continue to carry out technological innovation, improve product quality, in order to pursue breakthrough technology, increase their own innovation results, form their own core competitiveness. Specifically: First, the concentration of many enterprises in the free trade zone, learning from each other, forming a competitive relationship, promoting benign competition between enterprises, stimulating enterprises to carry out more teamwork and technology spillover, so as to be able to have more innovative achievements [16]. Second, enterprises in the free trade zone have a small competitive advantage when there are many competitors in the zone, so enterprises will increase investment in research and development, create innovative output, and enhance their competitiveness.

(2) Transaction cost mechanism. The cost paid by economic entities to obtain accurate market information is transaction costs, and the pilot free trade zone will weaken information asymmetry, curb opportunistic behavior and increase transaction frequency through innovation agglomeration, economies of scale and innovation spillover effects, which is an economic mechanism to save transaction costs. The root cause is mainly because the establishment of China's free trade pilot area has created a good environment for companies in the zone to promote technological innovation, in order to use product technology innovation to obtain competitive advantages, our competent departments will also carry out product technology innovation management consulting services, entrust intermediaries to carry out technical consultation, and provide services to improve product technological innovation conditions, which leads to an increase in the exchange cost of business management functions when we carry out such activities. Therefore, to a certain extent, it can encourage us to increase investment in product technology innovation and increase the output of product technology innovation. At the same time, considering that the Shanghai Free Trade Zone has brought preferential tax policies, R&D subsidies, loan convenience, etc. to private enterprises in the zone, including preferential tax rate policies, etc., which have reduced the actual expenses of the company's operating tax and income tax, financial service support and loan facilitation policies have reduced the company's interest rate cost and financial handling fee to obtain loans, and the expenses incurred to raise the company's production and operation funds. These measures

can effectively reduce the capital market transaction costs and political transaction costs of China's small and medium-sized private enterprises, and also help to further reduce financing constraints for China's small and medium-sized private enterprises, thereby encouraging small and medium-sized enterprises to innovate.

(3) Heterogeneity of the internal environment of the enterprise. (1) Heterogeneity of enterprise ownership. Enterprises with different ownership systems of property rights will have different innovation responses to policy shocks and market fluctuations, and in general, state-owned enterprises are often less active in innovation and R&D than private enterprises due to their special responsibilities such as providing public goods and stabilizing the economy, as well as the stability of their employee structure and organizational structure[18]; (2) Enterprise lifecycle heterogeneity. In different periods of the company's existence, there are obvious differences in its operating ability, corporate strategy and corporate positioning[19]. (3) The heterogeneity of the industry in which the enterprise is located. High-tech enterprises tend to be more inclined to take technological innovation as their core competitiveness, so high-tech enterprises have stronger innovation incentives than non-high-tech enterprises.

Based on the above hypothesis:

Hypothesis H1: The establishment of a free trade zone increases the input and output of enterprise innovation.

Hypothesis H2: The innovative effect of the establishment of the free trade zone on enterprise innovation varies due to the ownership of the enterprise, the life cycle of the enterprise, and the industry in which the enterprise is located.

4. Study Design

4.1. Sample Source and Data Selection

In 2013, the executive meeting of the State Council of China adopted the "Overall Plan for the China (Shanghai) Pilot Free Trade Zone" (draft), and since then China has begun the pilot reform of the pilot free trade zone, and then at the end of 2014, it was decided to set up additional pilot free trade zones in Guangdong, Fujian and Tianjin, and expand the regional scope of the Shanghai pilot free trade zone. Therefore, this paper selects the first two batches of Shanghai and Shenzhen A-share listed companies in the four regions of Shanghai, Guangdong, Fujian and Tianjin to set up the free trade zone as the research object, and in order to ensure the completeness of the sample data, this paper sets the sample period as 2010-2020, and excludes the following enterprises: First, the enterprises listed after 2013 (the establishment of the Shanghai Free Trade Zone) in Shanghai, and the enterprises listed after 2015 (the second batch of free trade zones) in Guangdong, Fujian and Tianjin. Second, it is not possible to identify the enterprise with the exact place of registration. Third, enterprises with too many missing values in the sample. Fourth, financial and insurance industry companies, ST, *ST companies. After the above screening, this paper finally formed 3261 "enterprise-year" non-balanced panel data. The number of innovation patents granted by the listed companies in this article is mainly compiled by the Guotai An database and the State Intellectual Property Office, the basic financial data of the enterprise is mainly derived from the CSMAR database and Wind, and the remaining variables are derived from the National Bureau of Statistics and the statistical yearbooks of various provinces and cities. In this paper, Stata16 is used for data processing, and in order to control extreme value interference, all continuous variables are processed by Winsorize up and down 1%.

4.2. Model and Variable Definitions

The establishment of China Pilot Free Trade Zone provides a good quasi-natural experiment for this study, this paper takes Shanghai and Shenzhen A-share listed companies in four regions of

Shanghai, Guangdong, Fujian and Tianjin as research samples, constructs a multi-period double difference model (DID) on the basis of controlling the annual and firm fixed effects, and analyzes the regression results of the policy impact of the free trade zone from the two levels of enterprise innovation output and enterprise innovation input, as follows:

$$innov_{it} = a_0 + a_1 treatedyear + a_2 controls_{it} + \mu_i + \gamma_t + \varepsilon_{it} \qquad (1)$$

Among them, INNOV means that enterprise innovation is measured by the number of patent applications of enterprises and enterprise joint ventures plus the natural logarithm (rd_out) after 1 and the ratio of enterprise R&D investment to operating income (rd_input). treatedyearit is the core explanatory variable that reflects whether the region in which the listed company is located is in the free trade zone, and if the listed company is in the free trade zone, the value of treatedyear in the pilot year and subsequent years is 1, otherwise it is 0. If the listed company is not in the free trade zone, the treatedyear value is 0, and its coefficient α1 reflects the policy effect of the establishment of the free trade zone on enterprise innovation, this project mainly examines the coefficient α1, if the coefficient α1 is significantly positive, it means that the establishment of the free trade zone is conducive to promoting enterprise innovation.

a0 represents the constant term, controlsit represents the control variable, i represents the individual enterprise, and t represents the year. Control variables refer to some enterprise characteristics and regional characteristics that may affect the technological innovation of enterprises, including: enterprise scale (scale), expressed by the natural logarithm of the enterprise's assets at the end of the period; The age of the enterprise, expressed by the natural logarithm of the number of years of establishment of the enterprise; The asset-liability ratio (leverage), expressed by the ratio of the total liabilities of the enterprise at the end of the period to the total assets; Operating cash flow, expressed as the net cash flow generated by the company's operating activities as a proportion of total assets; Return on total assets (ROA), expressed as the ratio of the company's net profit for the year to its total assets at the end of the period; Tangible assets (PPE), expressed as the ratio of fixed assets to total assets at the end of the period; Property nature (SOE), state-owned enterprises take the value of 1, otherwise 0; The degree of marketization (LNGOV), expressed by the ratio of local public financial expenditure to GDP, reflects the impact of government investment and intervention on the regional market mechanism.

5. Analysis of Empirical Results

5.1. Descriptive Statistics

Table 1 shows the results of the analysis of descriptive statistics for the main variables. Among them, the minimum values of the number of patent applications (rd_out) and the ratio of R&D investment to operating income (rd_input) after logarithmization were 0.693 and 0.0243, the maximum value was 7.136 and 21.89, and the standard deviation was 1.373 and 3.917, respectively, which indicates that there are large differences in innovation output and innovation input of different enterprises. The mean value of the free trade zone establishment variable treatedyear is 0.0785, indicating that about 7.85% of the samples during the sample period may be affected by the establishment of the free trade zone.

Table 1. Descriptive statistics of main variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
treatedyear	3,261	0.0785	0.269	0	1
rd_out	3,261	3.415	1.373	0.693	7.136
rd_input	3,261	4.560	3.917	0.0243	21.89
age	3,261	8.522	0.422	7.705	9.260
scale	3,261	22.02	1.256	19.94	25.89
leverage	3,261	0.381	0.198	0.0349	0.842
soe	3,261	0.315	0.465	0	1
cashflow	3,261	0.0446	0.0648	-0.136	0.228
roa	3,261	0.0456	0.0484	-0.142	0.210
PPE	3,261	0.208	0.162	0.00346	0.771
lngov	3,261	9.102	0.536	8.103	9.766

5.2. Analysis of Regression Results

Table 2. Regression results

	(1)	(2)	(3)	(4)
VARIABLES	rd_out	rd_out	rd_input	rd_input
treatedyear	0.248***	0.319***	0.178***	0.155***
	(0.0793)	(0.0774)	(0.0553)	(0.0545)
age		-1.318**		-0.791*
		(0.573)		(0.404)
scale		0.458***		-0.0789***
		(0.0433)		(0.0305)
leverage		0.372**		-0.801***
		(0.147)		(0.103)
soe		0.182		0.0563
		(0.149)		(0.105)
cashflow		0.335		-0.159
		(0.254)		(0.179)
roa		0.107		-1.138***
		(0.368)		(0.259)
PPE		0.201		-0.144
		(0.142)		(0.0997)
lngov		0.484***		0.420***
		(0.0684)		(0.0482)
Constant	3.908***	-22.95***	0.561***	6.817*
	(0.276)	(5.180)	(0.192)	(3.648)
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Observations	3,261	3,261	3,261	3,261
R-squared	0.804	0.815	0.879	0.884

Concentrate:***, **, * represents significant at the levels of 1%, 5%, and 10%, respectively, with the t-value in parentheses.

In this paper, the double difference model is used for empirical testing, and the regression results are shown in Table 2. As can be seen from Table 2, in the regression results of the benchmark model, columns (1) and columns (3) are the estimated results that have not been added to the control variables, and columns (2) and columns (4) are the estimated results of the control variables. The results show that the coefficient of the free trade zone establishment variable (treated year) is significantly positive regardless of whether the control variable is added or not. The results show that the regression coefficient of the establishment variable of the free trade zone on enterprise innovation input (rd_input) is 0.155, which is significant at the level of 1%, which indicates that the establishment of the pilot free trade zone is conducive to promoting enterprise innovation input. The regression coefficient of policy dummy variables on firm innovation output (rd_out) is 0.319, which is significantly positive at the 1% level, indicating that the establishment of pilot free trade zones has promoted enterprise innovation output. In addition, the larger the scale of the enterprise, the stronger the innovation output ability; To a certain extent, the age of the company is negatively correlated with the technological innovation output of enterprises, indicating that the younger the enterprise, the stronger the awareness of technological innovation.

5.3. Parallel Trend Test

This paper uses the intertemporal dynamic panel model to examine the dynamic changes of enterprise innovation input and innovation output before and after the implementation of the pilot free trade zone, so as to test the parallel trend of policy effects. Specifically, this paper sets dummy variables according to the establishment time of the national pilot free trade zone, and examines the policy effects of the first 2 years (pre_3), the first 1 year (pre_2), the current year (current), the last 1 year (post_1), the last 2 years (post_2), the last 3 years (post_3), and the last 4 years (post_4) on the innovation input and innovation output of enterprises. The results of the common trend and dynamic effect test are shown in Figure 1. Among them, the left side of Figure 1 shows the dynamic effect of the innovation output of enterprises in the impact zone of the establishment of the free trade zone, and the right side of Figure 1 shows the dynamic effect of the innovation output in the impact zone of the establishment of the free trade zone.

Among them, the round black dot in the middle indicates the coefficient size of the policy effect of the free trade zone, and the dotted line represents the confidence interval. Firstly, by observing the innovation input and output of enterprises in the experimental group and the control group before the establishment of the free trade zone, it can be seen that the corresponding estimated coefficient values are close to 0 in the two years before the establishment of the free trade zone, and are not statistically significant, which indicates that there is no significant difference between the changes in enterprise innovation input and innovation output before the establishment of the free trade zone, that is, the research sample before the establishment of the free trade zone meets the parallel trend assumption. Secondly, this paper further examines the dynamic characteristics of the impact of the free trade zone on the innovation input and innovation output of enterprises. Combined with the two figures in Figure 1, it can be seen that after the establishment of the free trade zone, the policy effect of the establishment of the free trade zone on the innovation output of enterprises in the zone lags behind, and after the establishment of the free trade zone, it will have an immediate impact on the innovation input of enterprises, but in general, the establishment of the free trade zone has an obvious effect on the innovation output and innovation input of enterprises in the zone, which verifies the robustness of the benchmark regression results.
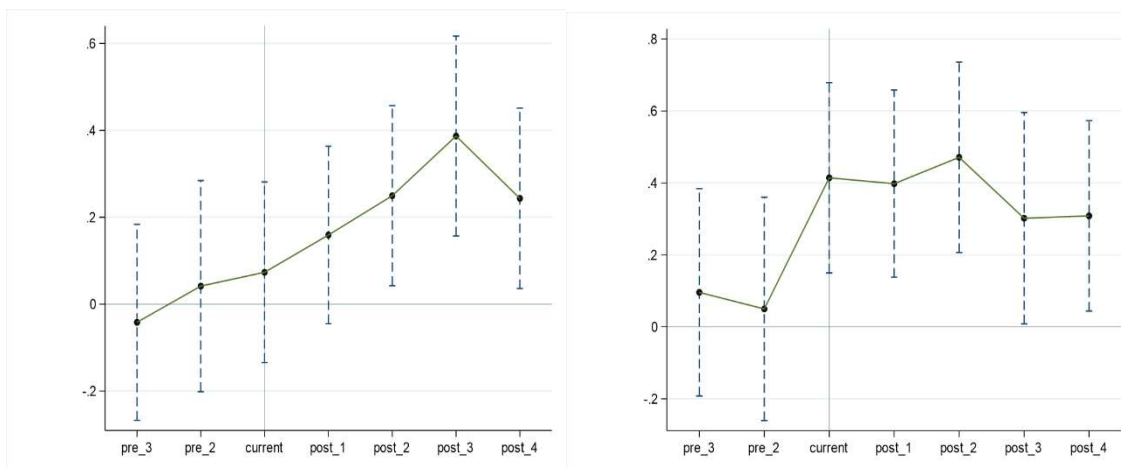
Fig. 1 Common trend and dynamic effect test

5.4.   Heterogeneity Test

Trea di Ferens Inter Enpaqué Bent Estahlish Gate Ben Pilo Freetra De Nzone Innovatien Ben Di Ferrent Tide Props Ben Ent Ente Pris, Anderte Separat Analyssis Ben Ente Prisg Herplov Droneti Hr Puerto Di Le Ex Pro Le Plot Im Streamer Mecha Sum Ben Sta Gli Gate Ben Fri Tra De Ness En Ente Pris Innovatien.

5.4.1. Heterogeneity of Enterprise Ownership

This paper divides the sample into two groups according to the nature of enterprise ownership, state-owned enterprises and non-state-owned enterprises, and examines the impact of the establishment of pilot free trade zones on the technological innovation investment of companies with different ownership characteristics, and obtains the regression results of columns (1) to (4) in Table 5. As far as state-owned enterprises are concerned, the impact of the establishment of free trade zones on the innovation investment of state-owned enterprises is not statistically significant. For non-state-owned enterprises, the regression coefficient for the innovation output of non-state-owned enterprises in the establishment of the FTZ is 0.503, which is significantly positive at the level of 1%; The regression coefficient of the impact of the establishment of the free trade zone on the innovation input of non-state-owned enterprises is 0.227, which is significantly positive at the level of 1%. This shows that the impact of the pilot free trade zone on the innovation behavior of state-owned enterprises is not obvious, but to a certain extent, it stimulates the innovation behavior of non-state-owned enterprises.

Table 3. Results of the heterogeneity test of enterprise ownership

VARIABLES	State-owned enterprises		Non-state-owned enterprises	
	(1)	(2)	(3)	(4)
	rd_out	rd_input	rd_out	rd_input
treatedyear	0.447***	0.0461	0.503***	0.227***
	(0.0964)	(0.0786)	(0.123)	(0.0858)
Constant	-7.611***	2.911***	-6.246***	3.648**
	(1.672)	(0.735)	(1.149)	(1.470)
controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Observations	1,016	1016	2,223	2223
R-squared	0.869	0.830	0.800	0.902

5.4.2. Heterogeneity of the Life Cycle Stages in Which the Enterprise is Located

This paper divides enterprises into growth period (7 years or less) and maturity period (more than 7 years) according to life cycle to test the heterogeneity of the impact of the establishment of free trade zones on enterprise innovation at different life cycle stages. It can be seen from Table 6 that for enterprises in the growth stage, the regression coefficient of innovation output in the free trade zone is 0.386, which is significantly positive at the level of 1%, while the regression coefficient of innovation input has not passed the significance test, which indicates that the establishment of the free trade zone has promoted the increase of innovation output of enterprises in the growth stage, but the impact on innovation input is not obvious. For mature enterprises, the regression coefficient of the establishment of the free trade zone for the innovation output of mature enterprises is significantly positive at the level of 1%, and the regression coefficient of innovation input is significantly positive at the level of 10%, which indicates that the establishment of the free trade zone has a significant role in promoting the innovation input and output of mature enterprises. The main reason is that enterprises in the growth stage are more susceptible to policy incentives. In order to obtain market position with innovative products, they are often constrained by limited factors such as funds, resulting in insufficient R&D investment; Mature enterprises have a more mature scale structure after early market exploration, R&D experience accumulation, etc., and are also able to acquire and acquire some innovative small enterprises, so mature enterprises are more willing to increase innovation investment to develop new products and technologies.

Table 4. Results of heterogeneity test at enterprise life cycle stage

VARIABLES	Growth period		Maturity period	
	(1)	(2)	(3)	(4)
	rd_out	rd_input	rd_out	rd_input
treatedyear	0.386***	0.118	0.493***	0.149*
	(0.145)	(0.0771)	(0.0895)	(0.0781)
Constant	-8.632***	3.559***	-4.919***	2.287**
	(1.392)	(0.738)	(1.275)	(1.104)
controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Observations	1,663	1,663	1,579	1,579
R-squared	0.787	0.847	0.852	0.872

5.4.3. Enterprise Industry Heterogeneity

High-tech enterprises play a leading role in technological innovation in all enterprises, are the "leaders" of enterprise technological innovation, and are more motivated to carry out technological innovation. This paper divides the sample into high-tech enterprises and non-high-tech enterprises according to the Administrative Measures for the Identification of High-tech Enterprises issued by the Ministry of Science and Technology. It can be seen from Table 7 that for high-tech enterprises, the regression coefficient of the variable treatedyear set up in the free trade zone on the innovation output and input of enterprises is positive under the significance test of 1%, for non-high-tech enterprises, the regression coefficient of the variable treatedyear set up in the free trade zone on the innovation output of enterprises is positive under the 1% significance test, and the regression coefficient of enterprise innovation input has not passed the significance test, which indicates that the improvement effect of the

establishment of the free trade zone on enterprise innovation is more obvious in high-tech enterprises.

Table 5. Results of enterprise industry heterogeneity test

VARIABLES	High-tech enterprises		Non-high-tech enterprises	
	(1)	(2)	(3)	(4)
	rd_out	rd_input	rd_out	rd_input
treatedyear	0.535***	0.208***	0.332***	0.111
	(0.103)	(0.0803)	(0.118)	(0.0691)
Constant	-5.759***	4.191***	-8.375***	4.126***
	(1.393)	(1.072)	(1.410)	(0.825)
controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Observations	1,771	1,771	1,452	1,452
R-squared	0.844	0.885	0.817	0.816

6. Conclusion and Revelations

Starting from the micro-enterprises themselves, this paper uses the data of Shanghai and Shenzhen A-share listed companies and provincial panels in the four regions of Shanghai, Guangdong, Fujian and Tianjin, China, conducts quasi-natural experiments, and uses the double difference model to empirically investigate the impact effect and mechanism of innovation policy pilot on enterprise innovation in the pilot free trade zone. The results show that compared with enterprises not in the free trade zone, the innovation input and innovation output of enterprises in the free trade zone are significantly increased, and the establishment of the free trade zone promotes enterprise innovation by promoting benign market competition and reducing transaction costs, and the innovative effect of the establishment of the free trade zone on enterprise innovation varies due to the ownership of enterprises, the life cycle of enterprises, and the industry in which the enterprises are located.

Through the research conclusions, the following enlightenment can be drawn: First, the establishment of the China Free Trade Zone will have important significance for improving the technological innovation level of small and medium-sized enterprises, which also shows that after the establishment of the China Free Trade Zone, it can achieve endogenous improvement and extension improvement by enhancing the technological innovation level of small and medium-sized enterprises, so as to promote institutional innovation, further improve the construction system of China's free trade zone, and gradually expand the construction scale of China's free trade zone in the whole province, which should be the content that needs to be examined in the process of formulating and implementing economic policies in the future. Second, this paper finds that the construction of China's free trade zone has a greater effect on the improvement of the innovation level of small and medium-sized enterprises than in the development of non-state enterprises and high-tech enterprises, so in the planning and construction process of the construction of the trade zone, it is also necessary to take into account the differences in enterprise property rights and business, coordinate the layout, not only give play to the driving function of non-state enterprises and high-tech enterprises, but also attach importance to the joint effect and collaborative development function between

small and medium-sized enterprises, and fully mobilize the enthusiasm of state-owned enterprises for innovation.

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