Research Article
Research on the Influence of Emission Trading System on Enterprises’ Green Technology Innovation

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This paper uses the data of China’s A-share listed companies in Shanghai and Shenzhen stock markets from 2003 to 2014 and takes the pilot emission trading policy in 2007 for a quasinatural experiment to explore the role of the pilot emission trading policy in promoting enterprises’ green technology innovation. The empirical research shows a Porter effect in the emission trading system in China. Specifically, first, the emission trading policy can significantly promote enterprises’ green technology innovation in pilot areas. In addition, the incentive effect of emission trading policy on green technology innovation is significantly different due to the types of green patents. Second, the incentive effect of emission trading policy on enterprises’ green technology innovation is different due to the nature and scale of enterprises. The incentive effect is greater in state-owned enterprises than in non-state-owned enterprises, and it is greater in large-scale enterprises than in small-scale enterprises. Finally, the incentive effect of emission trading policy on enterprises’ green technology innovation has heterogeneity of regions. It has the greatest incentive effect in eastern region, followed by western region and then central region.

1. Introduction

After more than 30 years of development, China’s economic aggregate has experienced qualitative growth. In 2021, China’s total domestic GDP reached nearly 101.6 trillion yuan, successfully maintaining the second position in the world. However, the cost of rapid economic development is often the pollution of the ecological environment. If the traditional economic development model is not shifted and the ecological environment problems are neglected, it will be difficult to achieve the transformation point of ecological environment improvement. China has adopted related policies and measures against environmental pollution and achieved remarkable results. However, with the rising quality of China’s economic development, the current ecological and environmental problems are still quite serious. In 2018, Yale University released the Global Environmental Performance Index ranking, in which China ranked 120th, reflecting that China’s existing environmental protection still needs to be further improved. The management of environmental pollution has a strong externality. It is difficult for enterprises, the main body in the profit-seeking market, to realize lucid waters and lush mountains only by their own consciousness. Therefore, it is necessary for the government to intervene. The purpose of the government’s environmental policies is to enable the harmonious development of economy and ecology and promote the transformation of economy to high quality. Government’s environmental regulation policies can be divided into two categories: command-oriented environmental regulations and market-oriented environmental regulations [1]. Compared with command-oriented environmental regulations, market-oriented environmental regulations are more conducive to technological innovation of enterprises [2–4]. With the improvement of marketization in China, the market-oriented environmental regulation policy has gradually become an important tool to improve the environment [5]. Whether the market-oriented environmental policy has advantages needs to be verified. Meanwhile, whether market-oriented environmental policy tools can
speed up the construction of a green technology innovation system in China needs to be further studied.

The existing market-oriented environmental regulation tools in China mainly adopted are emission trading, carbon emission trading, and environmental tax. In July 2002, the pilot emission trading policy was implemented in Shandong Province, Shanxi Province, Jiangsu Province, Henan Province, Shanghai City, Tianjin City, Liuzhou City, and China Huaneng Group Corporation, also known as the "4 + 3 + 1" pilot emission trading policy. In 2007, China gradually expanded the scope of the pilot areas. Zhejiang Province, Hubei Province, Chongqing City, Hunan Province, Inner Mongolia Autonomous Region, Hebei Province, Shaanxi Province, Henan Province, and Shanxi Province were also included in the pilot areas of emission trading. With the expansion of the pilot areas, the pollution varieties included in emission trading are gradually growing, and the emission trading volume is also increasing year by year [6]. At the same time, the total amount of pollutant emissions also shows an apparent downward trend. In 2010, China’s sulfur dioxide emissions were only 85.71% of those in 2005, down by 14.29%. It can be seen from the data that China’s emission trading system plays a significant role in environmental governance.

In April 2019, China issued the “Guiding Opinions on Building a Market-oriented Green Technology Innovation System,” which elaborated the path and time of building a green technology innovation system. Building a green technology innovation system has become an urgent problem to be solved. Due to China’s slow process of marketization, imperfect market mechanism in the past, and slow construction of intellectual property protection systems, enterprises lack the motivation for technological innovation. However, the core factor for the coordinated development of ecological environment and economic society is science and technology. The progress of science and technology is conducive to the better coordinated development of the two. At this stage, most enterprises tend to adopt passive and defensive measures when facing environmental regulation policy, and they are less likely to take the initiative to manage the environment. When dealing with environmental pollution, enterprises often focus on the end treatment of pollutant discharge, without paying attention to the process and source treatment of pollutant discharge, which leads to the increase of environmental treatment cost. This is insufficient to meet the growing demand for green products. As the main body of the market, enterprises are the essential objects of building a green technology innovation system. Enterprises’ green technology innovation is closely associated with market-oriented environmental policies. Because emission trading is relatively mature in China, this paper will explore the relationship between emission trading and enterprises’ green technology innovation.

From the existing literature, there are few studies on the relationship between pilot emission trading policy and environmental tax, especially those on enterprises’ green technology innovation, the main body of microeconomy. This paper aims to theoretically analyze the theoretical mechanism and verify the influence mechanism between them through actual data. The theoretical significance of this paper is to elaborate the theoretical mechanism of emission trading policy on enterprises’ green technology innovation and quantitatively analyze the incentive effect of pilot emission trading policy on enterprises’ green technology innovation by using the measurement methods such as score matching and DID, thus supplementing the existing literature. The practical significance is to verify the incentive effect of the pilot emission trading policy on enterprises through actual data and further elaborate the influence mechanism between emission trading policy and green technology innovation in a certain period, thus providing some inspiration for building a green innovation system and further improving the emission trading policy.

The possible innovations of this paper are as follows. First, there are few studies on the relationship between emission trading system and green technology innovation. Moreover, domestic and foreign studies are primarily based on the “Porter Hypothesis.” However, due to the differences in methods and indicators adopted by scholars, the conclusions drawn are not entirely consistent. Most of the existing studies are located in the whole industry, the polluting industry, or the green industry. There are few studies only taking the SO2-emitting industry as the research object. Therefore, it is innovative to take SO2-emitting enterprises as the research sample in this paper. Second, this paper details the action mechanism of emission trading system on enterprises’ green technology innovation and explores the heterogeneity of the incentive effect from a multidimensional perspective.

2. Literature Review

The influence of environmental regulation policy on green technology innovation has been controversial in academic circles. According to neoclassical economics theory, namely, from a static point of view, environmental regulations increase enterprises’ pollution-control cost, thus generating a crowding-out effect on their R&D innovation and inhibiting their green technology innovation. For example, Rhoades [7] thinks that the environmental regulation policy makes enterprises in the fierce market competition environment passively transform technologies and processes, change the original high-pollution production mode, and guide them to carry out innovation activities that have economic effects and protect the ecological environment. However, in reality, the complexity of green technology innovation often leads to the weakening of enterprises’ green technology innovation. Gray and Leonard empirically find that environmental regulations force enterprises to shift some production resources to pollution control, thus increasing their production costs and reducing high-risk innovation activities [8, 9]. Fisher et al. [10] divide two stages when enterprises face environmental regulations, namely, the compliance stage and the active management stage. In the first stage, enterprises are generally unwilling to follow the regulations and respond passively because these regulations will increase their governance costs. In the second stage, enterprises...
gradually pay attention to the active management of ecological environment, but will not rely on green technology innovation. From the heterogeneity of regions, Dong Zhqing [11] argues that the development of highly polluting enterprises in neighboring places with high environmental regulation intensity drives the overall output value up in the long term, which in turn increases the investment in green technology innovation. In the long run, polluting enterprises in neighboring areas gradually shift to clean technology, thus eventually weakening their green technology innovation.

From a dynamic perspective, the most representative one is the “Porter Hypothesis” put forward by foreign scholar Potter in 1991. Its core view is that environmental regulations will increase the pollution-control cost of enterprises, but it will generate their innovation activities. The effect brought by innovation activities may offset the increased cost, thus reducing the overall production cost and enhancing the competitiveness of enterprises. Subsequently, Porter and Vander Linde, Xepapadeas et al., and Ambec et al. conclude that environmental regulations can promote technological innovation of enterprises, resulting in “innovation offset” [12–14]. Chinese scholars Bai Jia et al. and Chen Qiang et al. empirically verify that the Porter Hypothesis is also applicable in China, and appropriate environmental regulation can promote the technological innovation of enterprises [15, 16]. Li Wei et al. [17] find that traditional enterprises are inclined to internalize pollution costs when confronting environmental regulations, increase R&D investment in clean and green technologies, and then promote the efficiency of green technology innovation. Tao Feng et al. [18] prove that environmental regulations can drive enterprises’ green technology innovation from the perspective of environmental protection target responsibility system, and this system has a positive effect on the number of green patent applications, but it will lead to the corresponding decrease in the quality of innovation. However, a number of scholars discover that the relationship between environmental regulations and technological innovation is not a simple linear relationship, but a more complicated U-shaped relationship. For example, UIECE has investigated more than 2,500 enterprises in Europe and found that environmental regulations both promote and inhibit the technological innovation of enterprises, but the promotion effect is weaker than the inhibition effect. Jiang Fuxin [19] use data on manufacturing industries in Jiangsu and empirically verify that the technological innovation of enterprises decreases first and then increases as environmental regulations intensify. Meanwhile, they state that environmental regulations can promote the technological innovation of enterprises only when the intensity of environmental regulations exceeds a certain degree. Zhang Juan et al. [20] find a positive U-shaped relationship between environmental regulations and green technology innovation by using the game model.

Because the influence of environmental regulations on technological innovation will be affected by various factors, simple linear or nonlinear relationship can not describe the relationship between them well. Zhao Xikang and Aiken et al. find that environmental regulations do not affect the technological innovation of enterprises, and environmental regulation policy does not have a significant Porter effect on enterprises [21, 22]. Jiang Ke [23] states that when the quantitative indicator of enterprise innovation is the number of patent applications, there are different effects between them due to the influence of human capital, but there is no obvious statistical relationship between them when other quantitative indicators are taken. You et al. [24] explain that the reason for this insignificant relationship between them is that environmental regulations bring both positive and negative effects to the technological innovation of enterprises, and the two kinds of effects hedge against each other, thus leading to an overall insignificant relationship.

The existing studies on the effect of emission trading policy are carried out from environmental performance, economic performance, and technological innovation. First of all, the research conclusion proves that the emission trading policy has a significant emission reduction effect. For example, Schleich and Betz [25] find that the emission trading system can effectively promote the emission reduction activities of small- and medium-sized enterprises, but the emission reduction effect largely depends on the actual reported emission levels of enterprises. Betsil and Hoffmann [26] think that the emission trading mechanism can effectively reduce greenhouse gas emissions in industry. Yan Wenjuan et al. [27] and Li Yongyou [28] conclude that the emission trading policy can effectively reduce the emissions of pollutants in the pilot areas. In other words, the emission trading policy has a significant emission reduction effect. Shi Dan and Li Shaolin [29] conclude that emission trading can significantly improve the total factor energy utilization rate of unit area, and the limited emission trading policy may even have a restraining effect. Shin [30] argues that China’s environmental policy has weakened its own institutional innovation due to the excessive imitation of foreign environmental policy, thus leading to the failure of China’s emission trading system. Borghesi et al. [31] conduct an empirical analysis using data from Italian manufacturing enterprises and demonstrate that European emission trading policy has a limited emission reduction effect. Chinese scholars, Li Yongyou, and Shen Kun [32] find that the pilot emission trading policy in 2002 does not play a significant role in reducing pollutant emissions, but increases the pollutant emissions in the pilot areas. From the energy perspective, Shao et al. [33] believe that the reason why the emission reduction effect of emission trading is not obvious lies in the energy rebound effect. Tu et al. [34] think that the emission trading system in 2002 does not realize the “Porter effect.” Ren et al. [35] conclude from the perspective of total factor productivity that the emission trading policy adjusts enterprises’ technological innovation and market resource allocation to improve total factor productivity. Qi et al. [36] explore the issues of emission trading policy and green technology innovation and discover that the emission trading policy promotes enterprises’ green innovation in 2007.

After sorting out the relevant literature, it is found that there are three deficiencies in existing studies. First, there are few studies on emission trading policy and enterprises’ green
technology innovation. Second, the effect of emission trading policy is controversial, and whether it has a positive or negative impact on enterprises’ green technology innovation needs to be verified urgently. Third, they do not consider the effects of industry, ownership nature, and other factors in emission trading policy influencing enterprises’ green technology innovation.

3. Theoretical Analysis and Research Hypotheses

Based on the “Porter Hypothesis,” this paper expounds the mechanism between emission trading policy and enterprises’ green technology innovation. Porter believes that appropriate environmental regulations can generate enterprise innovation activities [12]. Emission trading, as one of the core tools of market-oriented environmental regulation policy, should also generate innovation activities of enterprises in theory. The emission trading system is based on the ownership of pollutants, which quantifies the price of pollutant emissions. In this regard, enterprises can reduce their pollutant emissions through green technology innovation, sell the excess emission rights in the market, and obtain extra profits. Because the emission trading system makes the amount of pollutant emissions market-priced, enterprises can plan their costs according to their actual situation and make flexible decisions on whether to carry out green innovation and whether to buy emission credits, thus helping them achieve the goal of pollution control at the lowest cost [37, 38]. The emission trading policy simply means that the local government sets the maximum emission quotas for each region and then allocates these emission quotas to each enterprise reasonably. Then, enterprises can freely trade these quotas in the market. As the emission trading system makes the pollutant emission have a price, the cost of enterprises with higher pollutant emissions will increase, and the returns and profits will decrease. When the unit return is equal to the unit cost, enterprises will reach the point of stopping business and face three choices of stopping business, relocating to other places, or carrying out green innovation locally, so as to reduce their pollutant emissions and the related cost. The opportunity cost of stopping business or relocating is generally too high. The cost of factory building and market development will become sunk cost, and there is uncertainty about the future implementation of emission trading policy in the relocated place. Therefore, enterprises will prioritize carrying out green innovation locally [39].

In view of this, this paper puts forward H1: the emission trading policy promotes enterprises’ green technology innovation.

From the nature of enterprises, state-owned enterprises are often far less sensitive to prices than non-state-owned enterprises. When the emission rights are marketized, non-state-owned enterprises will be more active in green technology innovation. Moreover, when emission trading is not implemented, green technology innovation is similar to public goods, and its yield rate is low. After the implementation of the emission trading policy, the private attributes of green technology innovation products mean that enterprises can obtain excess returns by carrying out green innovation. State-owned enterprises attach more importance to social responsibility and are far larger than non-state-owned enterprises in capital and enterprise scale. The implementation of emission trading will encourage state-owned enterprises to carry out green innovation, so that they can obtain profits while fulfilling their social responsibilities. In the meantime, because non-state-owned enterprises pay more attention to private interests, they will compare the returns from green technology innovation with those from their own main product innovation and then choose the optimal solution. Due to the large investment and long payback period of green technology innovation, it is riskier for them. Compared with its main product innovation, green technology innovation is more difficult and less profitable, so non-state-owned enterprises tend to shift their capital to main product innovation.

Based on the above analysis, this paper puts forward H2: the incentive effect of emission trading policy on enterprises’ green technology innovation is heterogeneous due to the nature of enterprises, and its incentive effect on state-owned enterprises is greater than that of non-state-owned enterprises.

From the perspective of enterprise scale, large-scale enterprises are far superior to small- and medium-sized enterprises in capital and technology. After the marketization of emission rights, small- and medium-sized enterprises confront greater competitive pressure. The main reason is that green technology products become more personal and exclusive after the marketization of emission rights. Small- and medium-sized enterprises have to intensify their green technology innovation to enhance their competitiveness. In addition, after the implementation of emission trading, the pollution-control cost of small- and medium-sized enterprises correspondingly rises due to the lack of technology, thus reducing their profits and further worsening the living environment of enterprises. From the types of enterprises’ green innovation products, the profits brought by invention patents are generally much higher than those brought by utility model patents. As the main body in the profit-seeking market, enterprises pursue the maximization of profits and tend to choose high-profit invention patents.

Hence, this paper puts forward the following hypotheses.

H3: emission trading has a stronger incentive effect on large-scale enterprises’ green technology innovation.

H4: compared with enterprises’ green utility appearance patents, emission trading has a stronger role in promoting enterprises’ green invention patents.

4. Model Setting and Variable Description

4.1. Model Setting. This research expects to evaluate the pilot emission trading policy. A DID model is set up to study the influence of emission trading on enterprises’ green technology innovation. The model is set as follows:
Among them, \( t, i, \) and \( j \), respectively, represent the year, the individual enterprise, and its region. \( \phi_t \) represents the time fixed effect. \( q_j \) represents the region fixed effect. \( e_{ijt} \) represents the random interference item.

The explained variable is \( \text{EnvPatent}_{ijt} \), which indicates the number of green patent applications of listed companies. In the heterogeneity analysis, this paper also discusses the results of utility model green patents. The explanatory variables of the model include the dummy variable of the policy pilot area and the dummy variable of the policy pilot time. \( \text{treat}_j \) represents the dummy variable of the emission trading pilot area. If the enterprise is located in a pilot area, the value is 1; otherwise, the value is 0. \( \text{post}_t \) represents the dummy variable of the time for implementing the policy. It is the time during the pilot period of emission trading (2007 and afterward), the value is 1; otherwise, the value is 0.

4.2. Variable Selection and Processing. In this paper, SO2-emitting enterprises in A-shares of Shanghai and Shenzhen stock markets are selected as research objects, and the sample period is from 2003 to 2014. The selection steps are as follows. First, the SO2-emitting industries are identified. Referring to the research of Qi et al. [36], the mining industry and manufacturing industry are selected as the research industries, and the criterion for determining the industries is the “11th Five-Year Plan for the Prevention and Control of Acid Rain and Sulfur Dioxide Pollution” issued by the State Environmental Protection Administration. Second, the scope of SO2-emitting enterprises is determined by referring to the SO2 emission information in the annual report and social responsibility report (CSR) of listed companies manually collected by Ren et al. [35]. Third, to make the results of this paper more robust and reliable, the enterprises with severe sample missing and ST enterprises are excluded by referring to the common practices in the existing literature.

In this paper, the economic characteristics at the enterprise-level are selected as the control variables of the model. It mainly includes enterprise scale (logarithm of net assets and logarithm of number of employees), enterprise maturity (logarithm of enterprise age), enterprise social wealth creativity (logarithm of Tobing), and enterprise credit evaluation (logarithm of enterprise liabilities). Descriptive statistics of variables in this paper are presented in Table 1.

5. Empirical Analysis

5.1. Baseline Analysis. According to the previous research hypotheses, this paper first tests the hypotheses based on model (1). In columns (1)-(3) of Table 2, the time fixed effect and region fixed effect are gradually increased. In columns (4)-(6), the control variables are further added and replaced by panel regression. To eliminate the influence of time trend term, this paper adds in columns (7) and (8) the time trend effect of provinces and the time trend effect of industries. In addition, the standard error used in the regression of this paper is the robust standard error adjusted by heteroskedasticity.

The regression results in Table 2 show that the emission trading system promotes enterprises in the pilot areas to carry out green technology innovation activities. The regression results presented in columns (1)-(3) of Table 2 reveal that the coefficients of “did” are positive, and the coefficients are all significant at the level of 10%, which preliminarily indicates that the emission trading system can significantly promote enterprises in pilot areas to carry out green technology innovation activities. In columns (4)-(6), after adding control variables and replacing with panel linear regression, the coefficients of “did” are still positive, showing that the baseline model set in this paper is reasonable. Taking column (4) as an example, the implementation of emission trading system increases the number of enterprises’ green patent applications by 1.3198, which is significant at the level of 1%. After adding the time trend effect, the regression results of columns (7)-(8) demonstrate that the coefficients of “did” are still significantly positive at the level of 10%, indicating that it is still reasonable after controlling the stricter effect, and the emission trading system increases the number of enterprises’ green patent applications in the pilot areas. To sum up, hypothesis 1 is verified.

5.2. Robustness Test

5.2.1. Measurement Errors. Exclude the year when the policy is launched. Since the emission trading system was introduced in the middle of 2007, the samples in 2007 are excluded in this paper to avoid possible measurement errors. Specifically, this paper reassigns the values for the policy identification items. When the year is within 2003–2006, Post is 0; when the year is within 2008–2014, Post is 1. Other variable settings are consistent with model (1). Column (1) of Table 3 lists the regression results after excluding the year when the policy is launched. It can be seen that the coefficient of “did” is 1.3368, which is still significant and positive at the level of 1%, indicating that the previous conclusion is relatively robust.

5.2.2. Missing Variables. PSM-DID estimation: because DID method is prone to “Selection Bias” and it cannot guarantee that the sample characteristics of the policy group and the control group are the same before the policy implementation, errors may occur when the sample size is large. The samples in this paper are listed enterprises all over the country, and the economic development level and technical ability vary greatly in different regions. Therefore, this paper uses the propensity score matching (PSM) to use control variables as identification objects, matches the enterprises in the policy group and the control group, and then regresses the retained samples with the DID method. Figure 1 demonstrates the 1:1 nearest neighbor matching result.

\[
\text{EnvPatent}_{ijt} = \beta_0 + \beta_1 \text{post}_t \ast \text{treat}_j + \beta_2 \text{post}_t + \beta_3 \text{treat}_j + \rho X_{it} + \phi t + \varphi j + \epsilon_{ijt}. \tag{1}
\]
of the PSM, suggesting that the matching result is good. Column (2) of Table 3 presents the results of the PSM-DID model, indicating that the emission trading system still significantly improves the green technology innovation of listed companies, and the previous conclusions are still robust.

### 5.3. Heterogeneity Analysis

#### 5.3.1. Heterogeneity of Patent Natures

To expand the research on the types of enterprise green innovation, this paper uses enterprises’ green utility model patents to replace the green patent applications. Furthermore, it investigates the
Porter effect of different natures of patent. This paper continues to use the Poisson regression. The regression results in Table 4 show that the influence of green utility model patents is not significant compared with the positive promotion of green patents at the level of 1%. It indicates that the Porter effect of emission trading policy on green innovation of enterprises mainly lies in green invention patents with "profound" innovation rather than green utility model patents.

Table 4: Heterogeneity of patent natures and enterprise natures.

| Variable          | (1) Green patent | (2) Green utility model patents | (3) Non-state-owned enterprises | (4) State-owned enterprises |
|-------------------|------------------|--------------------------------|---------------------------------|-----------------------------|
| did               | 1.3198***        | 0.3605                         | -1.5346**                      | 2.0282***                   |
| (0.4112)          | (0.2665)         | (0.6648)                       | (0.4060)                       |
| Treat             | -2.7290***       | -1.3860***                     | -0.0218                        | -3.1195***                  |
| (0.6465)          | (0.4302)         | (0.9073)                       | (0.7532)                       |
| Post              | 0.9545*          | 2.6131***                      | 16.8917                        | 0.5431                      |
| (0.5029)          | (0.2878)         | (13.2532)                      | (0.5072)                       |
| Control variable  | Controlled       | Controlled                     | Controlled                     | Controlled                   |
| Time fixed effect | Controlled       | Controlled                     | Controlled                     | Controlled                   |
| Region fixed effect | Controlled       | Controlled                     | Controlled                     | Controlled                   |
| N                 | 13515            | 13515                          | 6341                           | 7174                        |
| $R^2$             | 0.6462           | 0.4075                         | 0.3682                         | 0.7484                      |

Table 5: Heterogeneity of enterprise scale and region.

| Variable          | (1) Large-scale | (2) Small-scale | (3) Eastern region | (4) Central region | (5) Western region |
|-------------------|-----------------|-----------------|--------------------|--------------------|--------------------|
| did               | 1.4500**        | 0.0573          | 1.6855***          | -2.1302*           | 1.1579             |
| (0.6421)          | (0.4309)        | (0.4209)        | (1.1566)           | (0.8925)           |
| Treat             | -2.8513***      | -2.0659**       | -2.4403***         | 2.7855**           | 0.7730             |
| (0.8735)          | (0.8250)        | (0.4436)        | (1.3797)           | (0.8881)           |
| Post              | 0.8186*         | 3.2583***       | 0.9163*            | 17.5341***         | 1.6934**           |
| (0.4803)          | (0.7003)        | (0.5235)        | (1.2225)           | (0.7598)           |
| Control variable  | Controlled      | Controlled      | Controlled         | Controlled         | Controlled         |
| Time fixed effect | Controlled      | Controlled      | Controlled         | Controlled         | Controlled         |
| Region fixed effect | Controlled      | Controlled      | Controlled         | Controlled         | Controlled         |
| N                 | 7043            | 6693            | 8312               | 3364               | 1839               |
| $R^2$             | 0.6645          | 0.1299          | 0.6878             | 0.2144             | 0.2978             |

5.3.2. Heterogeneity of Enterprise Natures. Emission trading is a policy. To explore the response of enterprises with different ownership systems to the policy, this paper divides enterprises into non-state-owned enterprises and state-owned enterprises. Column (3) of Table 4 shows that the coefficient of "did" for non-state-owned enterprises is -1.5346, significant at the level of 5%, indicating that the emission trading system reduces the level of green technology innovation of non-state-owned enterprises. Column
(4) presents that the coefficient of “did” for state-owned enterprises is 2.0282, significant at the level of 1%, indicating that state-owned enterprises are more stimulated by green innovation in the emission trading system. Although the result is contrary to hypothesis 2, it may be in line with reality. Because of the characteristics of China’s political system, the state-owned enterprises have higher flexibility for the policies put forward by the state than non-state-owned enterprises, so they will react more strongly when the policies are introduced. Therefore, this result is understandable.

5.3.3. Heterogeneity of Enterprise Scale. The innovation level of enterprises is obviously closely related to the enterprise scale. Based on hypothesis 3, we divide enterprises into large-scale enterprises and small-scale enterprises according to their median net assets, and we further investigate the heterogeneity of the influence of the emission trading system. From the results in columns (1) and (2) of Table 5, it can be observed that the larger the enterprise scale, the greater and more significant the incentive effect of emission trading system. Thus, hypothesis 3 is verified.

5.3.4. Heterogeneity of Region. The eastern region has long been economically developed in China. The strategy of developing the western region is also launched in the western region in the time interval selected in this paper. To further study the heterogeneity of the influence of emission trading system, this paper divides the regions of enterprises into eastern, central, and western regions according to the regions where enterprises are registered. The results listed in columns (3)-(5) of Table 5 demonstrate that the incentive effect in the eastern region is the most significant and greatest, followed by the western region and then the central region.

6. Conclusion

This paper makes a quasinatural experiment with China’s pilot emission trading policy introduced in 2007. Based on the data of enterprise-level green patent applications of A-share listed companies in Shanghai and Shenzhen stock markets from 2003 to 2014, the differences of green innovation applications, enterprise ownership, enterprise scale, and region are defined. The influence of the pilot emission trading system on enterprise-level green innovation activities is verified by DID, two-way fixed effect model, and PSM-DID.

The empirical results are as follows. First, the emission trading policy effectively promotes the enterprises in the pilot areas to carry out green technology innovation activities. Second, the emission trading policy has a stronger promoting effect on green invention patent applications than on green utility model patent applications. Third, the incentive effect of emission trading policy on green technology innovation is stronger in state-owned enterprises, enterprises with higher net assets, and enterprises in the eastern region.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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