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The Impact of Capital Market Opening on Enterprise Green Technology Innovation: Insights from the Shanghai–Hong Kong Stock Connect

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Abstract: China's economy has experienced a period of remarkable growth and entered a stage of high-quality development, necessitating the implementation of innovative eco-friendly practices involving green technology innovation. The capital market environment plays a direct role in influencing the sources and scale of external financing for businesses, thus affecting their green technology innovation activities. The Shanghai–Hong Kong Stock Connect (SHSC) mechanism in China is the first official two-way opening of China's capital market. Therefore, this paper regards the SHSC policy as a quasi-natural experiment platform for the opening of the capital market and employs a difference-in-difference methodology to investigate the impact of the SHSC policy on enterprise green technology innovation and its influence mechanisms. The overall sample covers Chinese A-share listed enterprises from 2012 to 2017. The findings demonstrate that the SHSC policy significantly enhances the level of green technology innovation by enhancing corporate governance and alleviating financing constraints. Non-state-owned enterprises are more affected than state-owned ones, and there is no significant difference in the impact between heavily polluting industries and non-heavily polluting ones.

Keywords: green technology innovation; capital market opening; Shanghai–Hong Kong Stock Connect; difference-in-difference model

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1. Introduction

Since the 21st century, the survival and development of human beings have been seriously threatened by the emission of pollutants [1–3]. Promoting green technology innovation is crucial for the construction of the modern, urban, and sustainable development of human society [4–8].

Going green is not only an inevitable choice for economic development and social prosperity but also a core requirement of many national policies in recent years [9–11]. At present, China's economy has shifted from the stage of high-speed growth to the stage of high-quality development, which focuses more on environmental protection and sustainable green development. In 2021, as the world's largest source of carbon emissions, China's carbon emissions of the second-largest economy are 11.47 billion tons, which is twice as much as that of the United States and four times as much as that of the European Union [12].

Existing studies show that technological innovation and green development are two major engines for high-quality economic development [13], and the intersection of the two is the green technology innovation of enterprises. Green innovation is a type of innovation that not only can have benefits for consumers and enterprises but also can greatly decrease the adverse effects on the environment [14,15]. As an integral part of green innovation, green technology innovation refers to the introduction of new types of technical environmental innovations to enforce new technologies and promote sustainable development [16,17]. The exploration of China's green technology innovation system appeared in the form of green technology or environmental technology at the beginning. According to the definition of China National Intellectual Property Administration, green technology refers to technology that is conducive to saving resources, improving energy efficiency, preventing and controlling pollution, and realizing sustainable development, while green patents are patents with green technology as the subject of invention. Green patents represent the output of enterprises' green technology innovation activities, so green patents' data can be used to evaluate enterprises' green technology innovation ability [18].

The essence of green technology innovation is to form a green economic growth mode [19,20]. Promoting the coordinated and efficient development of enterprise green technology innovation is of great significance to the realization of high-quality economic development in China [21]. In addition, green technology innovation is an important driving force for the sustainable growth of the global economy [22–24]. The current research on the influencing factors of enterprise green technology innovation mainly focuses on the following three aspects: In terms of environmental regulation, relevant studies have found that it is difficult to completely rely on the means of a spontaneous market system to promote enterprise green technology innovation [25]. Meanwhile, environmental protection tax reforms [26], pollution charges [27], low-carbon city pilot policies [28], and environmental responsibility systems [29] can promote enterprise green technology innovation. In terms of green finance, more scholars mainly take the two types of financial instruments, green credit and green bond, as the entry point, and find that green bond [30,31] and green credit [32,33] can promote enterprise green technology innovation. In terms of individual characteristics of enterprises, Cao and Chen, and Huang and Li explored the green innovation behaviors of enterprises from the perspective of executives' environmental awareness and found that the dynamic coordination ability of enterprises is an important driving force for green technology innovation [34,35]. Amore and Bennedsen found that enterprise governance and green technology innovation are significantly correlated, with poorer governance firms having a lower share of green patent output relative to their total innovation output, and this negative effect is more pronounced in firms with smaller institutional shareholdings, smaller green patent stocks, and more financial constraints [36]. Conversely, there is a scarcity of research examining the impact of capital market opening on enterprise green technology innovation.

Capital market opening refers to a government's decision to remove restrictions on foreign investors and allow them to participate in the stock market as domestic investors [37]. Capital market opening has been shown to have a significant impact on the economy [38] by increasing enterprise innovation [39], reducing information asymmetry [40–42], improving risk sharing and investment efficiency [43,44], improving governance level [45], and reducing financing cost [46,47].

The opening of China's capital market has developed rapidly from the establishment of B-share, Qualified Foreign Institutional Investor (QFII), Qualified Domestic Institutional Investor (QDII), and H-share trading system to the launch of Shanghai–Hong Kong Stock Connect (SHSC) and Shenzhen–Hong Kong Stock Connect (SZHSC) policies. The SHSC policy is the first official realization of the two-way opening of China's capital market and a milestone event in the process of China's capital market opening. It has fundamentally changed the closed status of China's stock markets. Under the SHSC trading mechanism, investors in the two regions are allowed to trade specified stocks and stock ETFs listed in each other region's stock exchange, which is very different from the strict regulation under the previous QFII and QDII systems. The establishment of the SHSC mechanism and the subsequent opening up of the scale and the gradual expansion of the project have resulted in a large number of high-quality enterprises in Shanghai being optional trading targets for investors in the Hong Kong stock market. Undoubtedly, the SHSC policy is an important step in China's financial reform. According to Wind data, from 2015 to 2022, the annual average value of the transaction amount of the Hong Kong-to-Shanghai part of the SHSC and Hong Kong-to-Shenzhen part of the SZHSC accounted for more than 60% of the total transaction amount of the Shanghai and Shenzhen stock markets, and the overall trend is increasing. The total amount of mainland stocks held by Hong Kong and overseas investors through Shanghai Stock Connect and Shenzhen Stock Connect has continued to grow, from CNY 86.5 billion at the end of 2014 to CNY 2.2 trillion on 30 November 2022.

The existing literature mainly explores the relationship between the SHSC and China's domestic capital market, enterprise innovation, and enterprise ESG (Environmental, Social, and Governance) performance. First, studies found that the opening of the SHSC can significantly improve the efficiency of the capital market [48], reduce the idiosyncratic volatility of the stock prices of the underlying stocks in the Shanghai Stock Connect [49], and enhance the efficiency of resource allocation in China's domestic stock market [50]. Second, a few studies point out that the SHSC improves the level of technology innovation of enterprises by reducing credit dependence, enhancing the role of external supervision to improve the level of enterprise R&D [51], optimizing the channels of enterprise information environment to improve the level of enterprise innovation [52], etc., thus significantly contributing to the quality of enterprise innovation [53,54]. Finally, Lei points out that, under the mechanism of SHSC, enterprises are more willing to disclose their social responsibility information, and the quality of enterprise ESG disclosure is significantly improved in both "content" and "industry" [55].

In conclusion, the current research mainly focuses on the impact of the SHSC policy on enterprise governance, capital market efficiency, and enterprise innovation, with no further breakdown of the types of enterprise innovation. Regarding the factors influencing the level of green technology innovation of enterprises, the existing results mainly focus on environmental regulation, green finance, and individual characteristics of enterprises. However, there are few studies on the role of capital market opening on the green technology innovation of enterprises and the mechanism of influence.

Against this background, this study focuses on the following four questions:

(1) What is the impact of the opening of the SHSC on the level of green technology innovation of the underlying enterprises of the Shanghai Stock Connect? Is the effect on the "quality" and "quantity" of green technology innovation symmetrical?
(2) What is the mechanism by which the impact takes place?
(3) Is the effect consistent across state-owned enterprises and non-state-owned enterprises, as well as between heavily polluting industries and non-heavily polluting industries?
(4) What are the inspirations for policymakers to improve the relevant system to promote the level of green technology innovation of enterprises?

To this end, microdata from Chinese A-share enterprises listed on the Shanghai Stock Exchange (SSE) from 2012 to 2017 are considered as samples, and the launch of the SHSC in November 2014 is considered as a quasi-natural experiment. The difference-in-differences method is applied to explore the impact of the SHSC policy on green technology innovation developed by enterprises. We then test the robustness of the model by conducting a placebo test and PSM-DID, replacing the control group and the explained variable, and excluding other policy interference. To analyze the mechanisms of the influence, we further conduct a mechanism analysis from the perspectives of corporate governance and financing constraints. Additionally, we conduct a heterogeneity analysis based on the diversity of property rights and industry, aiming to discern disparities between state-owned enterprises and non-state-owned enterprises, as well as differences between heavily polluting industries and non-heavily polluting industries.

The innovation of this paper is that it refines the object of research on enterprise innovation into green technology innovation and studies its influence mechanisms. Through the results of this research, it tries to enhance the green technology innovation of enterprises and contribute to the realization of high-quality development of China's economy.

The remainder of the paper is organized as follows. Section 2 introduces the theoretical background and research hypotheses. Section 3 designs the empirical model and provides a detailed explanation of the variables in the model. Section 4 conducts the empirical studies, including multiple regressions, the parallel trend tests, and the robustness tests. Section 5 conducts a mechanism analysis and heterogeneity analysis. Section 6 discusses the results and innovations of this paper. Section 7 summarizes the paper.

2. Theoretical Background and Research Hypothesis

2.1. The Opening of the SHSC and Enterprise Green Technology Innovation

According to Modern Corporate Finance Theory, information asymmetry leads to differences in internal and external financing costs of enterprises, which is also known as the generation of financing constraints, and then financing constraints significantly inhibit enterprise innovation [55,56]. One possible reason is that large amounts of capital, mainly derived from internal and external financing, are continuously utilized for the research and development activities of enterprises over a long period, and external financing is a key factor in influencing the research and development investments made by enterprises [57]. The implementation of the SHSC can not only facilitate the interconnection of stock transactions between the two markets but also signify the gradual integration of the rules and mechanisms of the mainland stock market and the Hong Kong Stock Exchange, establishing a more mature supervision mechanism. Previous studies have shown that capital market opening has improved the level of enterprise innovation [53] and significantly promoted the quality of enterprise innovation [54], with a gradual shift in the patent structure towards high-quality invention patents, as well as an increase in the rate of patent citations [58]. Yu et al. found that the number of analysts tracking the market increased after the implementation of the SHSC, and the higher the level of analysts' attention, the more patent output a corporation produces at a later stage [55]. Furthermore, Tan and Yang found that the shareholding ratio of foreign institutional investors is positively related to the number of innovation activities of Chinese listed enterprises [59].

In addition, according to Keynesian Expectancy Theory, psychological expectancy factors can have an impact on investors' economic behavior. Li and Lu pointed out that institutional investors prefer listed enterprises with better environmental performance and which have more bank loans and lower loan costs [60]. The proportion of institutional investors in mature capital markets in Western countries is much higher than that in the A-share market in China. However, the anticipation effect created by A-share listed enterprises improving their environmental performance and green technology innovation can attract more favor from foreign institutional investors. Therefore, with the launch of the SHSC, A-share listed enterprises will have stronger incentives to improve their environmental performance. The evidence used to support this conclusion comes from a quantitative study by Huang and Xia, which proves that the SHSC significantly improves the ESG performance of the underlying stocks [61].

In summary, on the one hand, the capital market opening can promote enterprise innovation; on the other hand, the capital market opening can enhance the environmental performance of enterprises. Therefore, the authors propose the following hypothesis:

H1. *The SHSC has a significant positive impact on enterprise green technology innovation.*

2.2. Mechanism Analysis Based on the Level of Corporate Governance

The problem of separating ownership and operation in modern corporate governance results in a lack of consistency between the objectives of enterprise operators and owners. This, in turn, leads to the issue of moral hazard in enterprise green technology innovation activities [62]. Due to the long-term and high-risk nature of green technology innovation activities, operators may be reluctant to take risks in investing in innovation during their tenure, which could potentially hinder green technology innovation. After the opening of the capital market, foreign investors can play an effective supervisory role, restraining the opportunistic behavior of managers, improving the moral hazard caused by the principal-agent problem, and promoting green technology innovation in enterprises [63,64].

The level of corporate governance is crucial for enterprise green technology innovation. Brown et al. demonstrate that stronger shareholder protection plays a crucial role in innovation projects with higher uncertainty and greater information asymmetry [37]. Amore and Bennedsen argue that firms with poorer corporate governance produce fewer green patents compared to all innovations [65]. García and Isabel suggest that a corporate shareholding structure with mutual checks and balances contributes to firms' green technology innovation [66]. Moshirian et al. highlight that the relaxation of financial constraints, the enhancement of risk-sharing between domestic and foreign investors, and the improvement of corporate governance can promote enterprise green technology innovation [67]. Wang and Chen found that board governance has a positive and significant impact on enterprise green technology innovation [36]. Additionally, board governance plays a significant positive moderating role in the impact of environmental regulations on enterprise green technology innovation. Based on Jensen and Meckling's Agency Theory, Feng and Wen further point out that independent directors, who often have no personal interest in the enterprise, can encourage management to reduce short-sighted behavior in enterprise innovation. This helps to mitigate the risk of failed innovation investments and ultimately promotes enterprise innovation. In addition, independent directors with scholarly backgrounds can offer technical advice and support to firms' innovation activities, thereby reducing the risk of innovation failure [68,69]. Based on the above analysis, this paper proposes the following hypothesis:

H2. *The SHSC can promote enterprise green technology innovation by improving the corporate governance level of the underlying enterprises.*

2.3. Mechanism Analysis Based on Financing Constraints

Green technology innovation is a long-term investment process that often requires significant internal capital investment. The characteristics of high uncertainty and high risk of failure hinder effective communication between firms and external investors, thus significantly increasing the cost of financing innovation activities [70]. In contrast, the opening of the capital market allows foreign investors to purchase shares of enterprises listed on domestic stock exchanges. This attracts more foreign capital inflows, which, in turn, can promote green technology innovation of enterprises by better meeting their financing needs [71].

Financing constraints are crucial for fostering enterprise green technology innovation. Enterprise green technology innovation activities require continuous capital investment, and relying solely on internal financing cannot meet the financial needs of such activities, so enterprise green technology innovation is susceptible to the impact of financing constraints. The Evaluation Report on Innovation Capability of Chinese Enterprises 2018 shows that high innovation costs and a lack of investment funds for innovation are significant factors impeding enterprise green technology innovation. Brown et al. argued that inadequate financing channels have a significant negative impact on innovative enterprises, depleting their internal capital and increasing their dependence on external finance [37,72]. Moshirian et al. discovered that alleviating financial constraints can stimulate innovation within enterprises [67]. Hu et al. found that equity financing promotes corporate innovation to a greater extent; based on their analysis of data from non-financial listed enterprises in China, they also discovered that firms with foreign investment receive assistance from foreign shareholders, thus reducing the likelihood of facing financial constraints [73]. Liu and Zang argue that when corporate financing constraints are reduced, firms have more funds available to invest in innovative activities, thereby enhancing their innovation in green technology [62]. Yang et al. examined the equilibrium solutions of two symmetric firms in terms of their strategies for improving technology, and they found that when the cost of firms' technology improvement was significantly higher, both firms chose not to improve the technology but to adopt the existing technology [74]. Gao and Lu found that there is currently a lack of innovation in green technology among manufacturing firms, and they discovered that firms with strong financial performance and state ownership are more likely to invest in green technology innovation, but the study revealed that financing constraints can significantly impede the research and development (R&D) investment in green technology by these firms [75]. Wang et al. argued that overcoming financial constraints on enterprise green technology innovation can enhance their motivation for green innovation; this, in turn, can encourage enterprises to play a leading role in green innovation and effectively address the structural imbalance of green innovation in China [76]. Therefore, this paper proposes the following hypothesis:

H3. *The SHSC can facilitate enterprise green technology innovation by alleviating the financing constraint faced by the underlying enterprises.*

3. Research Design

3.1. Sample Selection and Data Source

Considering the launch of the SHSC in November 2014 as a quasi-natural experiment, the overall sample of this paper is the A-share enterprises listed on the Shanghai Stock Exchange (SSE) from 2012 to 2017. Based on the difference-in-difference model, this paper researches the differences in green technology innovation between the experimental group and the control group before and after the opening of the SHSC. Specifically, we set the listed enterprises on the Shanghai Stock Connect (the part of SHSC through which investors can invest in specific stocks in the SSE) in the overall sample as the experimental group and exclude the listed enterprises that have been transferred into and then out of the Shanghai Stock Connect list during the sample period to ensure that the experimental group consists of the listed enterprises that were on the Shanghai Stock Connect list all the time during the sample period. We set the Non-Shanghai Stock Connect listed enterprises in SSE A-shares as the control group. In the subsequent robustness test, this paper replaces the control group with the listed enterprises on the Shenzhen Stock Connect in SSE A-shares.

Based on the IPC Green Inventory that was developed by the International Patent Classification (IPC), this paper classifies the patents in the IPC Green Inventory as green patents. The green patent data in this study were obtained from the China National Research Data Service (CNRDS) database, while other variable data were sourced from the Wind database. The sample excludes financial sector enterprises, enterprises under Special Treatment (ST), and those with missing data on key variables being excluded, resulting in a final sample of 9784 observations.

3.2. Variable Measurement and Description

The variables used in this paper are summarized in Table 1.

The main explanatory variables in this paper are the policy of the SHSC (*Post*), whether or not the enterprise is a Shanghai Stock Connect enterprise (*Treat*), and the interaction term between the two ($Post * Treat$). The event of the official launch of the SHSC (November 2014) is set as a dummy variable, whose value is 0 before the year of the policy implementation (2014), and 1 after the policy implementation. The value for enterprises that remained on the Shanghai Stock Exchange's general list from 2014 to 2017 is set to 1, while it is set to 0 for the other enterprises. The interaction term is the key explanatory variable of most interest in this paper. If its coefficient is significantly greater than 0, it indicates that the SHSC significantly promotes the green technology innovation of enterprises.

The explained variable is the green technology innovation of the enterprise. Referring to the practice of Li and Zheng, this paper's explanatory variable, which is the level of green technology innovation of enterprises, is measured by the number of annual green patent applications of listed enterprises [77]. This is because, first of all, the efficiency of resource input and use of enterprises is ultimately reflected in technology innovation. Therefore, the number of patent applications for innovation output can better reflect the innovation ability of enterprises [18]. Secondly, compared with the number of patent grants, the number of patent applications can better reflect the true level of enterprise innovation. Patent granting requires testing and payment of annual fees, which is more uncertain and unstable, and it is also susceptible to other factors, such as bureaucracy [18,78]. Finally, since the process of a patent from application to authorization often takes from 1 to 2 years, there is a certain lag, and the patented technology is likely to have an impact on the performance of the enterprise during the application process. Therefore, the patent application data have higher stability, reliability, and timeliness, and the number of green patent applications can better reflect the degree of technology innovation to a certain extent [79,80]. The green patent data in the China Research Data Service Platform (CNRDS) database can be applied jointly or independently by parent enterprises, subsidiaries, and merged groups. To more accurately measure the level of green technology innovation of enterprises, this paper selects the sum of the number of green technology invention patents applied independently in the year of mergers and the number of green utility model patents independently as the proxy variable of the explanatory variable. Considering that the number of patents of some enterprises is zero, the explanatory variable is expressed as ln(the number of green invention patents + the number of green utility model patents + 1). The explained variables are further divided into "green technology innovation quality" and "green technology innovation quantity", which are measured by the number of applications for "green invention patents" and "green utility model patents", respectively.

Table 1. The list of involved variables.

	Variable Name	Definition	Symbol
Explained variable	Green technology innovation of enterprises	The annual number of green patent applications is equal to ln(the number of green invention patent applications + the number of green utility model patent applications + 1)	*lnGI*
Explanatory variable	The implementation of the Shanghai–Hong Kong Stock Connect policy	The value of the variable is 0 before the policy implementation year (2014); after the implementation of the policy, the value of the variable is 1	*Post*
	Whether Shanghai Stock Connect enterprises	The Shanghai A-share enterprises that have remained on the Shanghai Stock Exchange's general list from 2014 to 2017 will take 1; otherwise, take 0	*Treat*
	Interaction	Equal to post × treat	*Post* × *Treat*
Control variable	Return of assets	Annual net profit/year-end total assets	*ROA*
	Size	The logarithm of total assets	*lnAsset*
	Total debt level	The logarithm of total liabilities	*lnDebt*
	Fixed assets ratio	Fixed assets/total assets	*FtA*
	Asset–liability ratio	Total liabilities/total assets	*DtoA*
	Annual growth rate of GDP	Annual growth rate of GDP	*GDP_Growth*

The following variables are used as control variables [27,81]: the return on total assets of the enterprise, which is equal to the ratio of the annual net profit of the enterprise to the total assets of the enterprise at the end of the year; the size of the enterprise, which is equal to the logarithm of the total assets of the enterprise at the end of the year; the total debt level, which is equal to the logarithm of the total debt amount at the end of the year; the proportion of fixed assets, calculated as the ratio of the number of fixed assets at the end of the year to the total assets of the enterprise; the asset–liability ratio, equal to the ratio of total liabilities to total assets at the end of the year; and the annual growth rate of GDP.

3.3. Model Construction

The difference-in-difference model set in this paper is as follows:

$$lnGI_{it} = \beta_0 + \beta_1 Post_t + \beta_2 Treat_i + \beta_3 Post * Treat + X_{it} + \varepsilon_{it} \quad (1)$$

where $Post_t$ is the policy dummy variable; $Treat_i$ is a group dummy variable; X_{it} is the control variable; and $lnGI_{it}$ is the green technology innovation of the experimental group, and the innovation activities of the enterprise are divided into substantive innovation and strategic innovation. This paper measures the overall green technology innovation level of the enterprise, as well as the quality and quantity of green technology innovation. In the robustness test part, the author replaces the explanatory variable with the number of green patent authorizations and sets ln(the number of green invention patent authorizations + the number of green utility model patent authorizations + 1) as the proxy variable of enterprise green technology innovation.

4. Empirical Results and Analysis

4.1. Baseline Regression

4.1.1. Results of Multiple Regression

According to Model (1), a regression analysis was performed using the STATA 14.0 software, and the results are shown in Table 2. The first column is the results of a univariate regression. The coefficient of the interaction term $Post * Treat$ is 0.324 and significant at the significance level of 1%, indicating that the SHSC has significantly promoted the level of green technology innovation in sample enterprises. The second column is the results after adding control variables, showing that the coefficient of the interaction term is slightly smaller than the result of the univariate regression, but it is still significantly positive. These results verify the hypothesis that capital market opening improves the level of green technology innovation. For the control variables, the coefficient of the return on total assets of the enterprise is −0.354, and it is significant at the 1% level, indicating that there is a significant negative correlation between the return on total assets and the number of green patent applications. If profitability declines, firms may be inclined to invest more in environmental protection to improve their reputation and promote green technology innovation, thereby reducing environmental costs. The coefficient of the variable of the total asset scale of the enterprise is 0.172, which is significantly positive at the 1% level, indicating that there is a significant positive correlation between the number of green patent applications and the total asset scale of the enterprise. Large enterprises usually have the financial capacity and resources to invest in green innovation and technology advancement, which makes them more likely to seek out patents related to green technology. The coefficient of the proportion of fixed assets of enterprises is −0.35, and the significance level is 1%, indicating a significant negative correlation between fixed assets and the level of green technology innovation. Enterprises with a high fixed asset ratio are likely to be more inclined to apply traditional production techniques in their operations and investments, rather than prioritize environmental protection and green technology innovation. The coefficient of the GDP growth rate is negative, indicating that economic growth has an inhibitory effect on green technology innovation. On the one hand, at the early stage of economic growth, enterprises may be more inclined to develop traditional industries rather than apply green technology innovations to obtain rapid economic returns. On the other hand, some scholars have found that to achieve higher economic growth goals, local governments will tend to inhibit the green innovation in local enterprises [82]. The coefficients of control variables such as the asset–liability ratio and total debt level of enterprises are not significant, indicating that there are no significant correlations. This may be attributed to differences in management and technology across enterprises.

To measure the level of green technology innovation of enterprises more accurately, the green technology innovation level of the enterprise can be further divided into the invention patents and the utility model patents. Invention patents are patents applied for products, methods, or related improvement schemes. The utility model patent is a new design scheme for the shape and outer packaging of the product. Compared with utility model patents, the examination of invention patents is stricter, involving five steps: acceptance, preliminary examination, publication, actual examination, and authorization. The examination process for utility model patents is relatively simple, consisting of three stages: acceptance, preliminary examination, and authorization. In addition, the terms of legal protection for these two types of patents are different: 20 years for invention patents and 10 years for utility model patents. Therefore, we regressed on these two types of innovation technologies, respectively.

Table 2. Results of baseline regression.

Explanatory Variables	Univariate Regression	Regression after Adding Control Variables
Post	0.133 ***	−0.035
	(6.36)	(−0.76)
Treat	0.800 ***	0.330 ***
	(24.60)	(9.74)
Post × *treat*	0.363 ***	0.324 ***
	(7.99)	(7.55)
ROA		−0.354 ***
		(−4.17)
DtoA		−0.086
		(−1.01)
GDP_Growth		−13.584 ***
		(−2.73)
lnAsset		0.172 ***
		(4.66)
lnDebt		0.033
		(0.92)
FtA		−0.350 ***
		(−7.05)
Constant	0.200 ***	−2.899 ***
	(12.80)	(−7.04)
Observations	9784	9744
r2	0.172	0.266
r2_a	0.172	0.265

Note: t-statistics in parentheses (*** $p < 0.01$).

The results are shown in Table 3. It can be seen that the opening of the SHSC has a significant promoting effect on the green invention patents and green utility model patents of the target enterprises, and the coefficient of the interaction term on the green invention patents is larger, indicating that the promotion effect of the SHSC on the quality of green technology innovation of enterprises is greater than that on the quantity.

Table 3. Regression results after classification of green patents.

Variable	Green Invention Patent	Green Utility Model Patent
Post	−0.051	−0.015
	(−1.39)	(−0.41)
Treat	0.249 ***	0.208 ***
	(9.07)	(7.51)
Post × *treat*	0.278 ***	0.223 ***
	(7.97)	(6.37)
ROA	−0.208 ***	−0.163 **
	(−3.01)	(−2.36)
DtoA	−0.054	−0.001
	(−0.78)	(−0.02)

Table 3. *Cont.*

Variable	Green Invention Patent	Green Utility Model Patent
GDP_Growth	−11.149 ***	−9.218 **
	(−2.77)	(−2.28)
lnAsset	0.135 ***	0.127 ***
	(4.51)	(4.23)
lnDebt	0.012	0.032
	(0.41)	(1.09)
FtA	−0.377 ***	−0.207 ***
	(−9.37)	(−5.12)
Constant	−1.977 ***	−2.427 ***
	(−5.92)	(−7.23)
Observations	9744	9744
r2	0.231	0.229
r2_a	0.230	0.228

Note: t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$).

4.1.2. Parallel Trend Test

One of the hypotheses of the difference-in-difference model is the parallel trend. That is to say, there is no significant difference in the level of green technology innovation between the experimental group and the control group before the implementation of the policy. At the same time, the previous results may be caused by the natural increase in the level of green technology innovation over time. To test the parallel hypothesis and exclude the time effect, we run regressions with variables for the interaction term $Post * treat$ in the year before the policy implementation year, in the policy implementation year, and in the year after, separately. If the coefficient of the interaction term is not significant in the year before the implementation of the policy, but is significant in the year of policy implementation and the year after the implementation of the policy, it can be considered to meet the parallel trend hypothesis, indicating that the difference between the experimental group and the control group after the policy year is caused by the implementation of the policy.

The results of the parallel trend test are shown in Table 4. The variable $before2$ is the $Post * treat$ term two years before the implementation of the policy, whose coefficient is not significant. The coefficient in the year of policy implementation and the subsequent years are significantly positive, and the coefficient value gradually increases over time, confirming that the previous results meet the parallel trend hypothesis. This indicates that the difference in green technology innovation between the SHSC and non-SHSC enterprises is not obvious before the implementation of the policy. After the implementation of the policy, the green technology innovation level of the enterprises in the experimental group is significantly improved.

Table 4. Results of parallel trend test.

Variable	Green Technology Innovation
before2	0.009
	(0.25)
Current	0.114 ***
	(2.66)
after1	0.190 ***
	(3.71)
after2	0.306 ***
	(5.38)
after3	0.449 ***
	(7.22)

Table 4. *Cont.*

Variable	Green Technology Innovation
2013. Year	0.033 ***
	(2.91)
2014. Year	0.086 ***
	(5.68)
2015. Year	0.163 ***
	(8.49)
2016. Year	0.239 ***
	(11.37)
2017. Year	0.381 ***
	(15.59)
Constant	0.275 ***
	(19.90)
Observations	9784
Number of Scode	1969
r2	0.132
r2_a	0.131

Note: Robust t-statistics in parentheses (*** $p < 0.01$).

4.2. Robustness Test

4.2.1. Placebo Test

Considering that the empirical results of this paper may be caused by some unobservable factors, this paper uses the random sampling method to carry out the placebo test. We randomly select an enterprise 500 times from the sample to generate the experimental group, and then we perform the difference-in-difference regression. The results are shown in Table 5. The *_pm_*1 in Table 5 is the coefficient estimated before sampling. The *p*-value under the two-sided test is 0.000, which indicates that the previously estimated value is a small probability event in the case of random sampling. Therefore, it can be inferred that the previous results are less likely to be affected by unobservable factors.

Figure 1 shows the results of the placebo test for the interaction coefficient. It can be seen that the estimated coefficients are distributed near zero and follow the normal distribution, which is in line with the expectations of the placebo test, further indicating that the results have a certain robustness.

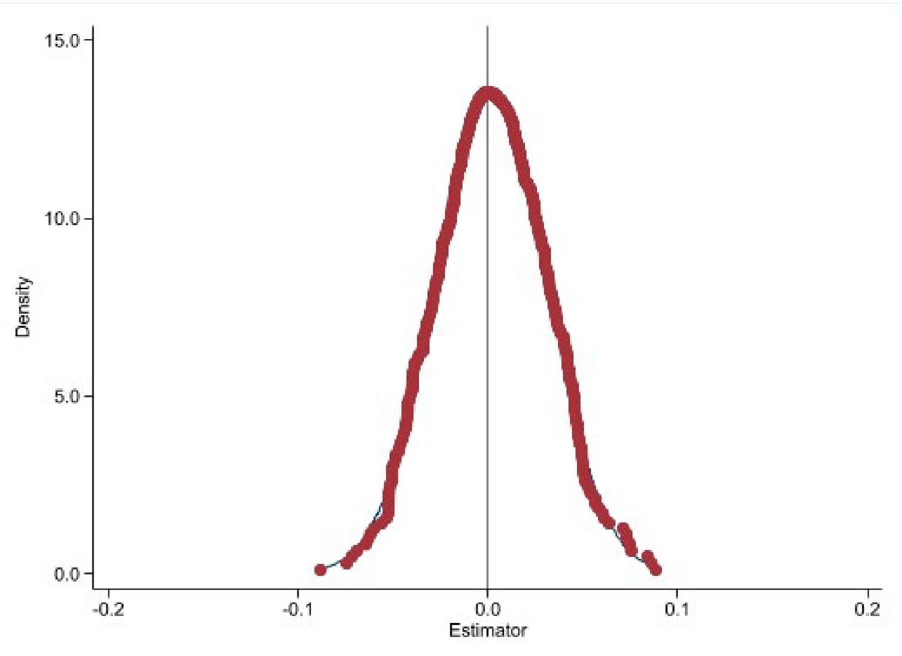

Figure 1. Distribution of regression coefficient of placebo test.

Table 5. Results of placebo test.

						Monte Carlo Error		
T	**T (obs)**	**Test**	**c**	**n**	***p***	**SE (*p*)**	**95%**	**CI (*p*)**
_pm_1	0.324	lower	500	500	1.000	0.000	0.993	1.000
		upper	0	500	0.000	0.000	0.000	0.007
two-sided					0.000	0.000		

4.2.2. PSM-DID

Considering that the experimental group and the control group may have large differences in regard to other aspects, such as enterprise characteristics, which may affect the previous regression results, this paper uses the propensity score-matching method to screen out this effect. Before the propensity score matching, it is essential to have enough similarity in propensity scores between the treatment and control groups and to ensure that the two groups have balanced covariates after matching. So, the author conducted the joint support hypothesis test and the balanced test. The results are shown in Figures 2 and 3.

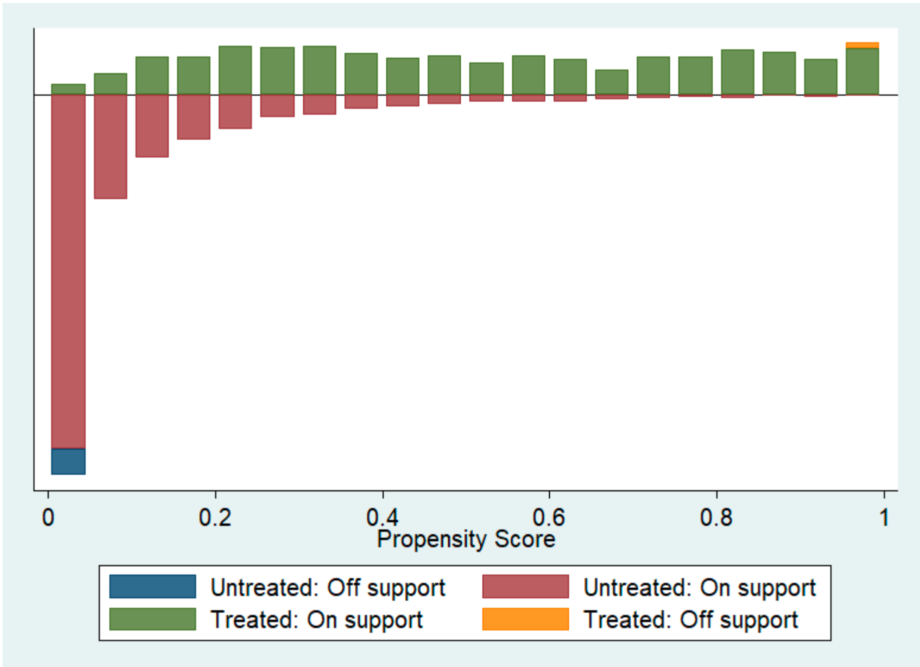

Figure 2. Joint support-hypothesis testing.

Figure 2 shows that the proportion of samples that failed to successfully match (off support) was small in both the experimental group and the control group.

Figure 3 shows that the standardized errors of each covariate after the matching are significantly reduced, indicating that the quality of the matching is better, and there is no significant difference between the matched and unmatched control group.

The regression results of the difference-in-difference after matching are shown in Table 6. The coefficient of the interaction term is 0.195, which is significantly positive at the 5% level, confirming the positive impact of SHSC on the green technology innovation of enterprises.

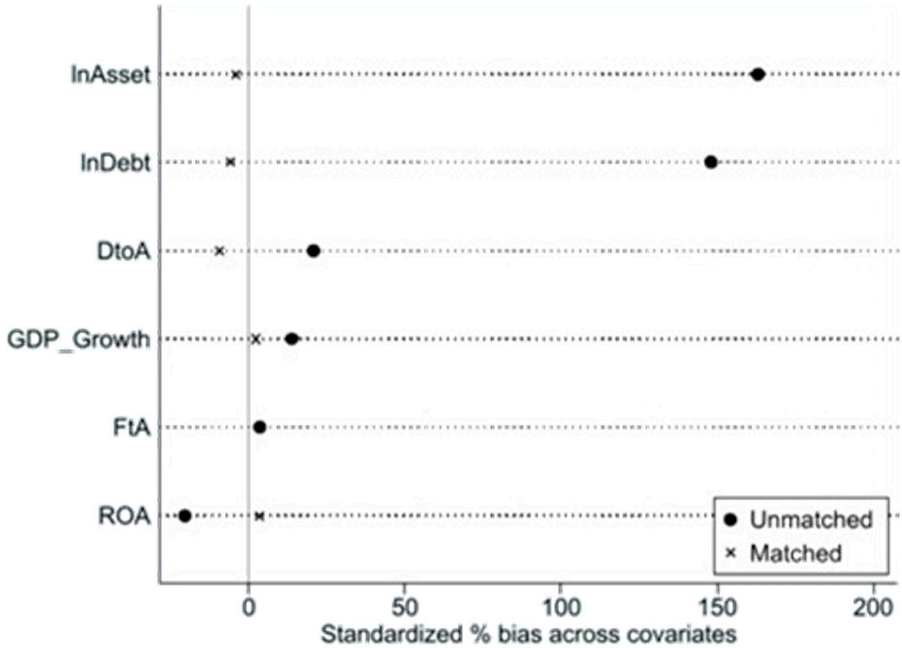

Figure 3. Results of the balanced test.

Table 6. Regression results after propensity score matching.

PSM-DID	
Explanatory Variables	**Green Technology Innovation Level**
Post	0.050
	(0.38)
Treat	0.326 ***
	(4.82)
Post × *treat*	0.195 **
	(2.05)
ROA	−0.603 ***
	(−2.65)
DtoA	−1.811 ***
	(−3.96)
GDP_Growth	−17.325
	(−1.31)
lnAsset	−0.555 ***
	(−3.03)
lnDebt	0.748 ***
	(4.07)
FtA	−0.495 ***
	(−3.74)
Constant	−0.979
	(−0.80)
Observations	2120
r2	0.105
r2_a	0.101

Note: Robust t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$).

4.2.3. Replacing the Control Group

The enterprises under the SZHSC are similar to those under the SHSC in many aspects, so they are taken as replacements for the control group, and financial enterprises and ST and *ST enterprises are also excluded from the DID regression. The results are shown in Table 7. The coefficient of the interaction term is still significantly positive, confirming the robustness of previous results.

Table 7. Difference-in-difference regression results after replacing the control group.

Explanatory Variables	Green Technology Innovation Level	Green Invention Patent	Green Utility Model Patent
post	−0.001	−0.027	0.007
	(−0.01)	(−0.42)	(0.11)
treat	−0.321 ***	−0.224 ***	−0.271 ***
	(−4.53)	(−3.73)	(−4.72)
Post × *treat*	0.163 **	0.132 **	0.159 ***
	(2.55)	(2.44)	(3.07)
ROA	−0.005 **	−0.003 *	−0.003 *
	(−2.21)	(−1.66)	(−1.65)
DtoA	−0.002 *	−0.001	−0.001
	(−1.74)	(−0.82)	(−1.43)
GDP_Growth	−24.350 ***	−20.380 ***	−9.556
	(−2.97)	(−2.94)	(−1.44)
lnAsset	0.166 ***	0.200 ***	0.132 ***
	(3.81)	(5.43)	(3.74)
lnDebt	0.142 ***	0.060 **	0.131 ***
	(3.97)	(1.97)	(4.52)
FtA	−0.027	−0.033	−0.008
	(−1.09)	(−1.57)	(−0.40)
Constant	−3.904 ***	−3.529 ***	−4.338 ***
	(−5.32)	(−5.69)	(−7.31)
Observations	6501	6501	6501
r2	0.151	0.136	0.154
r2_a	0.149	0.135	0.153

Note: t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$).

4.2.4. Replacing the Explained Variable

We replace the number of patent applications with the number of green patents obtained to further test the robustness of previous results. The regression results are shown in Table 8. In all three regressions, the coefficients of the interaction term are significantly positive, confirming the robustness of the previous results again.

Table 8. Regression results of the number of green patents obtained.

Explanatory Variables	Green Technology Innovation Level	Green Invention Patent	Green Utility Model Patent
post	0.017	0.007	−0.026
	(0.51)	(0.26)	(−0.73)
treat	0.199 ***	0.136 ***	0.234 ***
	(8.16)	(7.28)	(8.89)
Post × *treat*	0.197 ***	0.163 ***	0.134 ***
	(6.38)	(6.86)	(4.00)
ROA	−0.148 **	−0.087 *	−0.175 ***
	(−2.42)	(−1.85)	(−2.65)
DtoA	0.040	0.035	−0.012
	(0.65)	(0.74)	(−0.17)
GDP_Growth	−2.225	−1.946	−6.956 *
	(−7.11)	(−7.07)	(−7.20)
lnAsset	0.124 ***	0.096 ***	0.116 ***
	(−0.62)	(−0.71)	(−1.80)
lnDebt	−0.010	−0.009	0.029
	(4.67)	(4.71)	(4.04)
FtA	−0.273 ***	−0.218 ***	−0.214 ***
	(−0.40)	(−0.44)	(1.06)
Constant	−2.103 ***	−1.608 ***	−2.305 ***
	(−7.64)	(−7.95)	(−5.55)
Observations	9744	9744	9744
r2	0.184	0.179	0.212
r2_a	0.185	0.180	0.213

Note: t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$).

In addition, the coefficient value for the number of green utility model patents obtained is the lowest, indicating that the quality of green technology innovation is more positively affected. Table 9 shows the result of the parallel trend test. The replacement explained variable has passed the parallel trend test.

Table 9. Parallel trend test results of the number of green patents obtained.

Variables	Green Technology Innovation Level
before2	0.043
	(1.13)
Current	0.089 **
	(2.36)
after1	0.194 ***
	(4.21)
after2	0.218 ***
	(4.56)
after3	0.265 ***
	(4.92)
2013. Year	0.006
	(0.61)
2014. Year	0.009
	(0.77)
2015. Year	0.060 ***
	(4.63)
2016. Year	0.110 ***
	(7.11)
2017. Year	0.148 ***
	(8.56)
Constant	0.137 ***
	(12.57)
Observations	9784
Number of Scode	1969
R-squared	0.056
r2	0.0557
r2_a	0.0548

Note: Robust t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$).

4.2.5. Excluding Other Policy Interference

To exclude the impact of macro-policies on enterprise green technology innovation during the sample observation period of 2012–2017, this paper carries out the following robustness test. The Air Pollution Prevention and Control Action Plan, which has been implemented since 2013 and has a long coverage and a wide range of impacts, is selected as a proxy variable for environmental policies, and a dummy variable for air pollution prevention and control policies (AP) is added in the regression, with the value of 1 taken in 2013 and later, and 0 otherwise. In addition, the State Council issued "The 13th Five-Year Environmental Protection Plan" in 2016. The plan proposes to improve the quality of the environment as the core; implement the strictest environmental protection system; and fight the three battles of air, water, and soil pollution prevention and control. Considering the macro-impact of this policy, this paper takes it as a dummy variable for environmental protection policy (EPL), taking the value of 1 for 2015 and later, and 0 otherwise. Table 10 shows that, in the exclusion of "The Air Pollution Prevention and Control Action Plan", the exclusion of "The 13th Five-Year Environmental Protection Plan", and the simultaneous exclusion of the two policies, there is no significant difference between the two policies, and by excluding the effects of two policies at the same time, the coefficients of $Post * Treat$ are still all significantly positive at the 1% level, and the size of the coefficients is basically the same, indicating that the baseline regression conclusions are robust.

Table 10. Regression results after excluding other policy interference.

Explanatory Variables	Green Technology Innovation Level	Green Technology Innovation Level	Green Technology Innovation Level	Green Technology Innovation Level
post	−0.035	−0.051	−0.053	−0.055
	(−0.76)	(−1.03)	(−1.15)	(−1.10)
treat	0.330 ***	0.330 ***	0.331 ***	0.331 ***
	(9.74)	(9.73)	(9.77)	(9.76)
Post × treat	0.324 ***	0.325 ***	0.328 ***	0.328 ***
	(7.55)	(7.57)	(7.64)	(7.64)
ROA	−0.354 ***	−0.355 ***	−0.359 ***	−0.359 ***
	(−4.17)	(−4.19)	(−4.23)	(−4.23)
DtoA	−0.086	−0.088	−0.089	−0.089
	(−1.01)	(−1.03)	(−1.04)	(−1.04)
GDP_Growth	−13.584 ***	−16.532 ***	−8.449	−8.817
	(−2.73)	(−2.71)	(−1.62)	(−1.34)
lnAsset	0.172 ***	0.171 ***	0.168 ***	0.168 ***
	(4.66)	(4.64)	(4.56)	(4.55)
lnDebt	0.033	0.033	0.036	0.036
	(0.92)	(0.94)	(1.00)	(1.00)
FtA	−0.350 ***	−0.350 ***	−0.344 ***	−0.344 ***
	(−7.05)	(−7.04)	(−7.04)	(−6.92)
AP		−0.029		−0.003
		(−0.83)		(−0.09)
EPL			0.087 ***	0.086 ***
			(3.20)	(3.10)
Constant	−2.899 ***	−2.650 ***	−3.269 ***	−3.238 ***
	(−7.04)	(−5.20)	(−7.65)	(−5.96)
Observations	9744	9744	9744	9744
r2	0.266	0.266	0.267	0.267
r2_a	0.265	0.265	0.266	0.266

Note: t-statistics in parentheses (*** $p < 0.01$).

5. Further Research

5.1. Mechanism Analysis

From the above, it can be concluded that the SHSC significantly promotes enterprise green technology innovation. This section analyzes the mechanisms of the influence from the perspectives of corporate governance and financing constraints.

5.1.1. Improving Corporate Governance

Foreign investors can help improve the governance of an enterprise by increasing the effectiveness of board governance, which, in turn, promotes green technology innovation within the enterprise. A well-functioning board of directors provides strategic advice to management to ensure the maximization of long-term shareholder value, controls risky managerial behaviors, and oversees that managers are held accountable for business results [83].

The conflict that exists between professional managers and enterprise directors is one of the main problems in corporate governance. Professional managers are more likely to make short-sighted decisions that benefit their positions, whereas independent directors exercise more independent judgment when it comes to corporate decisions. This is in contrast to inside directors, who are accountable to the enterprise's shareholders [62]. In addition, independent directors can utilize their professional expertise to assist the board of directors in making more informed decisions. According to Adams and Ferreira, independent directors, who serve as a crucial supervisory entity in corporate governance, possess the ability to make impartial judgments regarding the enterprise's innovative projects during significant decision-making processes [84]. They fulfill the role of internal governance, preventing managers from engaging in shortsighted investment practices, while also expressing unbiased opinions that align with the interests of small- and medium-sized shareholders, thereby fostering enterprise innovation. Since the conflict of interest between independent directors and enterprises is smaller, and they can better coordinate the interests of owners and managers, a larger proportion of independent directors have more discourse power, as well as supervisory power, in the board of directors. As a result, their influence on the board's decision-making and supervisory behavior will be greater [69].

This paper refers to Huang and Chen [85] and utilizes the percentage of independent directors (*BG*) to measure corporate governance. To study the impact of the SHSC on the level of corporate governance, a regression analysis was conducted. The regression results are presented in Table 11, which indicates that the coefficient of the interaction term $post * treat$ is 0.016, and it is statistically significant at the 1% level. This suggests that the SHSC has a positive impact on increasing the percentage of independent directors in enterprises, thereby improving the level of corporate governance. Consequently, the SHSC can also promote the level of green technology innovation in enterprises. Therefore, the second hypothesis, H2, is supported.

Table 11. Test results of the percentage of independent directors.

Variables	Percentage of Independent Directors
Post	−0.003
	(−0.42)
treat	−0.022 ***
	(−4.95)
$Post \times treat$	0.016 ***
	(2.84)
ROA	−0.073 ***
	(−5.80)
DtoA	−0.008
	(−0.74)
GDP_Growth	2.564 ***
	(3.56)
lnAsset	0.044 ***
	(8.88)
lnDebt	−0.017 ***
	(−3.66)
FtA	−0.021 ***
	(−3.05)
Constant	−0.423 ***
	(−7.13)
Observations	7687
R-squared	0.136
r2	0.136
r2_a	0.135

Note: Robust t-statistics in parentheses (*** $p < 0.01$).

5.1.2. Alleviating Financing Constraints

The opening up of the capital market is beneficial for alleviating the financing constraints of enterprises caused by moral hazard and adverse selection issues, and, consequently, promoting the advancement of their green technology innovation. Financing constraints, such as difficulties in obtaining financing, high financing costs, and a high enterprise leverage ratio, have long restricted the innovation of enterprises [86]. According to Yu, financing constraints are negatively associated with green patent counts [87], mainly because investment in green innovation activities is not only quite risky and costly but also has a high failure rate, which requires sufficient and stable supporting funds [87,88]. In this context, improving the financing environment of enterprises and reducing the financing constraints of corporate green innovation projects are effective measures to encourage enterprises' participation in green technology innovation, thereby increasing the quality and quantity of green patents obtained [86].

At present, two methods are widely used to measure financing constraints: quantitative modeling and index indicators. The quantitative modeling method involves the investment–cash-flow model or the cash–cash-flow model. Bierlen and Featherstone first proposed the investment–cash flow model by analyzing the sensitivity of corporate investment to internal cash flow [89]. Khurana et al. improved the investment–cash-flow model to create the cash–cash-flow model [90]. Due to the complexity of calculating quantitative models and the challenges in obtaining relevant data, an increasing number of scholars use index indicators to assess financing constraints, such as the KZ index [91], *SA* index [92], WW index [93], ASCL index [94], and FCP index [95]. Compared to other indexes, the *SA* index has the advantage of providing a more comprehensive reflection of the financing constraint dilemma faced by enterprises. Additionally, it does not include the endogenous financial variables of the enterprise, which helps to avoid measurement errors [96]. Therefore, this paper uses the *SA* index as the measurement for financing constraints. The calculation formula is as follows:

$$SA = -0.737Size + 0.04Size^2 - 0.04Age \quad (2)$$

where *Size* represents the size of the enterprise, which is determined by the book value of assets (total assets in dollars, in logarithmical term); *Age* represents the number of years the enterprise has been listed; and the *SA* index indicates the severity of the enterprise's financing constraints. The regression results are shown in Table 12. The coefficient of the interaction term $post * treat$ is -0.047, and it is significant at the 1% level. This suggests that the SHSC can effectively reduce the level of financing constraints. Consequently, it can facilitate the adoption of green technology innovation. Therefore, the third hypothesis, H3, can be confirmed.

Table 12. Test results of financing constraints.

Variables	Financing Constraints
Post	−0.015
	(−0.79)
Treat	−0.014
	(−1.01)
Post × *treat*	−0.047 ***
	(−2.65)
ROA	0.867 ***
	(24.51)
DtoA	0.113 ***
	(3.19)
GDP_Growth	−3.620 *
	(−1.75)
lnAsset	0.951 ***
	(61.89)
lnDebt	−0.002
	(−0.10)
FtA	0.062 ***
	(3.01)
Constant	−17.835 ***
	(−104.01)
Observations	9744
R-squared	0.955
r2	0.955
r2_a	0.954

Note: Robust t-statistics in parentheses (*** $p < 0.01$ and * $p < 0.1$).

5.2. Heterogeneity Analysis

5.2.1. State-Owned and Non-State-Owned Enterprises

Generally speaking, there are differences between state-owned enterprises and non-state-owned enterprises in many aspects of enterprise characteristics. State-owned enterprises bear more social responsibilities and non-economic goals [97]. Non-state-owned enterprises have stronger profit-making goals. These differences may lead to differences in their investment, financing, and technology innovation decisions. Therefore, the sample is divided into state-owned enterprise groups and non-state-owned enterprise groups, and the results are listed in Tables 13 and 14, respectively.

Table 13. Regression results of the state-owned enterprise group.

Explanatory Variables	Green Technology Innovation	Green Invention Patent	Green Utility Model Patent
post	−0.002	−0.053	0.042
	(−0.02)	(−0.63)	(0.52)
treat	0.158 ***	0.132 ***	0.053
	(2.62)	(2.62)	(1.07)
Post × treat	0.202 ***	0.192 ***	0.136 **
	(2.61)	(2.97)	(2.15)
ROA	−1.311 ***	−0.992 ***	−1.008 ***
	(−4.30)	(−3.91)	(−4.06)
DtoA	−0.194	−0.085	−0.114
	(−0.82)	(−0.43)	(−0.59)
GDP_Growth	−18.667 *	−15.297 *	−9.223
	(−1.79)	(−1.76)	(−1.08)
lnAsset	0.244 **	0.257 ***	0.198 **
	(2.21)	(2.81)	(2.21)
lndebt	0.071	−0.012	0.077
	(0.67)	(−0.13)	(0.89)
FtA	−0.639 ***	−0.671 ***	−0.407 ***
	(−6.88)	(−8.69)	(−5.38)
Constant	−4.731 ***	−3.745 ***	−4.839 ***
	(−5.17)	(−4.92)	(−6.48)
Observations	3437	3437	3437
r2	0.220	0.203	0.219
r2_a	0.218	0.201	0.217

Note: t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$).

Table 13 shows the regression results of the state-owned enterprise group. The interaction coefficient is 0.202, which is significantly positive at the 1% level and passes the robustness test. Furthermore, compared with the number for green technology innovation, the quality of green technology innovation is affected more by a higher coefficient value.

Table 14 shows that the parallel trend hypothesis is met.

Table 15 shows the regression results for non-state-owned enterprises, and the interaction coefficients are all significantly positive at the 1% level and significantly larger than those of state-owned enterprises. They pass the parallel trend test, as well (Table 16). This shows that the policy has a higher promotion effect for non-state-owned enterprises than for state-owned enterprises. Non-state-owned enterprises may be more flexible in allocating resources to green technology innovation. In comparison, state-owned enterprises may be subject to more regulations, hierarchies, etc., and have fewer resources available.

Table 14. Parallel trend test results of the state-owned enterprise group.

Variables	Green Technology Innovation Level
before2	−0.020
	(−0.37)
Current	0.077
	(1.32)
after1	0.129 *
	(1.84)
after2	0.201 ***
	(2.61)
after3	0.425 ***
	(5.03)
2013. Year	0.004
	(0.16)
2014. Year	0.086 ***
	(2.62)
2015. Year	0.181 ***
	(4.65)
2016. Year	0.290 ***
	(6.58)
2017. Year	0.391 ***
	(8.28)
Constant	0.646 ***
	(23.93)
Observations	3438
Number of Scode	576
r2	0.148
r2_a	0.146

Note: Robust t-statistics in parentheses (*** $p < 0.01$ and * $p < 0.1$).

Table 15. Regression results of the non-state-owned enterprise group.

Variables	Green Technology Innovation Level	Green Invention Patent	Green Utility Model Patent
Post	−0.009	−0.017	−0.009
	(−0.19)	(−0.50)	(−0.25)
Treat	0.530 ***	0.361 ***	0.386 ***
	(−13.04)	(−11.39)	(−11.76)
Post × treat	0.367 ***	0.323 ***	0.229 ***
	(−6.88)	(−7.75)	(−5.31)
ROA	−0.244 ***	−0.153 ***	−0.133 **
	(−3.34)	(−2.69)	(−2.27)
DtoA	−0.200 ***	−0.141 **	−0.103 *
	(−2.63)	(−2.37)	(−1.67)
GDP_Growth	−9.307 *	−7.005 *	−6.952 *
	(−1.91)	(−1.84)	(−1.76)
lnAsset	0.092 ***	0.062 **	0.058 **
	(−2.86)	(−2.48)	(−2.23)
Lndebt	0.035	0.023	0.031
	(−1.14)	(−0.96)	(−1.25)
FtA	−0.139 ***	−0.145 ***	−0.06
	(−2.60)	(−3.48)	(−1.40)
Constant	−1.629 ***	−1.026 ***	−1.134 ***
	(−4.02)	(−3.25)	(−3.47)
Observations	6307	6307	6307
r2	0.237	0.204	0.188
r2-a	0.236	0.203	0.187

Note: t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$).

Table 16. Parallel trend test results of the non-state-owned enterprise group.

Variables	Green Technology Innovation Level
before2	0.022
	(0.34)
current	0.143 **
	(1.98)
after1	0.236 ***
	(2.73)
after2	0.387 ***
	(3.89)
after3	0.443 ***
	(4.22)
2013. Year	0.044 ***
	(4.27)
2014. Year	0.085 ***
	(5.25)
2015. Year	0.154 ***
	(7.14)
2016. Year	0.219 ***
	(9.45)
2017. Year	0.374 ***
	(13.25)
Constant	0.081 ***
	(5.12)
Observations	6346
Number of Scode	1393
r2	0.119
r2_a	0.118

Note: Robust t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$).

5.2.2. Heavily Polluting Industries and Non-Heavily Polluting Industries

Furthermore, the sample enterprises are divided into two groups: heavily polluting industries and non-heavily polluting industries. The identification of heavily polluting industries is mainly based on the "Guidelines on Industry Classification of Listed Companies", revised by the China Securities Regulatory Commission in 2012; the "List of Listed Companies' Environmental Verification Industry Classification Management Directory", formulated by the Ministry of Environmental Protection in 2008 (Circular Letter [2008] No. 373) and the "Guidelines for Environmental Information Disclosure of Listed Companies" (Circular Letter [2010] No. 78). The specific category names and codes are shown in Table 17.

According to the above classification, 463 enterprises in our sample are heavily polluting enterprises, and 1167 are non-heavily polluting enterprises, with a total of 9785 observations. Tables 18–21 are the results of grouping regressions and the parallel trend test results. The coefficients of the interaction terms are all significantly positive at the level of 1% and pass the parallel trend test, indicating that the SHSC has a promoting effect in both types of industries. The difference between coefficient values for the two groups is small, suggesting that there is no significant difference between the effects on heavily polluting industries and non-heavily polluting industries. Heavily polluting enterprises are subject to stricter environmental regulations, which may encourage them to explore new green technologies to meet their environmental needs even before the SHSC, so the SHSC has less impact on them. In contrast, non-heavily polluting enterprises may not have previously focused on green technology innovation, so the SHSC has a greater impact on them, resulting in no significant difference between the two.

Table 17. Industry classification standard of China Securities Regulatory Commission—classification information of heavily polluting industries.

Industry Codes	Industry Name
B06	Coal mining and dressing industry
B07	Petroleum and gas extracting industry
B08	Black metal mining industry
B09	Nonferrous metal mining and dressing industry
C17	Textile industry
C19	Leather, fur, feathers, and their products and leather making
C22	Papermaking and paper-products industry
C25	Petroleum-processing, coking, and nuclear fuel-processing industries
C26	Chemical raw materials and chemical products manufacturing
C27	Pharmaceutical manufacturing industry
C28	Chemical fiber-manufacturing industry
C30	Non-metal mineral product industry
C31	Ferrous metal-smelting and rolling-processing industry
C32	Non-ferrous metal-smelting and rolling-processing industry
C33	Metal products industry
D44	Electricity, heat production, and supply

Table 18. Regression results of heavily polluting industries.

Variables	Green Technology Innovation Level	Green Invention Patent	Green Utility Model Patent
post	−0.038	−0.048	−0.014
	(−0.52)	(−0.80)	(−0.23)
treat	0.054	0.060	−0.032
	(1.02)	(1.38)	(−0.75)
Post × *treat*	0.331 ***	0.228 ***	0.242 ***
	(4.99)	(4.19)	(4.53)
ROA	−0.166	−0.127	0.010
	(−1.07)	(−1.00)	(0.08)
DtoA	0.182	0.126	0.096
	(0.92)	(0.78)	(0.60)
GDP_Growth	−11.973	−7.446	−9.215
	(−1.51)	(−1.14)	(−1.44)
lnAsset	0.383 ***	0.275 ***	0.273 ***
	(5.29)	(4.64)	(4.68)
lnDebt	−0.104	−0.084	−0.058
	(−1.46)	(−1.44)	(−1.02)
FtA	0.132	−0.042	0.233 ***
	(1.52)	(−0.60)	(3.33)
Constant	−5.019 ***	−3.487 ***	−3.912 ***
	(−7.50)	(−6.36)	(−7.26)
Observations	2773	2773	2773
r2	0.362	0.282	0.324
r2_a	0.360	0.279	0.322

Note: t-statistics in parentheses (*** $p < 0.01$).

Table 19. Parallel trend test results of heavily polluting industries.

Variables	Green Technology Innovation Level
before2	0.026
	(0.39)
current	0.137 *
	(1.78)
after1	0.218 **
	(2.54)

Table 19. *Cont.*

Variables	Green Technology Innovation Level
after2	0.379 ***
	(4.03)
after3	0.516 ***
	(4.65)
2013. Year	0.032
	(1.48)
2014. Year	0.076 ***
	(2.62)
2015. Year	0.139 ***
	(3.57)
2016. Year	0.179 ***
	(4.71)
2017. Year	0.333 ***
	(7.58)
Constant	0.301 ***
	(12.19)
Observations	2780
Number of Scode	545
r2	0.124
r2_a	0.120

Note: Robust t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$).

Table 20. Regression results of non-heavily polluting industries.

Variables	Green Technology Innovation Level	Green Invention Patent	Green Utility Model Patent
Post	−0.031	−0.052	−0.014
	(−0.55)	(−1.13)	(−0.30)
Treat	0.452 ***	0.333 ***	0.313 ***
	(10.65)	(9.70)	(9.01)
Post × treat	0.322 ***	0.302 ***	0.213 ***
	(5.98)	(6.92)	(4.83)
ROA	−0.413 ***	−0.227 ***	−0.218 ***
	(−4.09)	(−2.78)	(−2.65)
DtoA	−0.177 *	−0.114	−0.061
	(−1.84)	(−1.47)	(−0.78)
GDP_Growth	−13.418 **	−12.142 **	−8.520 *
	(−2.18)	(−2.44)	(−1.70)
lnAsset	0.123 ***	0.104 ***	0.088 **
	(2.77)	(2.91)	(2.44)
lnDebt	0.053	0.025	0.049
	(1.25)	(0.72)	(1.42)
FtA	−0.555 ***	−0.489 ***	−0.350 ***
	(−8.52)	(−9.27)	(−6.58)
Constant	−2.188 ***	−1.471 ***	−1.948 ***
	(−4.31)	(−3.58)	(−4.69)
Observations	6971	6971	6971
r2	0.248	0.225	0.213
r2_a	0.247	0.224	0.212

Note: t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$).

Table 21. Parallel trend test of non-heavily polluting industries.

Variables	Green Technology Innovation Level
before2	0.002
	(0.04)

Table 21. *Cont.*

Variables	Green Technology Innovation Level
current	0.103 **
	(2.01)
after1	0.178 ***
	(2.81)
after2	0.277 ***
	(3.90)
after3	0.422 ***
	(5.62)
2013. Year	0.034 **
	(2.53)
2014. Year	0.091 ***
	(5.08)
2015. Year	0.173 ***
	(7.84)
2016. Year	0.262 ***
	(10.42)
2017. Year	0.400 ***
	(13.63)
Constant	0.264 ***
	(15.85)
Observations	7004
Number of Scode	1424
r2	0.137
r2_a	0.135

Note: Robust t-statistics in parentheses (*** $p < 0.01$, ** $p < 0.05$).

6. Discussion

Through empirical research, it is found that the opening of the Shanghai–Hong Kong Stock Connect policy has significantly improved the green technology innovation level of the target enterprises; that is, the opening of the capital market is conducive to promoting the green technology innovation of enterprises. This is consistent with the results of Yan et al. [98]. On the one hand, the opening of the capital market can promote the green technology innovation of enterprises by improving the corporate governance level of the target enterprises; on the other hand, the policy can also improve the level of green technology innovation of enterprises by alleviating financing constraints.

Previous studies have mainly focused on the impact of capital market opening on corporate governance, capital market efficiency, and enterprise innovation, but there was no further subdivision of the specific categories affecting enterprise innovation, especially in the impact of capital market opening on the level of enterprise green technology innovation and its impact mechanism. Therefore, the related research needs to be further deepened and expanded. This paper further refines the research object of enterprise innovation into green technology innovation and studies the impact of capital market opening on green technology innovation of enterprises in China and its impact mechanism, to enrich the research in this field. Previous studies have found that the separation of ownership and management rights in modern corporate governance will lead to inconsistencies in the goals of business operators and owners, which may lead to moral hazard problems [62]. Because of the long-term and high risk of this problem, it will have a significant impact on the level of green technology innovation [63]. However, the opening of the capital market can improve the level of corporate governance, effectively reduce the moral hazard caused by the principal-agent problem, and then promote the green technology innovation of enterprises. Green technology innovation is a long-term investment process, which often requires a lot of internal capital investment. However, due to its high uncertainty and high risk, effective communication between enterprises and external investors is hindered, which significantly increases the financing cost of innovation activities [70]. The opening of the capital market provides foreign investors with the opportunity to buy shares of domestic listed enterprises, thereby attracting more foreign capital inflows [71], which can alleviate enterprise financing constraints and improve the level of enterprise green technology innovation.

In the absence of a policy such as SHSC, enterprises may encounter potential obstacles to green technology innovation. Under the condition of strong external supervision, the incentives of enterprises to misappropriate benefits through the manipulation of information and financial statements will be weakened [99], which is conducive to enterprise green technology innovation [100]. The absence of policies like SHSC hinders the establishment of robust external supervision, potentially resulting in insufficient pressure and motivation for enterprises to engage in green technology innovation. This, in turn, diminishes investment and attention to green technology innovation within enterprises. The higher the proportion of institutional investors focusing on long-term value, the more involved value investors can be in shaping enterprise investment decisions. This will encourage more green technology innovation activities by enterprises [101]. Without policy support such as SHSC, enterprises may find it challenging to attract institutional investors with a long-term investment orientation. This may affect the long-term planning and execution of green technology innovation, impeding the progress of green technology innovation within enterprises.

In the analysis of heterogeneity, this paper not only studies the heterogeneity of heavily polluting industries and non-heavily polluting industries; it also studies the heterogeneity of state-owned enterprises and non-state-owned enterprises. In comparison, the perspective of consideration is more comprehensive. On the whole, the research in this paper can provide strong support for the government to adjust and formulate the capital market opening policy, help to improve the efficiency of green technology innovation of enterprises, and further realize the sustainable development of the economy.

7. Conclusions and Enlightenments

7.1. Conclusions

This study aimed to examine the impact of capital market opening, represented by the SHSC policy, on the level of green technology innovation among domestic listed enterprises in China and explore the mechanisms through which the impact takes effect, hereby to evaluate whether and how this policy is beneficial in achieving China's strategic objective of high-quality economic development. The sample was selected from the Shanghai A-share enterprises listed from 2012 to 2017. We use the difference-in-difference model for regressions and test their robustness and heterogeneity through various methodologies. The following conclusions are drawn:

First, the opening of the SHSC has significantly improved the green technology innovation level of the A-share enterprises listed on the Shanghai Stock Exchange, and the effect on the "quality" of green technology innovation is greater than the "quantity".

Second, the policy promotes enterprise green technology innovation by enhancing corporate governance and alleviating financing constraints.

Third, the policy's effect is greater for non-state-owned enterprises than state-owned enterprises, and there is no significant difference between heavily polluting industries and non-heavily polluting ones.

7.2. Implications

Based on the above results, this paper proposes the following suggestions:

First, the government should streamline the listing process and enhance supervision. This will incentivize more high-quality enterprises to join the capital market, offering them alternative funding sources and opportunities for growth. Additionally, it will foster increased confidence among investors in the capital market. As a result, listed enterprises may respond more actively to investors' new investment concepts, such as ESG, to better capture the institutional dividends of capital market opening and enhance enterprise value. This, in turn, will promote enterprise green technology innovation.

Second, the government should fully utilize the phased financing mechanism of the capital market, particularly the regional stock market, to offer more financing support for enterprises. For example, it can appropriately reduce the size restriction of listed enterprises, expand the breadth of industries targeted, refine the stratification, and establish a service system of stratification and categorization to better meet the financing needs of green technology innovation.

Third, the government can enhance the disclosure requirements for green information. External supervision enables enterprises to disclose environmental information in a more standardized way, thereby reducing information asymmetry and agency costs, which reduces the financing constraints of enterprises' green investment projects and further supports enterprise green technology innovation. Meanwhile, improving the disclosure requirements of green information can make it easier for investors to obtain relevant information, enhance investor confidence in green technology innovation projects, and attract more capital to this field.

Finally, enterprises should enhance their governance structure and strengthen their internal management to improve the quality of green technology innovation. Listed enterprises should actively promote participation in the Shanghai–Shenzhen–Hong Kong Stock Connect to attract foreign institutional investors and give full play to the external governance effect of foreign investors. Also, listed enterprises need to standardize the environmental information disclosure system and promote green development with higher-quality environmental information disclosure.

7.3. Research Limitations and Perspectives

There are still the following limitations in this paper, which are worthy of further discussion in future research.

First, the paper does not examine why capital market openness has a stronger impact on the quality of green technology innovation than on the quantity. However, the quality and quantity of green technology innovation may have different influence mechanisms on the level of green technology innovation of enterprises. In the future, the relationship between the quality and quantity of green technology innovation should be compared, and the reason why the opening of the capital market will have different degrees of impact on them should be further explored.

Second, in the heterogeneity analysis, we divide the enterprise ownership into state-owned enterprises and non-state-owned enterprises for subdivision research. However, considering the situation of local enterprises in China, central state-owned enterprises and local state-owned enterprises may also have different green technology innovation preferences. In the future, we can consider further subdividing state-owned enterprises into central state-owned enterprises and local state-owned enterprises, to have a more comprehensive understanding of the impact of capital market opening on the green technology innovation level of different types of enterprises in China.

Third, the relationship between capital market opening and green technology innovation level is affected by factors such as international economic policy, international trade environment, and industrial structure. However, this paper does not analyze the impact of changes in the external macro environment on it. In the future, the influence of the external macro environment on related research should be considered.

In addition, future research can be extended to the international level. First of all, we can systematically sort out and compare the history and characteristics of capital market reforms in different countries and identify the key factors that have a significant impact on green technology innovation. Secondly, comparative research methods can be used to select representative developed and developing countries as comparative objects, such as the United States, European Union member states, Japan, India, etc., to analyze the different manifestations of green technology innovation in these countries after the opening of capital markets. Furthermore, the research can focus on the synergistic effect of capital market opening and green financial policy. For example, we can study how countries guide capital to flow to the field of green technology innovation through financial instruments such as green bonds and green funds and how these policies interact with capital market opening to promote green technology innovation jointly. Through the expansion and deepening of the above research directions, we can identify the impact mechanism and effect differences of different capital market opening strategies on green technology innovation, and we can also provide some academic support and reference for formulating sustainable development policies worldwide.

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