

The Incentive Effect of Fintech Policies on Corporate Green Technological Innovation: A Study Based on the Chinese A-Share Market

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Abstract. Against the backdrop of the rapid development of global fintech, the formulation and implementation of China's fintech policies have attracted widespread attention. These policies not only affect the financing efficiency and market competitiveness of enterprises but also have a profound impact on their green technological innovation. This paper analyzes data from Chinese A-share listed companies between 2007 and 2022 to explore how fintech policies specifically influence corporate green technological innovation. The research findings indicate that fintech policies have significantly promoted the green technological innovation of enterprises. This discovery remains robust after various robustness tests, including parallel trend tests, variable and model changes, sample adjustments, and propensity score matching methods. Further analysis reveals that the impact of fintech policies on green technological innovation is particularly significant for enterprises with weaker profitability, shorter establishment time, non-Big Four accounting firm audits, and smaller scales. Mechanism analysis further points out that fintech policies effectively reduce the costs and agency problems in the green technological innovation process by alleviating financing constraints. This study not only provides theoretical support for the economic effects of fintech policies but also offers empirical evidence for policymakers on how to use fintech policies to promote corporate green technological innovation, which has important practical value for promoting corporate sustainable development and addressing global climate change.

Keywords: fintech policies, financing convenience, green technological innovation.

1. Introduction

China is at a critical juncture in the formulation and implementation of fintech policies, a phase that not only marks the stimulation of innovation vitality in the financial market but also highlights China's growing importance in the global fintech arena. Fintech policies aim to integrate cutting-edge technologies such as big data, cloud computing, and artificial intelligence to establish an open, inclusive, and secure financial ecosystem. This promotes financial service inclusivity, enhances system efficiency and transparency, and ensures the protection of financial stability and consumer rights. These measures not only reflect the wisdom of balancing innovation with risk management but also lay the foundation for the deep integration of traditional finance and fintech. They provide more precise and efficient financial support for the real economy, thereby supporting the sustained and healthy growth of the Chinese economy and the stability of the global financial market. In this process, the impact of fintech policies on enterprises, especially those involved in green technological innovation, is particularly significant. By reducing transaction costs, stimulating financial innovation, and improving financial service efficiency, policies enhance the technological innovation capabilities of enterprises. Especially in promoting green technological innovation, fintech policies provide enterprises with a broader range of funding channels and more efficient resource allocation, making green technological innovation possible. With the implementation of fintech policies, the pilot programs launched in 49 regions have provided a practical foundation, ensuring the stability of the financial market and offering strong support for the transformation and upgrading of the real economy and the high-quality development of the national economy. Therefore, delving into the promotional role of fintech policies on corporate green technological innovation is of significant importance for achieving sustainable development goals.

Many researchers have explored the impact of fintech policies on corporate green technological innovation from multiple perspectives. For instance, a study by Bergek et al. (2013) shows that fintech policies significantly promote corporate green technology inventions and innovation activities by providing financial support and risk management tools. Tan Changchun (2023) suggests that fintech policies enhance the ability and willingness of enterprises to engage in green R&D by reducing financing costs and improving liquidity. Additionally, Huang Zhuo and Wang Pingping (2023) found that fintech policies have a positive effect on enterprises' adoption of clean production technologies and the achievement of environmental sustainability. Based on these studies, this paper will further explore the specific impact of fintech policies on corporate green technological innovation, aiming to provide theoretical and empirical support for policy formulation and corporate strategic planning.

Theoretically, fintech policies are widely believed to promote corporate green technological innovation. These policies, by providing a variety of financing channels and financial tools, help alleviate the financing constraints faced by enterprises, thereby improving corporate governance structures (Smith and Anderson, 2018). Specifically, fintech policies can enhance the transparency of decision-making processes and strengthen the loyalty of management to shareholder interests, both of which are key drivers for corporate green technological innovation. These positive changes help reduce agency problems in the innovation process, lower financing costs, and provide a more solid foundation for corporate green technological innovation.

However, fintech policies may also have negative impacts on corporate green technological innovation under certain circumstances. For example, to cater to policy requirements, controlling shareholders may adopt information manipulation strategies (Zheng Jun et al., 2013), which often lead to increased corporate financing costs (Zhou Kaitan et al., 2017). Given that corporate innovation activities are inherently high-risk and require substantial financial investment, obtaining continuous and stable financial support is crucial for the success of innovation projects (Hall and Lerner, 2010). Therefore, information manipulation by controlling shareholders to maintain their control rights may worsen the financing conditions of enterprises, thereby inhibiting their green technological innovation activities.

At the theoretical level, there is still controversy over the direction of the impact of fintech policies on corporate green technological innovation, and the exact mechanism of action urgently needs to be clarified by empirical research. This study selects data samples from Chinese A-share listed companies between 2007 and 2022 and confirms through rigorous empirical analysis that fintech policies have a positive promotional effect on corporate green technological innovation. Notably, even after changing the sample range, adjusting variable measurement methods, and applying propensity score matching, the conclusion still shows good robustness. Furthermore, we find that the positive effect of fintech policies is particularly significant in the subsamples with lower profitability, shorter establishment time, non-Big Four accounting firm audits, and smaller enterprise sizes. This finding further supports the view that fintech policies effectively promote corporate green technological innovation by alleviating financing constraints.

This study makes three main contributions to the field of research on the economic effects of fintech policies. First, this paper provides a useful supplement to the existing literature, which mainly focuses on the impact of fintech policies on financial market stability (Smith and Anderson, 2018), financial service efficiency (Jones and Porter, 2019), and corporate financing costs (Zheng Jun et al., 2013). Building on this, this paper further explores how fintech policies promote corporate investment in green technological innovation by alleviating financing constraints, offering a new perspective for understanding the complex relationship between policy and corporate behavior.

Second, this paper proposes a new analytical framework for the study of the impact of fintech policies on corporate innovation. Although existing literature has pointed out that fintech policies may promote corporate innovation by improving information transparency (Zhou Kaitan et al., 2017) or inhibit innovation due to information manipulation (Zheng Jun et al., 2013), this paper delves into the relationship between fintech policies and corporate innovation from the perspective of financing constraints, providing new dimensions for theoretical development and empirical research in this field.

Lastly, this study has significant practical implications. In the current global economy facing transformation and sustainable development challenges, green technological innovation is seen as a key driver for promoting green economic growth. The research findings not only provide policymakers with insights on how to promote green technological innovation through fintech policies but also offer valuable references for corporate managers in formulating related strategies, helping to promote investment and innovation activities in the field of green technology.

The structure of this paper is as follows: the second part is a literature review, the third part is research hypotheses and experimental design, the fourth part presents the main empirical results and analysis, the fifth part is further heterogeneity analysis and mechanism analysis, and the sixth part is the conclusion.

2. Literature Review

Research on Fintech Policies. Fintech policies aim to promote the deep integration of finance and technology, enhance service efficiency, and ensure financial security. Hu Bin and Ren Xiping (2021) pointed out that while fintech reduces costs and improves efficiency, it also brings new risks, and regulation needs to adapt to innovation. Zhang Lixin (2021) suggested that building an inclusive regulatory framework to balance innovation and risk, and matching regulatory technology with fintech applications to protect consumer rights, is necessary. Fintech policies need to seek a balance between innovation and security to promote high-quality development of the financial industry.

The combination of technology and finance is an important driving force for economic development and industrial upgrading, and multiple studies have shown that policy support has a significant impact on this process. Sasidharan et al. (2015) believe that government financial policies and tools can effectively complement the financial elements in the innovation process, achieving a complementarity between technology and finance. Zheng Shiming et al. (2020) found through empirical analysis that pilot policies for the integration of technology and finance significantly improved the level of technological innovation in pilot areas. Zhang Qi's (2016) research showed that the development of technology finance has a significant driving effect on the upgrading of the secondary industry, while Zou Jianguo and Li Mingxian (2018) pointed out that technology finance has a spatial spillover effect on industrial structure upgrading. Song Hong et al. (2019) revealed the positive effects of low-carbon city pilot policies in air governance, Li Zheng and Yang Siying (2019) analyzed the promoting effect of innovative city pilot policies on various aspects of urban innovation, and Shi Daqian et al. (2018) explored how smart city pilot policies enhance urban governance and innovation capabilities through information technology transformation. These studies collectively indicate that policy support is a key factor in promoting the integration of technology and finance and driving the development of industries and cities.

Environmental policies and fintech policies have a profound impact on corporate innovation and production behavior, with studies showing that these policies play a key role in promoting corporate innovation, optimizing product portfolios, and improving production efficiency. Zheng Lei and Zhang Wei (2018) pointed out that the support of capital markets, financial institution development, and technology finance policies significantly promotes corporate innovation output. Gu Shen and Wang Shujuan (2018) emphasized the regional and industrial heterogeneity of technology finance in promoting corporate innovation. Yu Hongwei et al. (2020) believed that technology finance policies increased financing channels through government guidance, alleviating corporate financing constraints. At the same time, Han Chao and Sang Ruicheng (2018) revealed the impact of environmental policies on corporate product portfolios and quality, Jiang Wei (2015) and Milani (2017) suggested that strengthened environmental regulations would prompt enterprises to increase R&D investment. Han Chao et al. (2017) found that under the constraints of emission reduction targets, the productivity of polluting industries improved. Shen et al. (2019) and Lu Yang (2011) analyzed the impact of environmental policies on environmental total factor productivity from the perspectives of industry heterogeneity and policy instruments, while Clarkson et al. (2004) focused

on the impact of environmental regulations on corporate costs. These studies collectively reveal the importance of policy in guiding corporate innovation and sustainable development.

Research on Corporate Green Technological Innovation. The characteristics and driving factors of corporate green technological innovation are multifaceted. As Shen et al. (2019) pointed out, these innovation activities are not only environmentally friendly but also emphasize the consideration of the entire lifecycle and interdisciplinary systemic innovation. At the same time, these innovations respond to market-driven demands and are highly dependent on policy and economic incentives. When engaging in green technological innovation, enterprises need to consider the constraints of environmental regulations (such as Clarkson et al., 2004) and are also driven by consumer green preferences (Milani, 2017). Technological progress provides a technological foundation for green technological innovation, while corporate strategic orientation determines the direction and depth of innovation. International cooperation offers a broader perspective and resources for green technological innovation, and the support of talent and knowledge resources is key to the success of innovation. An optimized financing environment provides the necessary financial support for innovation activities. These factors work together to achieve efficient resource utilization in the production process and minimize environmental impact, promoting the transition of enterprises and society towards sustainable development.

The close integration of finance and innovation is a key factor in driving economic growth and technological prosperity, a view supported by several studies. King et al. (1993) revealed the four key services that finance provides for innovation activities, including entrepreneur evaluation, fundraising, risk diversification, and assessment of innovation expected returns. Perez (2007) further pointed out that the profit-seeking nature of financial capital combined with the high returns of technological innovation promotes technological prosperity and financial development. In the field of green finance, Wang Yao et al. (2019) confirmed the positive role of green credit incentive policies in promoting the green transformation of the economic structure through a DSGE model. De Haas and Popov (2019) and Flammer (2020) provided global evidence of the promoting effects of green bond issuance and the development level of the stock market on corporate green innovation, respectively. The empirical study by Zhang Yuxin and Zhao Lili (2015) showed that investment in technology finance significantly improved the level of technological innovation in the short term, but the long-term effect was not significant. Wang Heng and Wang Lin (2018) found a U-shaped relationship between technology finance and technological innovation, indicating that only after reaching a certain threshold of development can technology finance have a positive impact on technological innovation.

Green credit, as an important tool for financial support of green development, has been theoretically confirmed to play an active role in promoting clean production. Li et al. (2018) theoretically confirmed that green credit can promote clean production, while Guo Lianbang and Wang Yong (2020) pointed out that the innovation output of Chinese enterprises is mainly constrained by financial constraints. Neff (2003) also emphasized the importance of financial support for corporate technological innovation, arguing that a lack of financial support would make technological innovation difficult. Hall (2002) and Piga et al. (2007) further analyzed the external financing constraints faced by innovation investment, such as revenue uncertainty, information asymmetry, and moral hazard. Schumpeter's (1912) classic theory also revealed the significant impact of financial elements on technological innovation. The research by the National Information Center (2020) revealed the challenges faced by enterprises during the transformation process, such as weak transformation capabilities, high costs, and great difficulty, which lead to insufficient transformation momentum and willingness. These studies collectively emphasize the key role of financial support in promoting corporate green innovation and transformation.

The impact of fintech policies on corporate green technological innovation is an emerging and important field of research. Although the effects of green finance, environmental regulations, and corporate social responsibility on green innovation have been discussed, the specific role of fintech policies has not been fully studied. Fintech, through technologies such as big data, artificial intelligence, and blockchain, provides new tools for green finance, which can help identify green

assets, reduce costs, and improve capital efficiency, potentially promoting green technological innovation. Against the backdrop of the rapid development of China's fintech, in-depth research in this field not only helps fill the gap in the literature but also provides guidance for policy formulation and practical decision-making. Studying how fintech policies incentivize green technological innovation not only enriches knowledge in related fields but also provides new strategies for achieving sustainable development, with profound implications for the economic green transformation and response to climate change.

3. Research Hypotheses and Empirical Design

Research Hypotheses. The characteristics of fintech policies lie in their technological drive and innovation support for the financial industry, aiming to promote the digital transformation of financial services, improve the efficiency and quality of financial services through policy guidance and incentives. These policies reduce the cost of corporate innovation, optimize resource allocation, and stimulate market vitality by providing policy support, financing convenience, and risk-sharing mechanisms. Hu Bin and Ren Xiping (2021) pointed out that the widespread application of fintech has introduced new risk factors into the financial system while improving financial operational efficiency, increasing the variety of financial products, and expanding the population served by financial services. This has created new issues for the use of fintech and brought new challenges to regulatory authorities. The implementation of fintech policies not only helps financial institutions improve service efficiency by utilizing technologies such as big data and artificial intelligence but also encourages them to develop green financial products and services to support the development of green industries. As shown in the research by Tan Changchun, Wang Zhuo, and Zhou Peng (2023), the development of fintech can significantly promote corporate green innovation activities, mainly manifested as a significant increase in the number of green patents.

The characteristics of corporate green technological innovation include environmental friendliness, innovation, and systemic nature, and these innovation activities typically require continuous financial investment and a good management system. Green technological innovation activities are often closely related to environmental regulations, policy support, and corporate social responsibility (ESG) performance. Yang Jingjing and Hu Jin (2022) found that ESG performance has a positive effect on the quantity and quality of corporate green innovation, while environmental regulations help promote corporate green technological innovation. As shown in the research by Deng Yuping et al. (2021), an increase of one unit in environmental regulations will enhance the level of corporate green technological innovation by 0.024 units.

The impact of fintech policies on corporate green technological innovation is mainly reflected in the expansion of financing channels. The development of fintech provides enterprises with more convenient and efficient financing methods, reduces financing costs, and makes it easier for enterprises to obtain financial support for green technological innovation. At the same time, fintech policies encourage financial institutions to strengthen risk management, improve corporate governance levels, and enable enterprises to manage and utilize resources more effectively, focusing on the innovation and application of green technologies. Tan Changchun, Wang Zhuo, and Zhou Peng (2023) found that fintech can not only improve the efficiency of green credit allocation "before the event," promoting the supply of green credit, but also play a supervisory role "after the event," enhancing the efficiency of green investment. These factors work together to promote the development of corporate green technological innovation, providing important support for enterprises to achieve sustainable development.

Hypothesis: Fintech policies promote corporate green technological innovation.

Empirical Design. To test whether fintech policies promote corporate green technological innovation, following the models set by Lan Fei et al. (2022) and Tan Changchun et al. (2023), the following regression model is established:

$$Green_{i,t+1} = \alpha + \beta Treat \times Post_{i,t} + \gamma' Control_{i,t} + \sum Year + \sum Industry + \sum Area + \varepsilon_{i,t} \quad (1)$$

Green represents the activities of enterprises in green technological innovation. In existing literature, the measurement of green innovation typically focuses on two dimensions: the quantity and quality of patents. Although some researchers use green investment expenditure as a proxy variable to measure corporate green innovation input (for example, Zhang & Scholten, 2017), such data often lack specific classification for green innovation activities and have limitations in terms of data availability and accuracy. In light of these challenges, this study, referring to the research method of Wang et al. (2018), chooses the number of corporate green patent applications as a proxy variable for measuring corporate green technological innovation activities. To more accurately reflect the green technological innovation of enterprises, this study specifically defines the dependent variable—corporate green technological innovation (*Green*)—as the total number of green invention patent applications and green utility model patent applications by an enterprise over a certain period, plus one, then takes the natural logarithm of this total to ensure the normal distribution of the data and reduce the impact of extreme values.

For the fintech policy variable, this study refers to the two batches of regional fintech pilot policies implemented in China in 2011 and 2016, using a dummy variable ($Treat \times Post$) as a proxy for the implementation of fintech policies. Specifically, if the study area is included in the fintech policy pilot during the pilot year, the variable takes the value of 1; if it is a non-pilot area or outside the pilot year, it takes the value of 0. The focus of this study is on the significance test of the coefficient β in the regression model. If the coefficient β is significantly greater than zero, it can be inferred that fintech policies have a positive promotional effect on corporate green technological innovation, thus supporting the research hypothesis of this study.

Controls represent a series of control variables, including total assets (*Size*), asset-liability ratio (*Alratio*), return on assets (*ROA*), book-to-market ratio (*BtoMA*), net operating cash flow ratio (*CLratio*), revenue growth rate (*Growth*), equity governance structure (*Firstshare*), board size (*Lnboard*), and board independence (*IdepBroad*). Year, Industry, and Area respectively indicate that this study controls for year, industry, and regional fixed effects. To control for potential cross-sectional correlation issues, this study clusters the standard errors at the company level in all regressions. Detailed definitions are provided in Table 1.

Table 1 Variable Definitions and Constructions

Variable Symbol	Variable Name	Variable Construction Description
<i>Green</i>	Corporate Green Technological Innovation	$\ln(\text{Number of green invention patents} + \text{Number of green utility model patents} + 1)$
$Treat \times Post$	Fintech Pilot Policy	Takes the value of 1 if the area is included in the fintech policy pilot during the pilot year; otherwise, takes the value of 0
<i>Size</i>	Total Assets	Natural logarithm of total assets
<i>Alratio</i>	Asset-Liability Ratio	Ratio of total liabilities to total assets
<i>BtoMA</i>	Book-to-Market Ratio	Market value per share / Book value per share
<i>CLratio</i>	Operating Cash Flow Ratio	Net cash flow from operations / Current liabilities
<i>Lnboard</i>	Board Size	Natural logarithm of the number of board members
<i>IdepBroad</i>	Board Independence	Independent directors / Total number of directors
<i>Growth</i>	Revenue Growth Rate	$(\text{Current year's revenue} - \text{Previous year's revenue}) / \text{Previous year's revenue}$
<i>Firstshare</i>	Equity Governance Structure	The largest shareholder's holding ratio
<i>ROA</i>	Return on Assets	$(\text{Net profit} + \text{Interest expenses} + \text{Income tax}) / \text{Average total assets} * 100\%$

Data Source. The corporate patent application data were obtained from the China Research Data Services Platform (CNRDS), which provided the International Patent Classification (IPC) codes for all invention patent applications and utility model patent applications of A-share listed companies. These were matched with the "International Patent Classification Green List" released by the World Intellectual Property Organization (WIPO) in 2010. If a patent application's classification code falls within the "International Patent Classification Green List," the patent application is identified as a green patent application; otherwise, it is considered a non-green patent application. Data for other variables were primarily sourced from the Guotai Junan (CSMAR) database, supplemented by the Wind database and CNRDS. Policy data were derived from the Financial Technology Database of the Chinese Academy of Social Sciences and the financial technology development plans published by the People's Bank of China.

The original data were processed as follows in this study: (1) Companies listed as ST, ST*, and those in the financial industry were excluded; (2) Samples with missing data were excluded; (3) Samples with obviously biased data, such as debt ratios less than 0 or greater than 1, were excluded. To control for the potential impact of extreme values, data for continuous variables were winsorized at the 1% and 99% levels.

Table 2 Variable Descriptive Statistics

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
<i>Green</i>	37,311	0.853	1.200	0	7.304
<i>Treat × Post</i>	37,311	0.503	0.500	0	1
<i>Size</i>	37,311	22.100	1.295	19.000	26.060
<i>Alratio</i>	37,311	0.424	0.208	0.051	0.980
<i>BtoMA</i>	37,311	0.616	0.243	0.104	1.154
<i>CLratio</i>	37,311	0.230	0.401	-0.679	2.064
<i>Lnboard</i>	37,311	2.134	0.200	1.609	2.708
<i>IdepBroad</i>	37,311	0.374	0.053	0.300	0.571
<i>Growth</i>	37,311	0.401	1.157	-0.759	9.088
<i>Firstshare</i>	37,311	34.810	14.940	8.720	74.450
<i>ROA</i>	37,311	0.038	0.066	-0.333	0.204

The mean value of the explanatory variable *Treat × Post* is 0.503, indicating that the selected sample is relatively average, with the number of years when pilot policies were implemented in pilot areas being roughly consistent with the years when they were not. The average value of *Size* is 22.10, suggesting that the selected enterprises have a relatively large asset scale. The average value of *Lnboard* is 2.134, indicating that the board size of the selected enterprises is relatively large. The standard deviations of both the explanatory variable *Treat × Post* and the dependent variable *Green* are relatively large, indicating significant differences among enterprises.

4. Empirical Results and Analysis

Analysis of Baseline Regression Results. Table 3 shows that the regression coefficient for fintech policy *Treat × Post* is significantly positive at least at the 5% level, indicating that fintech policies have a significant promoting effect on corporate green technological innovation, rather than an inhibitory one. The regression results for other control variables suggest that the larger the enterprise size, the more abundant the cash flow, the larger the board of directors, and the greater the operating revenue, the stronger the level of green technological innovation; conversely, the higher the debt ratio and the larger the market value per share of the enterprise, the lower the level of green innovation. All the above conclusions validate the hypotheses. The constant term in the model is negative and highly significant, indicating that after controlling for other variables, the intercept of the model has a significant negative impact on the dependent variable. The results of the variance inflation factor

(VIF) test for all variables show that the VIF values for all variables are less than 3, and the maximum overall VIF value for each model is 1.89, which is far less than 10, indicating that there is no serious problem of multicollinearity in the regression.

Table 3 Basic Regression Results

Variable	Green	
	Without Controls	With Controls
	(1)	(2)
<i>Treat × Post</i>	0.077** (2.564)	0.118*** (3.943)
<i>Size</i>		0.464*** (28.772)
<i>Alratio</i>		0.001 (0.015)
<i>BtoMA</i>		-0.376*** (-6.959)
<i>CLratio</i>		-0.124*** (-6.822)
<i>Lnbroad</i>		0.119 (1.625)
<i>IdepBroad</i>		0.304 (1.301)
<i>Growth</i>		0.013** (2.103)
<i>Firstshare</i>		-0.000 (-0.090)
<i>ROA</i>		0.558*** (4.873)
<i>Constant</i>	0.684*** (3.777)	-9.698*** (-23.133)
Observation	37,311	37,311
R ²	0.282	0.438
Industry	Control	Control
Year	Control	Control
Area	Control	Control

Note: *, ** and *** respectively indicate that the regression coefficients are significant at the 10%, 5%, and 1% levels, with the clustered standard errors at the enterprise level in parentheses, same below.

Robustness Test. The measurement of the dependent variable is diverse, the explanatory variable is chosen based on specific policy nodes, the sample includes a particular group, and it may not be suitable for the OLS regression model, which could lead to the randomness of the regression results. Therefore, a robustness test is conducted.

Parallel Trend Test. From Fig.1, we can observe that before the implementation of the policy, there was almost no change in the policy effect, and the execution interval passed through the horizontal line, indicating an insignificant policy effect. During the policy implementation year, the policy effect significantly increased, and the execution interval was above the horizontal line. After the policy implementation, the execution interval remained above the horizontal line, and the policy effect gradually increased. The policy effect was significantly lower before the policy implementation compared to after the implementation, with the effect significantly increasing and remaining above the baseline value after implementation. The parallel trend test is passed.

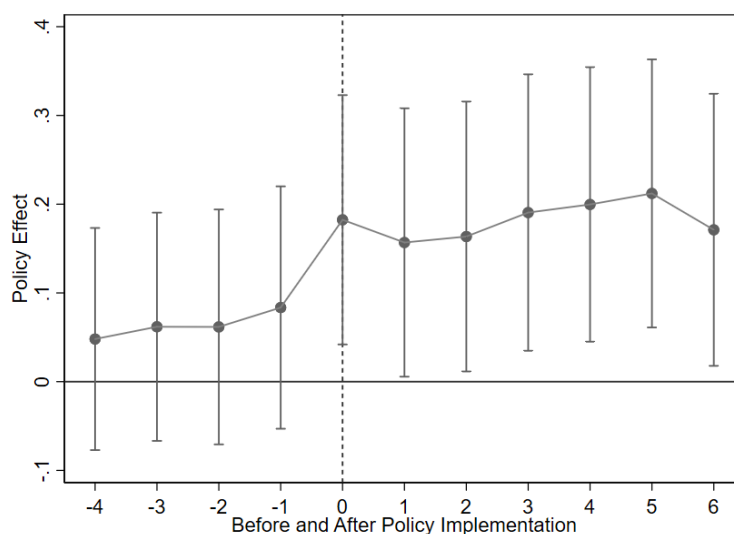


Fig. 1 Parallel Trend Test

Changing the Dependent Variable. We change the measurement method for corporate green technological innovation by adopting the total number of patent citations (*PatentsCite*), total acquisitions (*PatentsAcq*), and green invention patent applications (*Patents*) as the dependent variables for regression analysis, as shown in Table 4. The regression coefficient for fintech policies $Treat \times Post$ is significantly positive at the 1% level, and the overall results are similar to the baseline regression, not altering the main conclusions of this study.

Table 4 Robustness Test

Variable	PatentsCite (1)	PatentsAcq (2)	Patents (3)
<i>Treat × Post</i>	0.417*** (13.227)	0.175*** (7.231)	1.722*** (2.766)
<i>Size</i>	0.510*** (22.459)	0.396*** (23.957)	5.984*** (7.139)
<i>Alratio</i>	-0.003 (-0.036)	0.008 (0.139)	-3.905*** (-3.360)
<i>BtoMA</i>	-0.450*** (-6.443)	-0.321*** (-5.906)	-6.076*** (-3.613)
<i>CLratio</i>	-0.123*** (-5.129)	-0.104*** (-5.880)	-0.668* (-1.870)
<i>Lnbroad</i>	0.210** (2.159)	0.120* (1.787)	0.834 (0.406)
<i>IdepBroad</i>	0.710** (2.296)	0.336 (1.483)	11.516 (1.507)
<i>Growth</i>	0.017** (2.254)	0.007 (1.313)	0.215* (1.703)
<i>Firstshare</i>	0.001 (0.731)	0.000 (0.272)	0.028 (1.160)
<i>ROA</i>	0.474*** (3.149)	0.518*** (4.580)	-4.045* (-1.907)
<i>Constant</i>	-11.438*** (-21.468)	-8.913*** (-23.425)	-131.642*** (-7.064)
Observation	37,311	33,016	37,311
R ²	0.318	0.396	0.169
Industry	Control	Control	Control
Year	Control	Control	Control
Area	Control	Control	Control

Additional Robustness Tests. In this study, to ensure the robustness and reliability of the results, we employed various methods to test the main conclusions. First, we replaced the original regression model with a Tobit model. The Tobit model is a statistical model that better handles limited or censored data and is suitable for cases where the dependent variable is binary. As shown in the first column of Table 5, we found that the regression coefficient remained significantly positive, indicating that even after considering the censored nature of the data, our conclusions remain unchanged.

Secondly, we adjusted the regression sample by excluding samples with a dependent variable value of zero, eliminating the potential influence of outliers on the model estimation and ensuring that our results are not affected by extreme values. After removing these samples, we re-ran the original model for regression analysis, and the results still showed a significantly positive regression coefficient at the 1% level. This further confirms our main conclusion that there is a positive and significant relationship between fintech policies and corporate green technological innovation.

Lastly, we used the Propensity Score Matching (PSM) method for robustness testing. By matching individuals with similar characteristics in the treatment and control groups, this method simulates the conditions of a randomized controlled trial. This approach allows us to assess the treatment effect while controlling for potential confounding variables. After conducting propensity score matching, we found that the matched samples still showed a significantly positive regression coefficient. This result further consolidates our conclusion that even after controlling for selection bias, the impact of the independent variable on the dependent variable remains positive and significant.

Table 5 Additional Robustness Tests

Variable	Green		
	Model Change	Sample Change	PSM
	(1)	(2)	(3)
<i>Treat × Post</i>	0.118*** (3.970)	0.180*** (3.564)	0.096*** (2.588)
<i>Size</i>	0.464*** (28.968)	0.432*** (22.192)	0.484*** (27.961)
<i>Alratio</i>	0.001 (0.015)	0.061 (0.726)	0.022 (0.308)
<i>BtoMA</i>	-0.376*** (-7.007)	-0.240*** (-3.590)	-0.360*** (-6.031)
<i>CLratio</i>	-0.124*** (-6.869)	-0.095*** (-3.304)	-0.143*** (-6.921)
<i>Lnbroad</i>	0.119 (1.636)	0.031 (0.321)	0.140* (1.727)
<i>IdepBroad</i>	0.304 (1.310)	0.651** (2.212)	0.388 (1.470)
<i>Growth</i>	0.013** (2.117)	0.017* (1.745)	0.013* (1.913)
<i>Firstshare</i>	-0.000 (-0.091)	0.000 (0.394)	0.000 (0.257)
<i>ROA</i>	0.558*** (4.907)	0.526*** (3.353)	0.605*** (4.672)
<i>Constant</i>	-9.698*** (-23.291)	-8.492*** (-16.089)	-10.628*** (-23.301)
Observation	37,311	16,468	28,698
R ²	0.179	0.421	0.448
Industry	Control	Control	Control
Year	Control	Control	Control
Area	Control	Control	Control

5. Further Analysis

Heterogeneity Analysis

Profitability. Profitability is a measure of a company's ability to earn profits over a certain period, typically reflected by financial indicators such as profit margins. Companies with strong profitability usually have better financial conditions and credit, can provide higher returns to shareholders, enhance the company's debt-paying ability and cash flow, and thus face fewer constraints in financing. According to the research by Huang Zhuo and Wang Pingping (2022), fintech empowers green finance by alleviating information asymmetry, increasing the supply and innovation of green financial products, and improving service levels, injecting new vitality into the development of green finance. At the same time, Lan Fei and Yu Shuang (2022) pointed out that pilot policies for green financial reform and innovation can promote corporate green innovation. Therefore, it can be concluded that for companies with weaker profitability, fintech policies play a more critical role in promoting their green technological innovation. The reason for this phenomenon is that these companies face greater challenges in obtaining financial support, and once they receive funding, their promotion effect on green technological innovation will be more significant.

Whether a company's profit in the previous year is negative is a direct indicator of profitability. A positive profit indicates strong profitability, while a negative profit implies weak profitability. We grouped the samples based on whether the company's profit in the previous year was negative, with column (1) representing a negative profit in the previous year and column (2) representing a non-negative profit in the previous year. According to the regression results, we found that the regression coefficient is significantly positive. Therefore, for companies with weaker profitability, the promoting effect of fintech policies on corporate green technological innovation is stronger, confirming the inference.

Table 6 Heterogeneity Analysis - Profitability

Variable	Green	
	Profit Negative	Profit Non-Negative
	(1)	(2)
<i>Treat × Post</i>	0.158*** (2.887)	0.107*** (3.236)
<i>Size</i>	0.400*** (16.583)	0.472*** (27.311)
<i>Alratio</i>	0.043 (0.507)	0.003 (0.047)
<i>BtoMA</i>	-0.295*** (-3.069)	-0.384*** (-6.537)
<i>CLratio</i>	-0.107*** (-3.783)	-0.126*** (-6.102)
<i>Lnbroad</i>	0.165* (1.758)	0.111 (1.395)
<i>IdepBroad</i>	0.189 (0.556)	0.307 (1.221)
<i>Growth</i>	0.012 (1.154)	0.013** (1.995)
<i>Firstshare</i>	-0.002 (-1.422)	0.000 (0.168)
<i>ROA</i>	0.688*** (4.032)	0.482*** (3.637)
<i>Constant</i>	-8.283*** (-14.081)	-9.878*** (-22.014)
Observation	5,214	32,097
R ²	0.386	0.448
Industry	Control	Control
Year	Control	Control
Area	Control	Control

Enterprise Age. Enterprise age represents the time since a company's establishment and is a reflection of the company's experience and strength. Companies with a longer history typically have a more stable market position, a more mature management system, and a more complete corporate governance structure. These companies often have richer industry experience and a broader customer base, which makes it easier for them to gain trust and support when financing. Moreover, long-standing enterprises have established good credit records and financial transparency, making financing constraints more pronounced in younger companies. According to the research by Wang Qiang, Lin Chen, and Wu Shinong (2008), companies with better corporate governance have a stronger investment-cash flow sensitivity when facing higher financing constraints; whereas companies with poorer governance have relatively lower investment-cash flow sensitivity under moderate financing constraints, indicating that corporate governance may play a significant role in alleviating financing constraints, especially for companies with a longer history that usually have more mature corporate governance structures. If fintech policies can effectively alleviate financing constraints for companies and thereby promote their green technological innovation, we can expect this effect to be particularly evident in companies that were established later. This is because, compared to companies established earlier, those established later are more likely to suffer from the negative effects of financing constraints.

The enterprise's establishment time directly reflects its age. The samples are grouped based on whether the company's establishment time is earlier than the average, with column (1) representing companies established earlier and column (2) representing companies established later than the average. According to the regression results, we found that the regression coefficient for the group with later establishment times is more significant. The promoting effect of fintech policies on corporate green technological innovation is more likely to take effect in companies with younger age.

Table 7 Heterogeneity Analysis - Enterprise Establishment Time

Variable	Green	
	Establishment Time Earlier than Average	Establishment Time Later than Average
	(1)	(2)
Treat × Post	0.099 (1.156)	0.129*** (3.646)
Size	0.486*** (23.715)	0.444*** (20.457)
Alratio	-0.000 (-0.004)	0.006 (0.078)
BtoMA	-0.455*** (-6.108)	-0.344*** (-5.132)
CLratio	-0.122*** (-4.232)	-0.130*** (-6.033)
Lnbroad	0.217** (2.084)	0.053 (0.618)
IdepBroad	0.323 (1.035)	0.265 (0.894)
Growth	0.009 (1.122)	0.018** (2.112)
Firstshare	0.000 (0.107)	-0.001 (-0.513)
ROA	0.481*** (3.037)	0.579*** (3.774)
Constant	-10.219*** (-19.348)	-9.009*** (-16.167)
Observation	17,140	20,171
R ²	0.475	0.427
Industry	Control	Control
Year	Control	Control
Area	Control	Control

Enterprise Scale. Enterprise scale can better illustrate a company's financing capabilities. Larger enterprises often have higher credit ratings, more financing channels, and stronger negotiation abilities. Larger companies typically have more collateral and are more easily able to obtain financing, making financing constraints more pronounced in smaller enterprises. Zhu Kunlin (2011) explored the difficulties faced by small and medium-sized enterprises (SMEs) in the financing process, pointing out that enterprises experience scale and systemic discrimination, and SMEs themselves often default on credit and evade bank debts. The cooperation between the financial system and SMEs seems to exist only in words, and in reality, the relationship between the two parties is always a "zero-sum game." If fintech policies can alleviate financing restrictions and thereby promote corporate green technological innovation, we have reason to believe that this positive impact will be more significant in smaller enterprises. This is because smaller enterprises are generally more prone to financing difficulties, and thus, the supportive role of fintech policies for them will be more prominent.

This study, referring to the research by Nie Huihua and Li Wenbin (2006), uses assets to measure enterprise scale, and groups the samples based on whether the company's assets are greater than the average value. Column (1) in the table represents enterprises with a scale larger than the average, and column (2) represents enterprises with a scale smaller than the average. According to the regression results, we found that the regression coefficient for the group with a smaller enterprise scale is more significant. The promoting effect of fintech policies on corporate green technological innovation is more likely to take effect in smaller enterprises.

Table 8 Heterogeneity Analysis - Enterprise Scale

Variable	Green	
	Enterprise Scale Above Average	Enterprise Scale Below Average
	(1)	(2)
Treat × Post	0.092* (1.776)	0.105*** (3.204)
Size	0.595*** (23.041)	0.274*** (15.041)
Alratio	-0.033 (-0.329)	0.093 (1.531)
BtoMA	-0.278*** (-3.584)	-0.228*** (-4.086)
CLratio	-0.211*** (-5.284)	-0.103*** (-6.283)
Lnbroad	0.172* (1.682)	0.064 (0.854)
IdepBroad	0.656** (2.005)	-0.102 (-0.429)
Growth	-0.002 (-0.220)	0.019*** (2.931)
Firstshare	0.001 (1.053)	-0.002** (-1.998)
ROA	1.032*** (4.962)	0.672*** (5.949)
Constant	-13.433*** (-22.112)	-5.424*** (-11.632)
Observation	18,655	18,656
R ²	0.520	0.256
Industry	Control	Control
Year	Control	Control
Area	Control	Control

Audit Quality. Audit quality is a key indicator of the effectiveness of audit work and is directly related to the authenticity and reliability of corporate financial reporting. The higher the audit quality, the more accurate financial information a company can provide in corporate governance, thereby reducing information asymmetry and financing constraints. For example, Zhang Ruihuan (2018) pointed out in his research that audit opinions and reputation mechanisms alleviate debt financing constraints by reducing information asymmetry and providing a certain degree of "guarantee." Additionally, Li Xin and Guo Xingyu (2016) found that the degree of earnings management and upward earnings management have a significant adverse effect on financing constraints, while the standard audit opinion from auditors can mitigate this adverse effect. If the purpose of fintech policies is to alleviate financing constraints to stimulate corporate innovation vitality, it is reasonable to speculate that such policies will have a more significant effect in enterprises with lower audit quality. The reason is that enterprises with higher audit quality are generally less affected by financing constraints, and in comparison, fintech policies may play a more prominent role in promoting innovation activities for enterprises with lower audit quality.

This study, referring to the research by Lin Yongjian and Wang Zhiqiang (2013), uses whether the audit is conducted by one of the "Big Four" accounting firms to measure audit quality. In the table, column (1) represents audits conducted by the "Big Four," while column (2) represents audits conducted by non-"Big Four" firms. According to the regression results, we found that the regression coefficient is more significant in the group with non-"Big Four" audits. This indicates that fintech policies have a more pronounced promoting effect on green technological innovation in enterprises with lower audit quality, which is consistent with our expectations.

Table 9 Heterogeneity Analysis - Audit by Big Four

Variable	Green	
	Audit by Big Four	Audit by Non-Big Four
	(1)	(2)
Treat × Post	0.198 (1.061)	0.115*** (3.911)
Size	0.612*** (10.853)	0.431*** (27.255)
Alratio	-0.592* (-1.650)	0.044 (0.729)
BtoMA	0.300 (1.475)	-0.403*** (-7.442)
CLratio	-0.246** (-2.042)	-0.118*** (-6.559)
Lnbroad	-0.121 (-0.381)	0.149** (2.050)
IdepBroad	0.372 (0.390)	0.065 (0.291)
Growth	-0.013 (-0.426)	0.012** (2.107)
Firstshare	0.003 (0.893)	-0.001 (-0.963)
ROA	-0.064 (-0.090)	0.649*** (5.774)
Constant	-12.512*** (-10.188)	-8.893*** (-20.942)
Observation	2,237	35,074
R ²	0.733	0.410
Industry	Control	Control
Year	Control	Control
Area	Control	Control

Mechanism Analysis. Fintech policies support technological innovation and digital transformation, reducing corporate innovation costs, optimizing resource allocation, and stimulating market vitality. These policies not only improve the efficiency of financial services but also promote the development of green financial products and services, supporting the growth of green industries. The development of fintech has reduced financing costs and expanded financing channels, thereby significantly promoting corporate green technological innovation and providing important support for sustainable development. Financing constraints play a key role in this process, and through the implementation of fintech policies, enterprises can more easily obtain financial support to focus on the innovation and application of green technologies.

This study draws on the research methods of Chen et al. (2011) and Yu Wenchao et al. (2020), using two indicators, SA (Sensitivity of Accruals) and KZ (KZ Index), to quantify the degree of financing constraints faced by enterprises. These two indices are widely recognized in the field of financial economics and can reflect the limitations enterprises face in obtaining external funds. Specifically, the SA index measures the sensitivity of a company's accruals to changes in cash flow, while the KZ index assesses the ease of financing through the company's financial ratios. In both indices, a higher value indicates more severe constraints encountered by the enterprise in the financing process.

By conducting regression analysis on these two indicators, we found that the SA index shows a significantly negative relationship in the regression, indicating that with the implementation of fintech policies, enterprises become less sensitive in their accruals, suggesting they have become more flexible in fund-raising. Additionally, the results of the KZ index support this finding, showing a significantly negative relationship at the 10% level, further confirming the positive role of fintech policies in alleviating corporate financing constraints. This indicates that fintech policies have effectively reduced the barriers to financing for enterprises by providing a more diverse range of financing channels and tools, thereby promoting corporate liquidity and green technological innovation activities.

Table 10 Mechanism Analysis

Variable	SA	KZ
	(1)	(2)
Treat × Post	-0.021*** (-3.117)	-0.074* (-1.741)
Size	0.004 (0.979)	0.058*** (3.913)
Alratio	-0.132*** (-7.196)	5.518*** (74.464)
BtoMA	0.001 (0.065)	-2.653*** (-39.597)
CLratio	0.014** (2.564)	-2.100*** (-44.212)
Lnbroad	-0.010 (-0.563)	-0.077 (-1.056)
IdepBroad	0.184*** (2.804)	0.017 (0.073)
Growth	-0.003** (-2.267)	-0.022** (-2.414)
Firstshare	0.002*** (6.683)	-0.007*** (-8.789)
ROA	-0.037 (-1.145)	-7.846*** (-37.424)
Constant	-3.467*** (-30.662)	1.410*** (3.886)
Observation	37,311	37,311
R ²	0.353	0.701
Industry	Control	Control
Year	Control	Control
Area	Control	Control

6. Summary

With the rapid development and innovation vitality of China's financial market, the formulation and implementation of fintech policies are crucial for building an open, inclusive, and secure financial ecosystem. These policies aim to promote the inclusivity of financial services, enhance efficiency and transparency, while ensuring financial stability and consumer rights. This study explores how fintech policies impact corporate green technological innovation, especially in terms of alleviating financing constraints. We find that fintech policies significantly promote corporate green technological innovation, with this effect being particularly pronounced in samples with lower profitability, shorter establishment time, non-Big Four accounting firm audits, and smaller enterprise sizes. The research logic is based on fintech policies providing a variety of financing channels and financial tools, reducing financing costs, and laying a solid foundation for green technological innovation. This study not only provides a new perspective for understanding the complex relationship between fintech policies and corporate behavior but also offers insights for policymakers on how to promote green technological innovation through fintech policies, which has significant practical implications for driving investment and innovation activities in the field of green technology.

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