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The Impact of Green Credit Policy on Technological Innovation of Firms in Pollution-Intensive Industries: Evidence from China

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Abstract: How to promote technological innovation with green finance policy has been a focal topic in the global green finance field in recent years. Using the difference-in-difference approach model, this paper investigated the impact of the Green Credit Guidance (GCG) policy implemented by the Chinese government in 2012 on the technological innovation of firms in pollution-intensive industries. The empirical results indicated that GCG had a negative impact, not only on research and development (R&D) input, but also on innovation output, and the impacts on firms with different property rights and different scales were consistent. Further research showed that GCG reduced the long-term debt of firms in pollution-intensive industries, and then significantly decreased the R&D input and innovation output; that is, long-term debt is a mediator in GCG and technology innovation. The results revealed that GCG fails to promote the technological innovation of firms in pollution-intensive industries. This paper suggests that China's green credit policy should pay more attention to the technological innovation, transformation, and upgrading of firms in pollution-intensive industries.

Keywords: green credit policy; firms in pollution-intensive industries; research and development input; technological innovation; long term debt

1. Introduction

Green finance is an organic combination of economic sustainable development and finance. Since reform and opening, China has experienced rapid industrialization, but has also paid a huge cost, including ecological damage, environmental deterioration, and resource depletion. Green economy and sustainable development have become the most popular topics in China. How to realize the transformation from extensive development to intensive development, from low-quality development to high-quality development, and from a black or brown economy to a green economy are the major issues facing China. Since the start of the 21st century, the Chinese government has attached great importance to developing a green economy and has issued a series of green policies. China's green financial instruments continue to innovate, and the scale of green finance is increasing year by year. Just from 2016 to 2019, the scale of green bonds reached 1.1 trillion yuan, which has become the world's largest green bond market.

In the early stage of a green economy, the government plays a key role and green credit policies are an important tool of the government [1]. Altenburg and Rodrik found that it is difficult for the market to allocate resources to achieve the optimal performance when there is serious externality [2].

Due to the fact that it has the characteristics of positive externality, asymmetric information, a large amount of investment, and a long term of return, the green investment will be seriously insufficient when it just relies on the market to allocate resources [3]. Traditional financial investment only pays attention to profit and ignores the impacts on ecology, resources, and environment [4]. In the absence of a perfect system foundation, it is not feasible to only rely on the market or the investor's consciousness for social responsibility to achieve green development [5], because it is difficult to order firms to change the deep-rooted investment activities for profit in a short time. Therefore, the government is essential to green development and can develop green finance, promote the upgrading of industrial structure, and issue green credit policies. To transition in a country like China, which is in the initial stage of green finance, the essence of green finance is the mandatory institutional change implemented by the government [6].

In recent years, the Chinese government has issued a series of policies about green finance. In 2007, the Guidance of Credit on Energy Conservation and Emission Reduction and Opinions on Implementing Environmental Protection Policies and Regulations to Prevent Credit Risk were issued, the latter of which highlighted bank credit as an important tool of environmental protection and energy saving and emission reduction. The 2010 China Green Credit Development report was issued in 2011. These documents indicated that China attached great importance to green credit policy and laid a foundation for green credit. In 2012, the Green Credit Guidance (GCG) was issued, which required financial institutions to pay more attention to the environmental risk and social risk of firms, which put forward definite requirements for financial institutions to promote energy saving, emission reduction, and environmental protection. The GCG provides operational guidance for financial institutions on green credit policy, marking the formal implementation of the green credit policy in China. In 2014, Key Performance Indicators of Green Credit Implementation was issued, which marked the beginning of the quantitative method used to evaluate green credit. In 2015, Recommendations for the 13th Five-Year Plan for Economic and Social Development highlighted green finance as an important task in 2015–2020. Guidance on Building A Green Financial System was issued in 2016, which meant the beginning of the construction of a green financial system, and the G20 Green Finance Synthesis Report issued in the same year reflected China's attitude of adhering to green development. The Report of the 19th National Congress of the Communist Party of China in 2019 called for the reform of ecological civilization and emphasized the construction of a market-oriented green technology innovation system. In this series of policies, GCG in 2012 was the landmark and the most critical policy. Policies implemented before 2012 were focused on guiding banks on how to establish awareness of environmental protection and sustainable development; after 2012, policy focused on improving the evaluation mechanism of the implementation effect of GCG. In 2015 and 2016, policies were intended to focus on planning future green development, but no significant policies were implemented. However, GCG put forward clear requirements for green credit of banks. Therefore, GCG is the most critical policy in the series of policies of green finance in China, requiring all banks and nonbank financial institutions to implement this policy. In view of the actual situation in China, all banks will strictly comply with the green credit guidelines in accordance with the requirements of the Banking Regulatory Commission. As a result, GCG will significantly affect the green credit of banks and other financial institutions and motivate firms in pollution-intensive industries to increase technological innovation to affect the level of their R&D investment. This paper used GCG as the basis of its quasi-natural experiment.

The transformation and upgrading of firms in pollution-intensive industries is crucial to sustainable development. Firms in pollution-intensive industries are characterized by high investment, high energy consumption, and high pollution, which are the main causes of ecological damage and environmental degradation. Under the background of a green economy, the firms in pollution-intensive industries can realize sustainable development through two ways. One is industrial transformation, that is, from a pollution-intensive industry to non-pollution-intensive industry. However, this way is impossible at present, because many pollution-intensive industries are important in the national economy, and their products and services are closely related to the production and life of the public. The second way is through technological innovation, which can then improve production efficiency, reduce pollution emissions, promote transformation and upgrading, and can realize green low-carbon and sustainable high-quality development.

Technological innovation is one of the major purposes of green finance. Most of the previous studies focused on the macro qualitative impact of green finance on technological innovation. Whether green finance can promote the technological innovation of firms in pollution-intensive industries is still unclear, and financial institutions are unwilling to provide credit to them because of the high risk. Therefore, it has significant implications for both management practice and scholarly theory to investigate the impact of green credit policy on the technological innovation of firms in pollution-intensive industries.

Based on the data of A-share Chinese manufacturing listed firms from 2007 to 2017, the impact of GCG on technological innovation of firms was tested with the help of the difference-in-difference (DID) model. It can be seen from the results that GCG significantly reduces the R&D input and the innovation output of the firms in pollution-intensive industries. Further research showed that GCG significantly reduced the long-term debt of firms in pollution-intensive industries, thus decreasing the R&D input and innovation output, which indicates that GCG has not achieved its expected purpose.

The paper contributes to the literature in four ways. First and foremost, we investigated the availability of the green credit policy from the perspective of technological innovation. Most of the previous studies focused on the macro qualitative analysis of the scale of green credit or green financial instruments. This paper examined the impact of green credit policy on technology innovation from the micro perspective. Secondly, we calculated the pollution intensity of each manufacturing industry with a quantitative method and divided all the manufacturing industries into pollution-intensive industries and non-pollution-intensive industries according to the pollution intensity; The group of pollution-intensive industries was taken as the treatment group, and the other one as the control group. Then, based on the DID model, the impact of GCG on technological innovation was tested. Third, we focused on the firms in pollution-intensive industries. While supporting the emerging green industries, green credit policy should improve the technological innovation of firms in pollution-intensive industries in order to realize their transformation and upgrading. Fourth, this paper found that GCG failed to improve the technological innovation of the firms in pollution-intensive industries, because financial institutions focused on their loan risk and reduce long-term loans, which led to a significant decline in the R&D input and innovation output.

2. Literature Review and Hypotheses

Green finance has the nature of public goods, so green investment is often seriously insufficient under the mediation of market mechanisms, which require the government to issue policies for green development. Green finance, especially for transition countries, in essence is credit rationing based on environmental constraints [7], which is a compulsory institutional change implemented by the government. The major task of green finance in transition countries is to realize the transformation from the mode of high pollution and high energy consumption to the mode of energy saving, emission reduction, green, low carbon, and high efficiency [8]. Technological innovation is the first driving force for transformation. Prior studies mainly focused on two aspects, including the impact of green finance on technological innovation.

2.1. Environmental Regulation and Technological Innovation

Previous studies have mostly focused on the impact of environmental regulation on technological innovation. Most of the studies have held the opinion that environmental regulation can promote technological innovation. Innes found that environmental regulation can promote the acquisition of environmental protection patents of technological innovation [9]; Johnstone et al. found that different tools of environmental regulation can significantly promote technological innovation [10]; Blackman et al. pointed out that although strict environmental regulations would reduce adverse impacts on the environment in the short term, they can increase the production cost of enterprises, which would inhibit development [11]. However, Porter and Linda believed that appropriate environmental regulation will stimulate technological innovation [12], because income from technological innovation would make up for the increased cost of environmental regulation. More recently, this viewpoint has gained traction among researchers [13,14]. Jaffe and Palmer found that environmental regulation encourages enterprises to invest more in technological innovation, but it has no significant impact on the number of patents [15]. Guo et al. concluded that environmental regulation can force enterprises to increase R&D investment, but he pointed out it should be noted that low environmental regulation cannot change the behavior of firms in pollution-intensive industries, and high environmental regulation may worsen the financial situation of them, which is not conducive to technological innovation [16].

2.2. The Availability of Green Finance on Technological Innovation

The impact of green finance instrument on technological innovation is the other field studied by prior research. Green finance is a kind of sustainable financing, which plays an important role in environmental protection and sustainable development [17]. Zhou and Cui pointed out that green bond has a positive impact on technological innovation [18]; Guo et al. found that the scale of green credit in 30 provinces of China had a positive role in promoting green technological innovation. At the same time, some researchers have investigated the effectiveness of green finance policy [19]. Wang et al. found that financial institutions will adjust their investment strategies of firms in pollution-intensive industries, thus affecting the firms' investment structure and efficiency [20]; Johnstone et al., Chakraborty and Chatterjee examined the impacts of green policies on patent applications of R&D investment and technological innovation [21]; based on the Carbon Emission Trading Pilot policy issued in 2011, Du and Zheng found the policy significantly reduced the carbon emissions in the pilot areas [22]. However, some studies took different opinions. Falcone and Sica found that although green finance implemented in Italy provides a new way for the sustainable development of the environment, green firms are faced with institutional and financial problems due to the uncertainty of government policies and the low participation of financial institutions [23]; Wang et al. pointed out that the expected goal of the green credit policy hasn't been achieved in credit line, loan term, and promoting the transformation and upgrading of firms [24].

At present, most of the methods used in studies about the impact of green credit policy on technological innovation have been qualitative macro analyses, and most of the studies took the scale of green finance as the research object, but the technical difficulties of statistics and other factors make the statistics of green bonds, green credit, and other tools confusing, with unclear capital flow and other problems [25,26], meaning that only examining the supply index of green finance cannot accurately measure its economy effect [3]. The effect of green credit policy urgently needs to be evaluated from the micro perspective. So, this paper investigated whether green credit policy has an impact on technological innovation of firms in pollution-intensive industries.

2.3. Hypotheses

Green credit policies impact technological innovation of firms in pollution-intensive industries from the following two ways.

Firstly, from the perspective of firms in pollution-intensive industries, green development is the inevitable direction of them. To survive, they will pay more attention to the future. At the same time, their development should conform to the policies and actively undertake more social responsibilities. Therefore, under the guidance of green policies, they will pay the highest attention to transformation and upgrading, and the first driving force is technological innovation. Through technological innovation, they can improve production efficiency, reduce pollutant emission, and realize green development. Eiadat et al. pointed out that environmental regulation and stakeholders' and management's attention to the environment will promote the technological innovation of firms, and technological innovation will significantly improve the company's performance [27]. With the support of green policies, the cost of green investment will be reduced, which also can improve the profitability of firms [28]. Therefore, from the perspective of the firms in pollution-intensive industries, we can see that the green policies will enhance the willingness of firms to realize transformation and upgrading through technological innovation, which will be conducive to technological innovation.

Secondly, from the perspective of financial institutions. GCG requires financial institutions to promote green credit and refuse to loan to the firm or project who cannot comply with the environmental regulations. Cui et al. found that green loans help to reduce the credit risk of financial institutions in China [29]. Meanwhile, the implementation of GCG means that the credit line that can be obtained by firms in pollution-intensive industries will be strictly limited, and the policy risk they face will increase. At the same time, because of their huge transformation cost or environmental governance cost, their profitability will decline. Financial institutions are the executors of green credit—when the risk of a firm is expected to increase in the future, they may withdraw their loans before the due date or refuse to extend the maturity of the loan. For long-term loans, financial institutions will not provide or greatly reduce the amount of the loan. Due to the fact that technological innovation is a high-risk and large input production activity, after GCG, financial institutions will reduce their loan, especially the long-term loan, and some scholars even suggest they should stop providing loan to the firms [30], which will inevitably decrease their technological innovation.

Therefore, green credit policy can guide financial institutions to support the development of firms who are willing to realize the green transformation through capital supply, and it also can hinder the development of firms who are unwilling to realize green development by reducing their loan. Su and Lian found that green credit policies have a significant financing punishment effect on firms in pollution-intensive industries [31]. Wang et al. found that the implementation of green credit policy will promote financial institutions to adjust investment strategies for firms in pollution-intensive industries and will significantly reduce their long-term debt [20]. The major goal of green policy is to promote technological innovation of firms in pollution-intensive industries and reduce pollution emissions and improve the ecological environment. However, due to the imperfection of China's capital market, loans from financial institutions are an important source of capital for listed firms, while financial institutions are always focused on risk control. Due to the fact that technological innovation is a large investment, long-term, and high-risk activity, financial institutions are unwilling to invest in them to promote their technological innovation. Based on the above analysis, this paper put forward the following opposite hypothesis on the impact of green credit policies on technological innovation of firms in pollution-intensive industries.

Hypothesis 1a (H1a). *The implementation of GCG will be conducive to the technological innovation of firms in pollution-intensive industries.*

Hypothesis 1b (H1b). *The implementation of GCG will hinder the technological innovation of firms in pollution-intensive industries.*

3. Research Design

3.1. Sample Selection and Data Resources

This paper took the A-share manufacturing listed firms in mainland China from 2007 to 2017 as the samples, and we got the data from the CSMAR database. Samples whose financial state was in PT and ST, samples of "other manufacturing industries", and those with data missing were removed. Finally, 12803 samples observations were obtained. Samples were selected from 2007 because patent data and R&D fees and other relevant information in various databases listing Chinese companies only began to be published that year. Although China started to implement the green credit policy in 2007, the purpose of the policy was to establish the concept of green development and raise awareness to the risks that may be caused by it. At this time, no specific and effective green credit policy was adopted, so sample selection from 2007 did not affect the regression results of this paper.

In the research, by estimating the pollutant emission intensity of all the manufacturing industries, the manufacturing industries were divided into two groups—one group was pollution-intensive industries and the other group was non-pollution-intensive industries. Based on the policy of GCG in 2012, a quasi-natural experiment was constructed and used to investigate the impact of the green credit policy on technological innovation and to test the availability of the green credit policy.

3.2. Measurement of Pollution Intensity of the Manufacturing Industry and Classification of Groups

Referring to the method of Su and Lian [31] and Li and Tao [32], and based on the data of 2011, which was the year before the implementation of GCG, the pollution intensity of each manufacturing industry was measured. The estimation process was as follows, including five steps.

Firstly, pollutant emission of per unit output value (UE_{ij}) of each manufacturing industry was calculated. Model 1 is the calculation formula.

$$UE_{ij} = E_{ij}/T_i \tag{1}$$

where E_{ij} is the pollutant emission of kind j, industry i, and T_i is the total production value of industry i(i = 1,2, ... ,30; j = 1,2,3,4). The pollutant emissions included four kinds, which were So2, industrial dust, industrial waste water, and industrial solid waste, and the data were drawn from the China Statistical Yearbook (2012).

Secondly, UE_{ij} was linearly standardized. The calculation formula was as Formula (2).

$$UE^s_{ij} = [UE_{ij} - \min\left(UE_j\right)]/[\max\left(UE_j - \min\left(UE_j\right)\right] \tag{2}$$

where, min(UE_j) and max(UE_j) are respectively the minimum and maximum of the pollutant emission of kind j, and $UE_{ij}{}^s$ is the value of UE_{ij} after linear standardization.

Thirdly, we added up the standardized values of $UE_{ij}{}^s$ of the four kinds of pollutant emissions to obtain the pollution intensity (γ_i) of the industry i. The calculation formula is shown in model (3):

$$\gamma_i = \sum\nolimits_{j=1}^{4} UE^s_{ij}. \tag{3}$$

Fourthly, according to the median of pollution intensity(γi), each manufacturing industry was divided into pollution-intensive industries and non-pollution-intensive industries. According to the calculation results of Formula (3), the industries were put into pollution-intensive industries if $\gamma_i \geq 0.1142$ and into non-pollution-intensive industries if $\gamma_i < 0.1142$. In our paper, the first group was the treatment group and the second group was the control group. Table 1 shows the results of classification.

Finally, according to the industry of the listed firm, we put it into one of the groups.

Table 1. Group by industrial pollution intensity.

Pollution Intensity	Group	Industry
$\gamma_i \geq 0.1142$	Pollution- intensive industry	Manufacture of paper and paper products; manufacture of non-metallic mineral products; smelting and pressing of ferrous metals; manufacture of chemical fibers; manufacture of raw chemical materials and chemical products; manufacture of textile; manufacture of wine, drinks, and refined tea; smelting and pressing of nonferrous metals; processing of petroleum, coking, and processing of nuclear fuel refinery industrial; manufacture of food; manufacture of leather, fur, feather, and related products; manufacture of medicine; processing of food from agricultural products; processing of timber, wood, bamboo, rattan, palm, and straw products
$\gamma_i < 0.1142$	Non-pollution-intensive industry	manufacture of rubber; manufacture of metal products; manufacture of textile, garment, footwear, and hat products; recycling and disposal of waste; manufacture of tobacco; manufacture of general special machinery; manufacture of general purpose machinery; manufacture of plastic; manufacture of measuring instruments and machinery for culture activity and office work; manufacturing of transportation equipment; manufacture of handicrafts and other products; manufacture of furniture; printing and reproduction of recording media; manufacture of computers, communication, and other electronic equipment; manufacture of articles for culture, education, and sports activity; manufacture of electrical machinery and equipment

3.3. Empirical Model

Referring to the approach of Bertrand and Scholar [33], we used a DID model to test the impact of GCG on technological innovation. A Hausman test was carried out in this paper, and the result showed that P-value was 0.000, so the fixed effect model rather than random effect model was selected in this paper. The model waws as follows:

$$Innovation_{it} = \alpha_0 + \alpha_1 Treat_i + \alpha_2 Post_t + \alpha_3 Treat_i \times Post_t + \gamma Control_{it} + \delta_i + \lambda_t + \varepsilon_{it} \quad (4)$$

where $Innovation_{it}$ is the variable of technological innovation of firm i at time t, including R&D input and innovation output. *Treat* and *Post* are dummy variables. *Control* includes all the control variables. δ_i is individual fixed effect and λ_i is time fixed effect. ε_{it} is the residual. The coefficient α_3 is the DID estimator and was the parameter of our interest. The regression software was Stata 15.0. In order to avoid the influence of outliers, the continuous variables were winsorized at 1% of each tail.

3.4. Variable Definition

3.4.1. Dependent Variables

This paper measured the technological innovation of listed firms from R&D input and innovation output. In terms of R&D input, the intensity of innovation input (*Rd*) was chosen to measure the strength of technological innovation; in terms of output, because the number of granted invention patents (*Igrant*) is the most valuable embodiment of technological innovation, the number of granted invention patents was chosen to measure innovation output.

3.4.2. Key Explanatory Variables

Treat was a dummy variable that equaled 1 if the firm belonged to treatment group, and 0 if the firm was in control group. *Post* was also a dummy variable that equaled 0 before the implementation of GCG and it was 1 after GCG.

3.4.3. Control Variables

Referring to the previous studies, the control variables included: (1) The characteristic variables of the board of directors, including size of the board of directors and the proportion of independent directors. (2) The variable of ownership concentration. (3) The characteristic variables of the company, including size of the firm, debt ratio, proportion of fixed assets, profitability, and market value. Table 2 shows the definition of each variable.

Table 2. Variable definition.

Variable	Code	Definition
R&D input	*Rd*	The proportion of R&D input to total assets
Innovation output	*Igrant*	The natural log of granted invention patents plus 1
Group variable	*Treat*	Equaled 1 if the firm belonged to treatment group, and 0 if it was in control group
Event variable	*Post*	Equaled 0 before the implementation of GCG, and it was 1 after GCG
Board size	*Board*	The natural log of board size
Independence of board	*Indep*	The proportion of independent directors
Ownership concentration	*Sh1*	The ownership of the largest shareholder
Firm size	*Size*	The natural log of total assets
Debt to assets ratio	*Lev*	The proportion of total debt to total assets
Fixed assets	*Tangi*	The proportion of fixed assets to total assets
Profitability	*Roa*	The return on assets
Market value	*Q*	Tobin's Q

4. Empirical Results

4.1. Descriptive Statistics

According to the descriptive statistics results shown in Table 3. The average R&D input was 0.0171, and its standard deviation was 0.0216, indicating substantial variation among firms. The average granted invention patent was 0.9386, and its standard deviation was 1.0821, also indicating substantial variation among firms. The results show that the firms in pollution-intensive industries accounted for 41.28% of the total samples, and 70.83% of the samples were after the implementation of GCG. Table 3 also presents the descriptive statistics of other variables.

Table 3. Descriptive statistics for sample firms.

Variable	Obs	Mean	Std	Min	Max
Rd	12,803	0.0171	0.0216	0.0000	1.0395
Igrant	12,803	0.9386	1.0821	0.0000	4.5539
Treat	12,803	0.4128	0.4924	0.0000	1.0000
Post	12,803	0.7083	0.4545	0.0000	1.0000
Board	12,803	2.1440	0.1925	1.0986	2.8904
Indep	12,803	0.3709	0.0541	0.0909	0.8000
Sh1	12,803	0.3542	0.1457	0.0339	0.8999
Size	12,803	21.8512	1.1682	16.1613	27.3765
Lev	12,803	0.3985	0.4582	−0.1947	41.9394
Tangi	12,803	0.2354	0.1426	0.0000	0.8491
Roa	12,803	0.0598	0.2019	−0.3771	20.7876
Q	12,803	2.4272	2.7890	0.1533	192.7051

4.2. Correlation Analysis of Variables

Table 4 shows the Pearson correlation coefficients between variables. The results show that *Treat* had a significant negative correlation with R&D input and innovation output, indicating that the technological innovation ability of the treatment group was lower than that of the control group. *Post* had a significant positive correlation with the R&D input and innovation output, indicating that the technological innovation ability of manufacturing industry is continuing improve with the time. Compared with the control group, the implementation of GCG had a significant negative effect on the technological innovation of the treatment group. The highest correlation coefficient among the other variables was 0.48, indicating there was no serious multicollinearity among them. At the same time, we tested the variance inflation factor (VIF) of variables, and the results show that there was no multicollinearity between variables.

Table 4. Correlation analysis of variables.

Variable	*Rd*	*Igrant*	*Treat*	*Post*	*Board*	*Indep*	*Sh1*	*Size*	*Lev*	*Tangi*	*Roa*
Igrant	0.26 ***										
Treat	−0.16 ***	−0.11 ***									
Post	0.30 ***	0.20 ***	−0.06 ***								
Board	−0.07 ***	0.03 ***	0.06 ***	−0.15 ***							
Indep	0.04 ***	0.03 ***	−0.03 ***	0.07 ***	−0.48 ***						
Sh1	−0.03 ***	0	0.01 **	−0.06 ***	0	0.05 ***					
Size	−0.06 ***	0.28 ***	0.07 ***	0.09 ***	0.25 ***	0	0.15 ***				
Lev	−0.08 ***	0.01	0.01	−0.07 ***	0.07 ***	−0.01	0.02 ***	0.17 ***			
Tangi	−0.13 ***	−0.07 ***	0.34 ***	−0.07 ***	0.12 ***	−0.04 ***	0.04 ***	0.15 ***	0.09 ***		
Roa	0.01 ***	0	−0.01	−0.03 ***	−0.02 **	0.01	0.01	−0.07 ***	−0.01 **	−0.08 ***	
Q	0.02 **	−0.03 ***	−0.01	0.05 ***	−0.08 ***	0.03 ***	−0.09 ***	0.25 ***	0.07 ***	−0.09 ***	0.26 ***

Notes: ** and *** indicate significance at the 5% and 1% levels, respectively.

4.3. Impacts of GCG on Technological Innovation of Firms in Pollution-Intensive Industries

Table 5 shows the fixed effect regression results of the green credit policy on manufacturing technology innovation (controlling individual fixed effect and time fixed effect). Column (1) in Table 5 shows that the coefficient of *Treat*×*Post* on the R&D input of technological innovation was –0.0037, which is a significant negative correlation at the level of 1%, indicating that the R&D input of firms in pollution-intensive industries was significantly lower than that of firms in non-pollution-intensive industries after the implementation of GCG. Column (2) reports the impact of *Treat*×*Post* on technological innovation output. The results show that *Treat*×*Post* had a significant negative correlation with the granted invention patent at the level of 1%, indicating that innovation output of firms in pollution-intensive industries was significantly lower than that of firms in non-pollution-intensive industries after the implementation of GCG. The results in Table 5 show that the implementation of GCG significantly reduced the R&D input and innovation output of firms in pollution-intensive industries compared with firms in non-pollution-intensive industries. The above results verify hypothesis H1a.

Table 5. Impact of Green Credit Guidance (GCG) on technological innovation of firms in pollution-intensive industries.

Variable	(1) ***Rd***	(2) ***Igrant***
Treat	−0.0042 ***	0.1048 *
	(−2.59)	(1.65)
Post	0.0216 ***	0.9367 ***
	(18.47)	(20.68)
Treat×*Post*	−0.0037 ***	−0.2455 ***
	(−5.05)	(−8.74)
Board	0.0019	−0.0566
	(1.02)	(−0.81)
Indep	−0.0021	−0.1205
	(−0.37)	(−0.56)
Sh1	0.0054 *	−0.3398 ***
	(1.86)	(−3.04)
Size	−0.0023 ***	0.1143 ***
	(−4.91)	(6.22)
Lev	−0.0036 *	0.2607 ***
	(−1.93)	(3.67)
Tangi	0.0036	0.2606 ***
	(1.62)	(3.01)
Roa	0.0197 ***	−0.3241 *
	(3.95)	(−1.68)
Q	−0.0002 *	−0.0068
	(−1.90)	(−1.61)
Constant	0.0497 ***	−2.0409 ***
	(4.50)	(−4.77)
N	12803	12803
Adj-R^2	−0.0846	0.0119
F	62.4576	117.3703

Notes: * and *** indicate significance at the 10% and 1% levels, respectively. T statistic in parentheses.

4.4. Impacts of GCG on Technological Innovation of Firms in Pollution-Intensive Industries with Different Characteristics

There are obvious differences in the responses of firms with different characteristics to policies and the ability to use these policies. For example, state-owned firms will take more social responsibilities than non-state-owned firms, but there are many advantages for them in financing constraints, budget constraints, etc. Large firms have more advantages in understanding the policies, capital acquisition, and other advantages than small firms. So, the impact of the green credit policy on firms in pollution-intensive industries with different characteristics may be different, referring to the research of Chakraborty and Chatterjee [21]. Our paper divided the samples into different groups, according to the property right and the scale of firms, to investigate whether there were different impacts of the green credit policy on the technological innovation of firms in pollution-intensive industries with different characteristics.

Columns (1) to (4) of Table 6 show the results of group research based on the property right, and columns (5) to (8) show the results of group research based on the scale of the firms. Columns (1) and (2) show the impacts of GCG on the R&D input of state-owned firms and non-state-owned firms. It was found that the implementation of GCG significantly reduced the R&D input of the state-owned firms in pollution-intensive industries. Columns (3) and (4) show that the implementation of GCG significantly reduced the innovation output of all the firms in pollution-intensive industries. The results of columns (5) to (8) show that the implementation of GCG significantly reduced the R&D input and innovation output of firms in pollution-intensive industries, whether for large-scale or small-scale firms.

Table 6. Impacts of green credit on technological innovation grouped by different characteristics.

Variable	(1) *Rd* State-Owned	(2) *Rd* Non-State-Owned	(3) *Igrant* State-Owned	(4) *Igrant* Non-state-Owned	(5) *Rd* Large	(6) *Rd* Small	(7) *Igrant* Large	(8) *Igrant* Small
Treat	−0.0140 ***	−0.0010	−0.0163	0.1390 *	−0.0001	−0.0152 ***	0.0348	0.1651 *
	(−4.24)	(−0.51)	(−0.14)	(1.73)	(−0.04)	(−5.72)	(0.28)	(1.84)
Post	0.0182 ***	0.0247 ***	0.9435 ***	0.9125 ***	0.0195 ***	0.0217 ***	1.0669 ***	0.6954 ***
	(9.26)	(15.46)	(13.30)	(14.24)	(10.68)	(12.08)	(13.70)	(11.42)
Treat×*Post*	−0.0069 ***	−0.0009	−0.2447 ***	−0.2535 ***	−0.0067 ***	−0.0024 **	−0.2974 ***	−0.1565 ***
	(−5.47)	(−0.95)	(−5.34)	(−6.83)	(−6.04)	(−2.15)	(−6.26)	(−4.15)
Board	−0.0029	0.0049 **	0.0459	−0.0807	0.0040	0.0034	−0.1613	−0.0514
	(−0.85)	(2.22)	(0.37)	(−0.91)	(1.51)	(1.16)	(−1.44)	(−0.52)
Indep	0.0057	−0.0055	0.8496 **	−0.6285 **	0.0014	−0.0019	−0.6358 *	−0.0842
	(0.57)	(−0.80)	(2.35)	(−2.26)	(0.18)	(−0.22)	(−1.93)	(−0.28)
Sh1	−0.0026	0.0066*	−0.3750 *	−0.3098 **	0.0031	0.0049	−0.3095 *	−0.5002 ***
	(−0.44)	(1.90)	(−1.80)	(−2.22)	(0.73)	(0.90)	(−1.73)	(−2.71)
Size	−0.0000	−0.0037 ***	0.1526 ***	0.1192 ***	−0.0010	−0.0029 ***	0.2411 ***	0.0970 ***
	(−0.03)	(−6.22)	(4.54)	(5.00)	(−1.14)	(−2.85)	(6.51)	(2.84)
Lev	0.0014	−0.0021	0.3949 ***	0.2481 ***	−0.0015	−0.0045	0.2329 *	0.2935 ***
	(0.37)	(−0.98)	(2.92)	(2.84)	(−0.47)	(−1.55)	(1.77)	(2.99)
Tangi	0.0061	0.0048 *	0.2217	0.3268 ***	0.0073 **	0.0041	0.1160	0.2405 **
	(1.43)	(1.76)	(1.44)	(2.96)	(2.05)	(1.20)	(0.77)	(2.06)
Roa	0.0165	0.0222 ***	−0.7587 **	−0.0288	0.0199 **	0.0090	−0.1613	−0.2945
	(1.64)	(3.83)	(−2.09)	(−0.12)	(2.50)	(1.22)	(−0.48)	(−1.18)
Q	0.0001	−0.0002 *	−0.0093	−0.0048	0.0003	−0.0002 *	−0.0379 **	−0.0048
	(0.20)	(−1.73)	(−0.93)	(−1.02)	(0.68)	(−1.93)	(−2.17)	(−1.11)
Constant	0.0137	0.0684 ***	−3.4327 ***	−1.9613 ***	0.0131	0.0622 ***	−4.4118 ***	−1.6166 **
	(0.62)	(5.01)	(−4.34)	(−3.57)	(0.66)	(2.78)	(−5.17)	(−2.13)
N	4099	8704	4099	8704	5682	7121	5682	7121
Adj-R^2	−0.0047	−0.1636	0.0857	−0.0597	−0.0996	−0.2458	0.0005	−0.1816
F	31.5508	32.8706	51.7087	69.5478	34.2217	22.4454	57.2675	37.2273

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. T statistic in parentheses.

4.5. Dynamic Effect Test of the Impact of GCG on Technological Innovation

In order to test the dynamic effect of the impact of GCG on technological innovation, referring to the approach of Su and Lian [31], the model was constructed as shown in Equation (6).

$$\begin{aligned} Innovation_{it} = \; & \beta_0 + \beta_1 Treat_i + \sum \beta_t PostYear_t + \sum \theta_t Treat \times PostYear_t \\ & \gamma Control_{it} + \delta_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{5}$$

where $PostYear_t$ is a dummy variable of each year after the implementation of GCG, and $Treat{\times}PostYear_t$ is a new difference variable, whose coefficient measures the dynamic effect of GCG. It can be seen from Table 7 that the coefficient of each difference variable was significantly negatively correlated to R&D input and innovation output at the level of 5% or 1%. When observing the value of the coefficient of each difference variable, it was found that the negative impact of GCG on the R&D input increased from 2012 to 2015, and decreased step by step from 2015 to 2017. This dynamic change process shows that with the implementation of GCG on firms in pollution-intensive industries, the negative impact on R&D input has increased year by year, but after 2015, its negative impact has gradually weakened. Observing the dynamic effect of GCG on innovation output, we found that the absolute value of the coefficient of the difference variable was getting larger and larger from 2012 to 2017, which shows that the implementation of GCG had a far-reaching negative impact on the innovation output of firms in pollution-intensive industries.

Table 7. Dynamic effect test of the impact of GCG on technological innovation.

Variable	*Rd*	*Igrant*
Treat	−0.0042 **	0.1173 *
	(−2.57)	(1.85)
PostYear2012	0.0177 ***	0.6928 ***
	(17.06)	(17.27)
PostYear2013	0.0203 ***	0.6855 ***
	(18.96)	(16.59)
PostYear2014	0.0201 ***	0.6940 ***
	(18.40)	(16.41)
PostYear2015	0.0217 ***	0.9701 ***
	(18.70)	(21.62)
PostYear2016	0.0207 ***	1.0469 ***
	(17.33)	(22.73)
PostYear2017	0.0216 ***	1.0294 ***
	(17.65)	(21.75)
Treat×PostYear2012	−0.0023 **	−0.1651 ***
	(−2.09)	(−3.89)
Treat×PostYear2013	−0.0031 ***	−0.1072 **
	(−2.81)	(−2.48)
Treat×PostYear2014	−0.0040 ***	−0.1180 ***
	(−3.67)	(−2.78)
Treat×PostYear2015	−0.0053 ***	−0.3467 ***
	(−4.81)	(−8.18)
Treat×PostYear2016	−0.0039 ***	−0.3478 ***
	(−3.64)	(−8.43)
Treat×PostYear2017	−0.0036 ***	−0.4237 ***
	(−3.32)	(−10.19)
Board	0.0019	−0.0561
	(1.05)	(−0.80)
Indep	−0.0019	−0.0692
	(−0.34)	(−0.32)
Sh1	0.0055 *	−0.3112 ***
	(1.92)	(−2.79)
Size	−0.0024 ***	0.1048 ***
	(−4.96)	(5.71)
Lev	−0.0037 **	0.2268 ***
	(−1.99)	(3.19)
Tangi	0.0038 *	0.2788 ***
	(1.68)	(3.23)
Roa	0.0198 ***	−0.2156
	(3.96)	(−1.12)
Q	−0.0002 **	−0.0083 **
	(−2.00)	(−1.99)
Constant	0.0501 ***	−1.8753 ***
	(4.53)	(−4.39)
N	12803	12803
Adj-R2	−0.0845	0.0183
F	50.6770	98.2270

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. T statistic in parentheses.

5. Robustness Test

5.1. Sensitivity Test of Technological Innovation Index

In the robustness test, *Rd* was replaced by the *Rd1*, which is the proportion of R&D expenditure to operating revenue, and *Igrant* was replaced by *Iapply*, which is the natural log of the amount of the invention patent application quantity plus 1. From Table 8, we can see that the coefficient of *Treat*×*PostYear* had a significant negative correlation with the *Rd1* and *Iapply* at the level of 1%, respectively; that is to say, GCG had a negative effect on technological innovation of firms in pollution-intensive industries.

Table 8. Sensitivity test of technological innovation index.

Variable	*Rd1*	*Iapply*
Treat	−0.0106 ***	−0.0578
	(−3.01)	(−0.79)
Post	0.0289 ***	0.5137 ***
	(11.52)	(9.84)
Treat×*Post*	−0.0076 ***	−0.1726 ***
	(−4.86)	(−5.33)
Board	0.0038	0.2117 ***
	(0.99)	(2.61)
Indep	0.0018	0.5800 **
	(0.15)	(2.35)
Sh1	−0.0054	−0.3356 ***
	(−0.88)	(−2.60)
Size	−0.0006	0.1279 ***
	(−0.62)	(6.03)
Lev	−0.0150 ***	−0.0016
	(−3.80)	(−0.02)
Tangi	−0.0029	0.2541 **
	(−0.60)	(2.55)
Roa	−0.0567 ***	0.1743
	(−5.31)	(0.78)
Q	−0.0005 **	−0.0101 **
	(−2.13)	(−2.10)
Constant	0.0365	−2.4844 ***
	(1.54)	(−5.04)
N	12803	12803
Adj-R^2	−0.1268	−0.1093
F	41.3934	49.9585

Notes: ** and *** indicate significance at the 5% and 1% levels, respectively. T Statistic in parentheses.

5.2. Sensitivity Test through Grouping by Different Characteristics of Firms

According to the property right and the scale of the enterprise, the samples were divided into two groups, one group was state-owned firms and non-state-owned firms, the other one was large-scale firms and small-scale firms. During the regression, *Rd1* and *Iapply* were used as dependent variables. It can be seen from Table 9 that the impacts of GCG on technological innovation were significantly negative, and the results were consistent with Table 6.

Table 9. Sensitivity test grouped by different characteristics.

Variable	*Rd1* State-Owned	*Rd1* Non-State-Owned	*Iapply* State-Owned	*Iapply* Non-State-Owned	*Rd1* Large	*Rd1* Small	*Iapply* Large	*Iapply* Small
Treat	−0.0357 ***	0.0001	−0.0665	−0.0397	0.0013	−0.0368 ***	−0.1513	0.1707
	(−4.64)	(0.02)	(−0.50)	(−0.42)	(0.26)	(−5.96)	(−1.06)	(1.60)
Post	0.0273 ***	0.0291 ***	0.4369 ***	0.4721 ***	0.0281 ***	0.0281 ***	0.5545 ***	0.3419 ***
	(5.95)	(9.06)	(5.45)	(6.31)	(9.02)	(6.70)	(6.32)	(4.74)
Treat×*Post*	−0.0138 ***	−0.0027	−0.1050 **	−0.2252 ***	−0.0117 ***	−0.0069 ***	−0.2065 ***	−0.0980 **
	(−4.67)	(−1.47)	(−2.03)	(−5.20)	(−6.15)	(−2.66)	(−3.86)	(−2.20)
Board	−0.0013	0.0078 *	0.0490	0.3315 ***	0.0064	0.0054	−0.0034	0.2843 **
	(−0.16)	(1.76)	(0.35)	(3.20)	(1.42)	(0.80)	(−0.03)	(2.44)
Indep	0.0228	−0.0026	0.8474 **	0.5058	0.0176	−0.0081	0.6931 *	0.3751
	(0.97)	(−0.19)	(2.08)	(1.56)	(1.34)	(−0.39)	(1.86)	(1.06)
Sh1	−0.0164	−0.0038	−0.7125 ***	−0.1189	−0.0052	−0.0069	−0.2865	−0.3149
	(−1.22)	(−0.55)	(−3.03)	(−0.73)	(−0.73)	(−0.54)	(−1.42)	(−1.44)
Size	0.0017	−0.0014	0.1953 ***	0.1249 ***	−0.0007	−0.0003	0.2471 ***	0.1834 ***
	(0.76)	(−1.17)	(5.14)	(4.49)	(−0.44)	(−0.15)	(5.93)	(4.53)
Lev	−0.0016	−0.0151 ***	0.1235	−0.0872	−0.0011	−0.0269 ***	−0.1111	−0.0807
	(−0.18)	(−3.47)	(0.81)	(−0.85)	(−0.21)	(−3.99)	(−0.75)	(−0.70)
Tangi	0.0218 **	−0.0101 *	0.3537 **	0.2513 *	0.0171 ***	−0.0045	0.2963 *	0.1791
	(2.19)	(−1.84)	(2.04)	(1.95)	(2.84)	(−0.56)	(1.74)	(1.29)
Roa	−0.0133	−0.0802 ***	−0.3049	0.4088	−0.0109	−0.1012 ***	0.9300 **	−0.2546
	(−0.56)	(−6.87)	(−0.74)	(1.50)	(−0.81)	(−5.90)	(2.44)	(−0.86)
Q	−0.0000	−0.0005 **	−0.0125	−0.0062	−0.0004	−0.0007 **	−0.0367 *	−0.0039
	(−0.04)	(−2.28)	(−1.11)	(−1.13)	(−0.63)	(−2.41)	(−1.86)	(−0.76)
Constant	−0.0141	0.0458 *	−3.6041 ***	−2.6479 ***	0.0041	0.0522	−4.6766 ***	−3.7537 ***
	(−0.28)	(1.67)	(−4.03)	(−4.13)	(0.12)	(1.00)	(−4.87)	(−4.18)
N	4099	8704	4099	8704	5682	7121	5682	7121
Adj-R^2	−0.0727	−0.1909	−0.0199	−0.1956	−0.1254	−0.2725	−0.1065	−0.2828
F	18.6103	24.2986	28.4936	22.8501	26.9954	16.7220	31.0950	14.5783

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. T Statistic in parentheses.

6. Further Study: Analysis of the Mediator Effect of Long-Term Debt

Technological innovation is a long-term, high-input, and high-risk production activity, so it needs long-term financial support to be carried out in an orderly manner. From our study, we found that the implementation of GCG significantly reduced the R&D input and innovation output of the firms in pollution-intensive industries. According to the research conclusion of Wang et al. [20], we speculated that GCG had led to a decrease in the long-term debt of the firms in pollution-intensive industries, thus reducing their R&D input and innovation output; that is, long-term debt plays a role of mediator between GCG and technological innovation.

In order to test the mediator effect of long-term debt, according to the approach of Baron and Kenny [34], the regression models are shown in model (7) to model (9).

$$c\_Innovation_{it} = \alpha_0 + \alpha_1 Treat_i + \alpha_2 Post_t + \alpha_3 Treat_i \times Post_t + \gamma c\_Control_{it} + \delta_i + \lambda_t + \varepsilon_{it} \tag{6}$$

$$\mathrm{c}\_Longdebt_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 Treat_i \times Post_t + \gamma c\_Control_{it} + \delta_i + \lambda_t + \varepsilon_{it} \tag{7}$$

$$c\_Innovation_{it} = \varphi_0 + \varphi_1 Treat_i + \varphi_2 Post_t + \varphi_3 Treat_i \times Post_t + \varphi_4 \mathrm{c\_Longdebt}_{i,t} + \gamma c\_Control_{it} + \delta_i + \lambda_t + \varepsilon_{it}. \tag{8}$$

In order to test the mediator effect, all the continuous variables were decentralized in model (7) to model (9), and are shown as "c variable name". In model 8, $Longdebt_{it}$ is the ratio of long-term debt, it is the sum of the proportion of long-term loans, the proportion of bond payable, the proportion of long-term payables, and the proportion of special payables to total debts at the end of the year. The other variables are the same as model 4. According to the requirements of the mediator effect test, if the coefficients α_3, β_3, φ_3, and φ_4 are significant, this shows that *Longdebt* is a partial mediator. If the coefficient of α_3, β_3 and φ_4 are significant and φ_3 isn't significant, this shows *Longdebt* is a full mediator. From the results of Table 10, it shows that the long-term debt played a partial role as mediator between GCG and technological innovation. After the implementation of GCG, financial institutions reduced the long-term loans to firms in pollution-intensive industries for the sake of risk, thus affecting R&D input and innovation output.

Table 10. Mediator effect of long-term debt.

Varaible	(1) *Igrant*	(2) *Longdebt*	(3) *Igrant*	(4) *Rd*	(5) *Longdebt*	(6) *Rd*
Treat	−0.0622 *	0.0432 ***	−0.0505	−0.0027 ***	0.0432 ***	−0.0024 ***
	(−1.85)	(10.54)	(−1.50)	(−3.94)	(10.54)	(−3.50)
Post	0.7468 ***	−0.0085	0.7445 ***	0.0214 ***	−0.0085	0.0213 ***
	(14.18)	(−1.31)	(14.14)	(20.25)	(−1.31)	(20.21)
Treat×Post	−0.2578 ***	−0.0234 ***	−0.2641 ***	−0.0041 ***	−0.0234 ***	−0.0042 ***
	(−6.58)	(−4.90)	(−6.74)	(−5.19)	(−4.90)	(−5.39)
c_Longdebt			−0.2722 ***			−0.0068 ***
			(−3.76)			(−4.66)
c_Board	0.2145 ***	−0.0264 ***	0.2073 ***	0.0027 **	−0.0264 ***	0.0025 **
	(3.77)	(−3.80)	(3.65)	(2.37)	(−3.80)	(2.21)
c_Indep	0.6130 ***	0.0000	0.6130 ***	0.0088 **	0.0000	0.0088 **
	(3.14)	(0.00)	(3.14)	(2.24)	(0.00)	(2.24)
c_Sh1	−0.2371 ***	−0.0485 ***	−0.2503 ***	−0.0009	−0.0485 ***	−0.0012
	(−3.79)	(−6.34)	(−3.99)	(−0.70)	(−6.34)	(−0.96)
c_Size	0.2901 ***	0.0292 ***	0.2980 ***	−0.0012 ***	0.0292 ***	−0.0010 ***
	(29.05)	(23.91)	(29.22)	(−5.75)	(23.91)	(−4.67)
c_Lev	−0.2226 ***	0.1171 ***	−0.1907 ***	−0.0051 ***	0.1171 ***	−0.0044 ***
	(−3.74)	(16.12)	(−3.18)	(−4.31)	(16.12)	(−3.61)
c_Tangi	−0.2906 ***	0.1555 ***	−0.2482 ***	−0.0045 ***	0.1555 ***	−0.0034 **
	(−4.19)	(18.36)	(−3.54)	(−3.22)	(18.36)	(−2.44)
c_Roa	0.9978 ***	−0.1727 ***	0.9508 ***	0.0461 ***	−0.1727 ***	0.0449 ***
	(4.90)	(−6.94)	(4.66)	(11.28)	(−6.94)	(10.98)
c_Q	0.0031	0.0007 *	0.0033	−0.0003 ***	0.0007 *	−0.0003 ***
	(0.90)	(1.74)	(0.96)	(−3.95)	(1.74)	(−3.88)
Constant	−6.3585 ***	−0.5457 ***	−6.5071 ***	0.0215 ***	−0.5457 ***	0.0178 ***
	(−27.17)	(−19.09)	(−27.43)	(4.58)	(−19.09)	(3.74)
N	12803	12803	12803	12803	12803	12803
Adj-R^2	0.1544	0.2099	0.1553	0.1451	0.2099	0.1465
F	112.3103	162.9170	107.9585	104.4752	162.9170	100.8737

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. T statistic in parentheses.

7. Conclusions

In recent years, green finance has become a hot topic around the whole world. China has issued lots of green credit policies and innovated a lot of green financial instruments. There are many studies on the effects of the scale of green finance and green financial instruments, but few studies have focused on the effect of green credit policy. The major purpose of green credit policy is to promote the technological innovation of firms in pollution-intensive industries, improve production efficiency, reduce pollutant emissions, and realize transformation, upgrading, and green development. This paper selected the GCG issued in 2012 as the green credit policy, and took the manufacturing industry of China's A-share listed firms from 2007 to 2017 as the research object to investigate the impact of GCG on the technology innovation of firms in pollution-intensive industries. It was found that the implementation of GCG significantly reduced the R&D input and innovation output of firms in pollution-intensive industries compared with the firms in non-pollution-intensive industries. When the samples were divided into groups according to the property rights and the scale of firms, it was found that the impacts of GCG on technological innovation were consistent with above. Further research found that the long-term debt is a mediator between GCG and technological innovation.

In recent years, the Chinese government has attached great importance to the development of green finance, and China's green credit policies and green finance instruments are also at the forefront of the world. Green credit policy should help firms in pollution-intensive industries to carry out technological innovation, eliminate backward production capacity through improving quality and efficiency, and achieve sustainable development. China's green credit policy has been around for several years. When we tested the availability of the green credit policy, we found that it has not played its expected role in the technological innovation of firms in pollution-intensive industries; that is, to promote their technological innovation, to promote the technology upgrading, and to realize green development. We found that after the implementation of GCG, financial institutions reduced the long-term debt of firms in pollution-intensive industries in order to avoid risks, thus inhibiting their technological upgrading. Therefore, the government and financial institutions should dynamically evaluate the implementation effect of the green credit policy and promote more green investment by the design of punishment mechanisms and incentive mechanisms, rather than strengthening the financial constraints of technological innovation of firms in pollution-intensive industries.

This paper examined the implementation effect of green credit policy on technological innovation, but there are still some shortcomings: Firstly, the factors considered by firms in pollution-intensive industries, especially financial institutions, need to be investigated after the implementation of the green credit policy, so as to have a deeper understanding of the mechanism of the policy. Secondly, the analysis of the path and mechanisms of the impact of the green credit policy on technological innovation in this paper was relatively shallow, which needs to be further analyzed in the next research. Thirdly, due to the limitation of the sample period, this paper found that the impact of the green credit policy on the R&D input changed in 2015, but because the granted invention patents have a long time lag, the negative impact of the green credit policy on the granted invention patents is increasing day by day. Will the number of granted invention patents be increased due to the recovery of R&D input in the next year? We also need to carry out follow-up research. At the same time, the factors behind the turning point of R&D input are also worth studying. These are all the contents to be studied in the future.

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