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The Impact of Green Finance on Corporate Carbon Productivity

-- Taking China Great Wall Technology Group Co., Ltd. as an Example

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ABSTRACT

With the transformation of China's economy from high-speed growth to high-quality development, the extensive development mode that relied on a large amount of resource investment in the past has become unsustainable, promoting the green transformation of high polluting enterprises to become a necessary path for sustainable economic development. This article takes the carbon dioxide emissions and implementation of green finance policies of China Great Wall Technology Group Co., Ltd. from 2011 to 2020 as the research sample, and empirically analyzes the impact of the release and implementation of green finance policies on the carbon emissions of enterprises. Research has shown that the implementation of green finance policies has a significant positive promoting effect on corporate carbon emissions reduction, that is, the release and implementation of green finance policies can help reduce corporate carbon emissions. Based on empirical research, policy recommendations were ultimately proposed to facilitate the effective implementation of green finance policies.

KEYWORDS

Green Finance Policy; Carbon Productivity; Emission Reduction Measures; Carbon Information Disclosure.

1. INTRODUCTION

The massive emissions of greenhouse gases have made global warming an irreversible situation, and reducing emissions is an effective way to alleviate this problem. In China, as the main body of economic development and also the main emitter of greenhouse gases, it is particularly important to explore the issue of corporate carbon reduction. In response to climate change, China has also formulated a series of energy-saving and emission reduction measures, especially for high emission and high pollution enterprises and industries. In August 2016, the Guiding Opinions on Building a Green Finance System were issued, and China took the lead in building a policy framework for green finance. In 2017, the division of labor plan for implementing the Guiding Opinions on Building a Green Finance System was released. The release of the policy also showed that the country and the government have gradually increased their attention to the low-carbon transformation of Chinese enterprises, which has also prompted enterprises to gradually recognize the importance of low-carbon development and contribute their modest efforts to China's low-carbon transformation.

When facing carbon risks, enterprises will stimulate their efficient use of resources, promote green innovation, and thereby reduce their carbon emissions. However, the impact of green innovation on carbon reduction by enterprises is a double-edged sword. On the one hand, green innovation can reduce the carbon emissions of enterprises, alleviate the phenomenon of global climate change, and help achieve the goals of "carbon peak and carbon neutrality"; On the other hand, from an economic perspective, enterprises need to bear a significant amount of financial risks when engaging in green innovation, making it difficult for them to adhere to low-carbon reforms and potentially consuming more energy. Therefore, exploring whether green innovation and green finance policies can enable enterprises to achieve low-carbon development has profound research significance.

2. LITERATURE REVIEW

2.1. Research on Green Finance Theory

Regarding the role of green finance, Zeng Huizhi (2022) and Cai Yang (2024) stated that finance is the lifeblood of the economy. However, due to the conflict between human social development and the environment, the government and the market are in a state of "dual loss" to some extent, and the green finance industry has emerged. Wang Xiaojiang et al. (2009) stated that with the introduction of green finance policies, finance has become a unique way to integrate with low-carbon transformation of enterprises and bring huge benefits to society. Zhang Hong (2011) stated that green finance policies leverage the financial sector to achieve sustainable development of resources, introduce environmental protection concepts into corporate financial decision-making, and incorporate potential environmental impacts into corporate financial management. Chen Xiaoyun (2024) and others stated that the introduction of green finance policies has effectively alleviated the financing constraints of green enterprises and increased their long-term loan limits. Yang Yao et al. (2011) stated that the legality management of green policies and increasing the disclosure of environmental protection information by enterprises can help strengthen the supervision of enterprises.

2.2. The Relationship between Green Finance and Carbon Reduction

Regarding the relationship between green finance and carbon reduction, Qi Huaijin et al. (2023) believe that the implementation of green finance pilot policies has opened up diversified green financing paths for the development of China's green industry and traditional enterprise technology transformation projects, improved financing convenience, and helped promote green technology innovation in enterprises. Sun Zheyuan (2023) and Shi Sheng (2024) stated that green finance has a positive impact on urban carbon productivity by promoting green technology innovation, improving energy structure, and enhancing environmental awareness in enterprises. Wang Jia (2023) suggests that creating a favorable economic environment, reducing financing difficulties for enterprises related to green development, and suppressing the expansion of high energy consuming and high polluting enterprises is an innovative way to achieve green development. It is of great significance for China to promote energy conservation and emission reduction, achieve sustainable economic development, and promote the processes of "carbon peaking" and "carbon neutrality". Zhou Bing (2024) and others stated that enterprise technological innovation is the fundamental pillar and source of green development, and green finance can provide financial support for the green economy. The coordinated development of the two can help promote the development of China's green and low-carbon economy.

After reviewing existing literature, it was found that several articles have explored the role of green finance policies and how green finance policies can reduce corporate carbon emissions by improving the level of green technology innovation. There are few articles analyzing the importance of the government in the release of green finance policies. Therefore, this article explores the impact of

green finance on corporate carbon reduction from the policy and institutional levels, which is of great research significance.

3. EMPIRICAL ANALYSIS OF GREEN FINANCE EMPOWERING LOW-CARBON DEVELOPMENT OF ENTERPRISES

3.1. Data Source

Given the availability of data, this article selects relevant statistical data from China Great Wall Technology Group Co., Ltd. from 2011 to 2020 for empirical analysis. The data mainly comes from the Guotai An database, the National Bureau of Statistics, and the Conceptual "Annual Report of Listed Companies" and "China Energy Statistical Yearbook". Descriptive statistics of relevant variables are shown in Table 1.

Table 1. Descriptive statistics of each variable (N=10)

Variable	Mean value	S.D.	Max	Min
Enterprise carbon dioxide emissions	4.229	3.034	8.515	0.580
Industry carbon dioxide emissions	840.921	334.308	1622.666	595.331
Industry main business costs	82210.265	16289.507	107000.350	56534.990
Enterprise operating costs	448.040	312.678	733.000	74.500
Enterprise operating income	496.810	332.647	798.000	95.100

3.2. Model

3.2.1. Setting of Econometric Models

Based on the theoretical analysis and research hypotheses mentioned above, in order to verify the relationship between green finance policies and corporate carbon emissions, the article constructs a basic model as follows:

$$ECD_t = \gamma_0 + \gamma_1 DID_t + \gamma_2 DID_t \times EOC_t + \gamma_3 ICD_t + \gamma_4 MBC_t + \gamma_5 EOC_t + \gamma_6 EOI_t + \varepsilon_t$$

Among them, t represents the year, enterprise carbon dioxide emissions ECD is the dependent variable, γ_0 is the intercept term, γ_0 is the variable coefficient, and ε_t is the random disturbance term. The core explanatory variable is green finance policy DID. This article also introduces industry carbon dioxide emissions (ICD), industry main business costs (MBC), enterprise operating costs (EOC), and enterprise operating income (EOI) as control variables to introduce into the econometric model.

3.2.2. Variable Description

(1) Dependent variable. Enterprise carbon dioxide emissions (ECD). Due to the limited disclosure of carbon dioxide emissions by existing enterprises, this article will use the measurement method proposed by Li Wanhong (2023) and others to obtain data on industry carbon emissions from databases, and estimate the carbon emissions of enterprises based on their main business costs.

(2) Core explanatory variables. Green Finance Policy (DID), which is a dummy variable indicating whether a green finance policy was proposed and promoted in a certain year, is assigned a value of 1 for the year in which the green finance policy was introduced and promoted, and 0 for other years.

(3) Control variables. The control variables selected in this article include industry carbon dioxide emissions (ICD), industry main operating costs (MBC), enterprise operating costs (EOC), and enterprise operating income (EOI).

3.3. Empirical Analysis

3.3.1. Regression Analysis

Import the processed data into the regression model established above, and perform OLS regression estimation on the data using ordinary least squares method. The results are shown in Table 2.

Table 2. Parameter estimates

Variable	Coefficient	S.D.	t-Statistic	Prob.
C	25.02321	42.50257	0.588746	0.5974
DID	-14.21488	27.56724	-0.515644	0.6417
DID*EOC	0.076573	0.095320	0.803324	0.4805
ICD	0.001321	0.001102	1.199254	0.3165
MBC	-0.000179	0.000227	-0.791013	0.4867
EOC	-0.035946	0.194238	-0.185061	0.8650
EOI	0.024099	0.146492	0.164508	0.8798

R-squared	0.982861	Mean dependent var	4.228676
Adjusted R-squared	0.948582	S.D.dependent var	3.034339
S.E.of regression	0.688055	Akaike info criterion	2.286132
Sum squared resid	1.420261	Schwarz criterion	2.497942
Log likelihood	-4.430662	Hannan-Quinn criter.	2.053778
F-statistic	28.67243	Durbin-Watson stat	2.426711
Prob(F-statistic)	0.009616		

Based on the data in Table 2, a preliminary linear regression equation is obtained for the impact of green finance policies on corporate carbon emissions:

$$ECD_t = 25.02321 - 14.21488DID_t + 0.076573DID_t \times EOC_t + 0.0013121 - 0.000179MBC_t - 0.035946EOC_t + 0.024099EOI_t$$

3.3.2. Model Validation

(1) Economic significance test. For the core explanatory variable of this article, the estimated parameter value of green finance policy is -14.21488, indicating that the carbon dioxide emissions of enterprises gradually decrease after the introduction and promotion of green finance policy, which is consistent with the effect of green finance policy implementation. Therefore, it has passed the economic significance test.

(2) Statistical inference test. The corrected coefficient of certainty is 0.948582, indicating that at a 95% confidence level, the explanatory power of green finance policies, industry carbon dioxide emissions, industry main business costs, enterprise operating costs, and enterprise operating revenue on China's enterprise carbon dioxide emissions is 94.86%, indicating strong explanatory power and good fitting effect. F=28.67243>critical value 3.06, therefore rejecting the null hypothesis and

accepting the alternative hypothesis, and P=0.009616<given significance level 0.05, indicating that the combined effect of the above explanatory variables is statistically significant. And from the above results, it can be seen that none of the explanatory variables are significant, indicating the possibility of multicollinearity.

(3) Statistical testing and correction. This article will use the variance inflation factor method to conduct multicollinearity tests on the regression model. Based on the results, it is known that the model has severe multicollinearity, and a stepwise regression method will be used for correction. The revised parameter estimation results are shown in Table 3.

Table 3. Revised parameter estimation results

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	14.86935	1.617747	9.191394	0.0003
DID	-7.354108	1.633795	-4.501241	0.0064
MBC	-0.000130	2.10E-05	-6.199560	0.0016
DID*EOC	0.054079	0.019790	2.732671	0.0411
ICD	0.001359	0.000831	1.636159	0.1627

R-squared	0.982444	Mean dependent var	4.228676
Adjusted R-squared	0.968399	S.D.dependent var	3.034339
S.E.of regression	0.539402	Akaike info criterion	1.910143
Sum squared resid	1.454774	Schwarz criterion	2.061435
Log likelihood	-4.550714	Hannan-Quinn criter.	1.744175
F-statistic	69.95084	Durbin-Watson stat	2.377500
Prob(F-statistic)	0.000141		

The final linear regression equation for the impact of green finance policies on corporate carbon emissions fitted in this article is:

$$ECD_t = 14.86935 - 7.354108DID_t - 0.000130MBC_t + 0.054079DID_t \times EOC_t + 0.001359ICD_t \quad t =$$
$$(9.191394)\ (-4.501241)\ (-6.199560)\ (2.732671)\ (1.636159)$$
$$R^2 = 0.982444\ \overline{R^2} = 0.968399\ F = 69.95084\ DW = 2.377500$$

3.4. Empirical Results Analysis

The initial sample of this article is statistical data on carbon dioxide emissions and the implementation of green finance policies by China Great Wall Technology Group Co., Ltd. from 2011 to 2020. Through empirical analysis of the initial sample, the correlation between variables is deeply studied, and the relationship between enterprise carbon dioxide emissions and industry carbon dioxide emissions is further explored. The following conclusions are drawn through analysis:

The core explanatory variable of this article is that the implementation of green finance policies has a significant positive promoting effect on corporate carbon reduction work. That is, at a significance level of 5%, in the years when green finance policies are implemented, the average carbon dioxide emissions of enterprises decrease by 7354108 tons. It can be seen that the government's emphasis on corporate carbon reduction directly affects the carbon emissions of enterprises, and thus greatly affects the achievement of China's dual carbon goals.

In addition, according to the fitting results in the previous text, it can be seen that the carbon dioxide emissions of the industry, the main operating costs of the industry, and the operating costs of the enterprise also have a certain impact on the carbon dioxide emissions of the enterprise itself. It can be seen that carbon reduction cannot be achieved solely by the efforts of a single enterprise, but requires the joint efforts of the entire industry and even society.

Therefore, the government should strengthen its attention to green finance and take corresponding policy measures to better promote the smooth progress of China's carbon reduction work. A green economy and society are not only necessary for China's economic and social development, but also high-level requirements for the basic living standards of the vast majority of the people in our country. Therefore, it is necessary to propose policy recommendations to assist in the effective implementation of green finance policies and promote the development of the green economy on a virtuous cycle.

4. POLICY RECOMMENDATIONS

To implement green finance policies, it is necessary to design strategies at the top level of policies, systems, and other aspects. I believe that improvements can be made in the following five aspects.

4.1. Improve and Perfect Laws and Regulations Related to Green Finance

From a strategic perspective, it is necessary to fully recognize the positive effects that green finance brings to enterprise development, and establish a correct understanding of green finance on this basis. To achieve this goal, the government can issue guiding documents or industry norms to provide reference for enterprises to set carbon emission targets and specific targets. On this basis, mandatory carbon emission control shall be implemented for enterprises in the form of laws and regulations. Encourage enterprises to proactively set and achieve their emission reduction targets through various forms of economic stimulus such as tax reductions, subsidies, or low interest loans; At the same time, the government can provide training and educational resources for enterprises to help them understand the importance of carbon reduction and master relevant knowledge and skills; On this basis, by establishing partnerships with scientific research institutions, non-governmental organizations, and peer enterprises, we aim to explore and share the best path to achieving carbon reduction goals.

4.2. Enriching and Expanding Green Financial Instruments

The enrichment and expansion of green financial products is a significant measure to address climate change and achieve sustainable development. Therefore, the government can establish a complete green finance policy system, clarify the positioning and core goals of green finance, and provide policy guidance and support to encourage financial institutions to actively participate in green investment and green credit activities. In addition, the government can also establish green financial institutions such as green banks, green investment funds, or green insurance institutions to provide financing and insurance services for green projects and promote the construction of the green financial market. At the same time, the government can also provide scientific basis for the regulation and evaluation of green finance in China by requiring financial institutions to publicly disclose information on their carbon emissions, environmental effects, social effects, and other aspects.

4.3. Encourage Enterprises to Pursue High-quality Development Through Green Innovation

Each region should actively encourage enterprises to carry out green innovation, create a good environment, and promote the sustainable development of enterprises. Therefore, a special green innovation fund should be established to support enterprises in carrying out green technology research

and development; Build a green technology cooperation platform, promote collaboration among scientific research institutions, enterprises, governments, and other parties, and carry out green technology research and promotion; On this basis, efforts should be made to increase the protection of intellectual property rights related to green innovation, and encourage enterprises to actively engage in the research and development of green technologies and products; Enterprises should increase their efforts in cultivating and introducing green innovation talents, establish special plans for cultivating green innovation talents, and attract and cultivate more green technology talents through incentive measures such as scholarships and subsidies.

4.4. Deepen the Standardization Construction of Green Innovation

At present, there are no official identification and disclosure guidelines for green innovation investment and benefits for green enterprises in China. The vast majority of people still confuse green R&D investment with ordinary innovation investment, which makes it difficult for financial institutions to effectively and accurately allocate resources to green enterprises, thereby increasing support costs. Therefore, it is necessary to strengthen cooperation with relevant industry associations, international institutions, etc., and establish a unified green standard system; At the same time, green standards should be promulgated through legal and administrative means to encourage enterprises, industry associations, or other organizations to adopt them; At the same time, by establishing a green certification and labeling system, certification and labeling are provided for green products and services that meet standards, thereby helping consumers better understand green products and promoting the development of the green market. At the same time, regular evaluation and revision of green standards should be carried out to ensure that the standards formulated can adapt to the development of technology and meet the needs of industrial development; We can also actively participate in the formulation and cooperation of international green standards, connect with standard organizations in other countries or regions, promote international unity, help enterprises expand the international market, enhance the competitiveness of China's green products, and enhance China's comprehensive national strength.

4.5. Strengthen Supervision and Law Enforcement Efforts in the Green Industry

At present, a group of high pollution and high emission enterprises in China are moving towards a "green transformation" direction, but due to the lack of effective regulatory measures, the "green" transformation only stays on the surface and has not penetrated into the internal structure of the enterprises. To this end, it is necessary to establish a sound green industry management mechanism, clarify the responsibilities and authorities of environmental protection industry management, and ensure coordination and cooperation among various departments; At the same time, it is necessary to strengthen regulatory systems in areas such as environmental protection, resource utilization, and energy conservation, define green products and services, and standardize their management; Build a credit supervision system for the green industry, establish corporate credit files, provide rewards and preferential policies to enterprises with good credit, implement restrictions and punishment measures for untrustworthy enterprises, and enhance the awareness of legal compliance and integrity of enterprises. At the same time, the government should strengthen the openness and disclosure of information in the green industry, improve information transparency, establish a public opinion monitoring system, timely analyze and handle public opinion events in the green industry, and enhance the ability to guide and respond to public opinion.

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