Research on the Influence of Green Finance on the Green Innovation of Enterprises

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Abstract. Under the background of "double-carbon", green innovation is the key guarantee for promoting enterprise green development. Green finance is an emerging financing method, which is very important for enterprises to carry out green innovation. This study focuses on green finance and green innovation of enterprises, and explores its mechanisms. The results show that the development of green finance is conducive to overall enterprises green innovation, financing constraints and corporate social responsibility as paths of influence. The relevant conclusions provide a certain theoretical basis for the development of relevant standards and service optimization, and point out some reference for the realisation of green economic growth.

Keywords: Green finance, Green innovation, Financing constraints, Corporate social responsibility.

1 Introduction

Enterprise green innovation is the core to create value and achieve Chinese-style modernization. It is the fundamental guarantee to promote the transformation, upgrading, and high-quality development of enterprises. However, compared with traditional enterprise innovation, it requires more significant investment amounts and longer return cycles due to the more stringent environmental regulations, and the risks associated with the complexity and uncertainty of the innovation process increase accordingly. At the same time, in the process of financial resource allocation in China, more importance will be attached to the value of collateralizable assets, resulting in heavy polluting industries tend to have easier access to financial resources, and the problem of the rigidity of resource allocation is becoming more and more prominent.

To substantially alleviate the financing dilemma of enterprises and guide social capital to be more inclined to green and low-carbon fields, we also need to rely on further improving the green financial system. Therefore, how to make full use of the role of green finance in the allocation and optimization of capital to promote green innovation in enterprises is a very important issue.

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2 Research Hypotheses

2.1 The Effect of Green Finance on Enterprise Green Innovation

The term "green finance" first originated from "environmental finance", which takes the market as the basis for research and realizes the organic integration of financial activities and environmental protection. With the development of the green financial market, Growing amounts of market capital are being provided to support corporate green innovation, its role as a financial "reservoir" has progressively come to light. Thanks to its potent convergence function, it may convert a sizable quantity of idle social capital into capital for the financial sector, ensuring that the amount of capital invested in the green field never stops growing. The use of markets to direct the direction and flow of funds can solve the financing problems of enterprises in a rapid and timely manner.

The structure of green financial products has gradually been improved and optimized to better suit the features of enterprise' capital needs for green innovation, thanks in part to the growth of green finance. Green insurance and green trust has been enriched, and various green financial innovation services have emerged. Financial institutions can provide more targeted green financial products with different maturities, risks, and uses according to the characteristics of funds required by different types of enterprises in the green innovation process [1]. Efficiently and accurately providing enterprises with targeted support effectively contributes to the green output.

Hypothesis 1: Green finance can encourage green innovation of enterprises.

2.2 The Mediating Effect of Financing Constraints

With regard to the financial market's financing and investing operations, enterprises often belong to the party with more information, which makes it difficult for investors to identify the merits and value of investment projects, and the extra "lemon premium" raises the financing cost. Following the growth of green finance has increased the effectiveness of investments and funding, applying green technology in green finance has steadily increased the ability to collect, process and transmit information [2]. Enterprises' green information and environmental violations can be synchronized to the national credit information sharing platform in real-time, and the information asymmetry problem is better solved [3]. For enterprises, the cost of obtaining financial support decreases significantly, and the feasibility of obtaining exogenous financing increases [4], and the easing of financing constraints allows them to have sufficient capital [5].

Hypothesis 2: Green finance can alleviate financing constraints and facilitation corporate green innovation.

2.3 The Moderating Effect of CSR

CSR requires enterprises to meet the needs of stakeholders in the production and operation process, not at the expense of the environment, and to be responsible for the society on which they depend [6]. From the perspective of credit acquisition, with the

greening adjustment of China's loan structure, environmental considerations are increasingly having a significant impact on how financial organizations evaluate risk and make loan decisions. This makes it easier for enterprises with good fulfillment of social responsibility to enjoy the credit preferences brought by the development of green finance. Second, fulfilling CSR increases the capital investment in green and other aspects and makes enterprises more able to take environmental benefits into account in their daily production and operation, which thus motivates to take part in more and more green R&D activities. [7][8].

Hypothesis 3: CSR plays a moderating role in green finance and corporate green innovation.

3 Research Design

3.1 Choose Samples and Data Collection

The research selects listed companies from 2010-2021 as the study sample, the following processing was carried out: (1) exclude companies with ST and *ST categories; (2) disqualify finance industry mentioned companies; (3) remove samples with severe missing of primary variables. Finally, 18786 sample observations were obtained. Patent data obtained from CNRDS, data on green finance from iFinD financial terminal and various yearbooks on finance, insurance, etc. other economic data were obtained from Guotaian Database.

3.2 Model Setting

For subsequent empirical analyses, the required model needs to be constructed first. In order to test the previous hypotheses, the following models 1 to 4 are constructed for verification:

$$Patent_{it} = \alpha_0 + \alpha_1 GF_{jt} + \alpha_2 \sum Control_{ijt} + \theta_i + \mu_t + \varepsilon_{it} \tag{1}$$

$$FC_{it} = \beta_0 + \beta_1 GF_{jt} + \beta_2 \sum Control_{ijt} + \theta_i + \mu_t + \varepsilon_{it} \tag{2}$$

$$Patent_{it} = \lambda_0 + \lambda_1 GF_{jt} + \lambda_2 FC_{it} + \lambda_3 \sum Control_{ijt} + \theta_i + \mu_t + \varepsilon_{it} \tag{3}$$

$$Patent_{it} = a_0 + a_1 GF_{jt} + a_2 CSR_{it} + a_3 GF_{jt} * CSR_{it} + a_4 \sum Control_{ijt} + \theta_i + \mu_t + \varepsilon_{it} \tag{4}$$

Variable selection and description

Explanatory Variables

Enterprise green innovation (Patent). Previous studies have shown that enterprises' patent situation can better measure enterprises' green innovation activities. To study the impact of green finance on different types of patents, green innovation are further

divided into green substantive innovation (Patent1) and green strategic innovation (Patent2) [9].

Core Explanatory Variables

Green finance (GF). China's green finance has achieved vigorous development. There is yet to be a unified consensus among academics on the measurement of green finance, and many scholars have constructed a system of indicators to measure the extent of its development. In this paper, drawing on previous studies and because of the availability of data, the green credit, green securities, green insurance, green investment, and carbon finance are selected to design a comprehensive indicator system, use the entropy method to calculate the final score for each province [10].

Mechanism Variables

(1) Financing constraints (FC). Measured by the SA index. (2) Corporate social responsibility (CSR). Measured by the Hexun.com Social Responsibility Rating Score.

Control Variables

The control variables at the enterprise level are: TobinQ, return on net assets (ROA), asset-liability ratio (Lev), tangible asset ratio (Ppe), enterprise size (Size), the highest shareholder's shareholding ratio (Top), GDP per capita (AGDP) and industrial structure (Str).

Table 1 show the definitions of all variables in this paper.

Table 1. Description of main variables

Variables	Variable Name	Symbol	Variable Definition
Explained Variables	Green Innovation	Patent	The green patent applications takes the natural log after adding 1
	Green Substantive Innovation	Patent1	The invention patent applications takes the natural log after adding 1
	Green Strategic Innovation	Patent2	The green utility patent applications takes the natural log after adding 1
Explanatory variables	Green Finance	GF	Entropy method calculation
Mechanism variables	Financing Constraints	FC	SA index's absolute value
	Corporate Social Responsibility	CSR	Hexun social responsibility rating score
Control variables	Enterprise Tobin's Q	TobinQ	Market value to total assets
	Return on net assets	ROA	Return on net assets
	Asset-liability ratio	Lev	Ratio of total liabilities to total assets
	Tangible Assets Ratio	Ppe	Tangible Assets to Total Assets
	Enterprise size	Size	Natural logarithm of total assets
	Highest shareholder's shareholding	Top	Percentage of the largest shareholder's shares in listed firms
	GDP per capita	AGDP	GDP per capita by province as a natural log
	Industrial Structure	Str	GDP of secondary industries as a percentage of total regional GDP

3.3 Descriptive Statistical

Table 2 shows the basic statistics of the data collected for each research variable. The gap between the patent ownership of different enterprises is relatively large, and the green finance in each province of China is relatively modest, and there are still particular gap between provinces. Results Indicates that imbalances between provinces need to be addressed, this will also be an important launching point for the future.

Table 2. Descriptive statistics

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Patent	18786	0.814	1.089	0.000	6.941
Patent1	18786	0.319	0.694	0.000	6.282
Patent2	18786	0.683	1.004	0.000	6.537
GF	18786	0.302	0.124	0.063	0.725
FC	18786	3.783	0.273	2.113	4.889
CSR	18786	24.893	16.712	-16.950	90.870
TobinQ	18786	1.928	1.216	0.848	8.129
ROA	18786	0.038	0.057	-0.224	0.193
Lev	18786	0.456	0.204	0.066	0.936
Ppe	18786	0.931	0.080	0.549	1.000
Size	18786	22.432	1.330	19.96	26.426
Top	18786	0.359	0.152	0.089	0.750
Agdp	18786	11.061	0.474	9.963	11.994
Str	18786	0.412	0.091	0.160	0.538

4 Analysis of Empirical

4.1 Regression Analysis

The results of the regression, which looked at the connection between green finance and enterprise green innovation, are shown in Table 3. The results indicates that green finance can promote enterprise green innovation in general, the higher the level of green finance development is more beneficial to the output of enterprise green patents. But with the promotion effect on green strategic innovation is more effective than green substantive innovation. This is due to the fact that in order to cope with government regulation and obtain more financial subsidies or policy incentives, many companies usually choose less difficult and less time-consuming strategic innovations. Hypothesis 1 is successfully argued.

Table 3. Regression results

Variable	Patent	Patent1	Patent2
GF	0.345***	0.196***	0.286***
	(0.085)	(0.060)	(0.083)
TobinQ	0.021***	0.007	0.020***
	(0.006)	(0.004)	(0.006)
ROA	-0.389***	-0.337***	-0.277**
	(0.113)	(0.080)	(0.110)
Lev	-0.012	-0.037	-0.001
	(0.050)	(0.036)	(0.049)
Ppe	0.253**	0.039	0.366***
	(0.099)	(0.070)	(0.097)
Size	0.331***	0.143***	0.300***
	(0.013)	(0.009)	(0.013)
Top	-0.233***	-0.157***	-0.168**
	(0.076)	(0.054)	(0.075)
AGDP	-0.026	0.038	0.008
	(0.112)	(0.079)	(0.110)
Str	1.180***	0.775***	0.990***
	(0.353)	(0.250)	(0.346)
_cons	-7.395***	-3.805***	-7.165***
	(1.183)	(0.837)	(1.159)
Individual Year effect	Yes	Yes	Yes
N	18786	18786	18786
R^2	0.242	0.097	0.213

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. Same as below.

4.2 Test the Mediating Effect of Financing Constraints

Table 4 suggest that there is some degree of mediation occurring between green finance and overall enterprise green innovation due to financial restrictions. As the same time, financing constraints also play a mechanism between green finance and green substantive or green strategic innovation. In conclusion, financial limitations are one way that green finance development might affect corporate green innovation, this transmission channel is effective. Hypothesis 2 is verified.

Table 4. Mechanism tests based on financing constraints

Variable	FC	Patent	Patent1	Patent2
GF	-0.021***	0.323***	0.177***	0.264***
	(0. 008)	(0.085)	(0.060)	(0.083)
FC		-1.058***	-0.893***	-1.032***
		(0.081)	(0.057)	(0.079)
variable	Control	Control	Control	Control
Individual, Year effect	Yes	Yes	Yes	Yes
N	18786	18786	18786	18786
R^2	0.113	0.250	0.110	0.221

4.3 Test the Moderating Effect of CSR

Table 5 displays the moderating influence of CSR outcomes. The results show that under the influence of CSR, the facilitating role of green finance is enhanced, suggesting that companies with better social performance are more likely to be favored by investors, and have an advantage in the R&D and innovation process. The hypothesis 3 holds.

Table 5. Mechanism test based on CSR

Variable	Patent	Patent1	Patent2
GF	-0.206	-0.427	-0.309
	(0.395)	(0.312)	(0.392)
CSR	-0.002	-0.006**	-0.001
	(0.003)	(0.002)	(0.003)
GF*CSR	0.017**	0.022***	0.017**
	(0.008)	(0.006)	(0.008)
variable	Control	Control	Control
Individual, Year effect	Yes	Yes	Yes
N	18786	18786	18786
R^2	0.212	0.121	0.168

5 Conclusions

The empirical study draws the following conclusions: Firstly, China's green finance has positive effects on enterprises green innovation, however, Chinese companies are more likely to pursue strategic innovations with lower technological content. Secondly, for firms with financing difficulties, green finance can mobilize capital to increase investment in innovation. Thirdly, companies with better social performance have a stronger role of green finance for their green innovation. Synthesizing the theoretical and empirical analysis, the following countermeasures are proposed.

Firstly, improve the institutional environment and develop differentiated green finance policies to safeguarding the motivation of enterprises, then start going for breakthrough substantive innovation. Increase financial support for high-technology content projects and introduce incentive programs. Secondly, encourage the development of new green finance services and products, financial institutions should take the lead, in order to design more diversified products for businesses. Thirdly, enterprises should take the social responsibility and continuously improve their green innovation ability. Enterprises need to actively fulfill their responsibilities to obtain more effective resource support, and create higher economic and environmental benefits.

References

1. Flammer C. Green bonds: effectiveness and implications for public policy[J]. Environmental and Energy Policy and the Economy, 2020, 1: 95-128.
2. Taghizadeh-Hesary F, Yoshino N. Sustainable solutions for green financing and investment in renewable energy projects[J].Energies, 2020, 13(4): 1-18.
3. Cao Y, Xin H X, Zhang Z R.The impact of the implementation of the new environmental protection law on the efficiency of investment in heavy pollution industries. China Soft Science, 2020(8): 164-173.
4. Zhang X, Liu B B, Wang T, Li C T. Credit rent-seeking, financing constraints and corporate innovation. Economic Research Journal, 2017, 52(5): 161-174.
5. Braun M, Briones I, Islas G. Interlocking directorates, access to credit, and business performance in Chile during early industrialization[J].Journal of Business Research, 2019, 105: 381-388.
6. AlSuwaidi M, Eid R, Agag G. Understanding the link between CSR and employee green behaviour. Journal of Hospitality and Tourism Management, 2021, 46: 50-61.
7. Singh S K, Giudice M D, Chierici R, Graziano D, Phillips F. Green innovation and environmental performance: The role of green transformational leadership and green human resource management[J].Technological Forecasting and Social Change, 2020, 150: 119762.
8. Xiao H J, Yang Z, Ling H C. Does CSR have a green innovation effect?. Economics Perspectives, 2022(8): 117-132.
9. Li W Q, Zheng M N. Substantive or Strategic Innovation? ——the impact of macro-industrial policy on micro-firm innovation. Economic Research Journal, 2016, 51(4): 60-73.
10. Zhou T, Tian F. Measurement analysis of regional green finance development levels in China——based on different economic development stages. Economic Research Guide, 2019(33): 60-62+73.

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