



A Study on Green Innovation, Financing Constraints and Financial Performance of Listed Companies

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Abstract. The paper studies the relationship between green innovation, financing constraints and financial performance of listed companies, using the sample of the A-share listed companies on the Shanghai and Shenzhen Stock Exchanges from 2010 to 2019. The study finds that the financial performance of listed companies is significantly positively correlated with their green innovation capabilities, and it can help improve financial performance for the strengthening of green innovation by listed companies. Then, the paper also finds that the financing constraints of listed companies negatively moderate the relationship between financial performance and green innovation. Through Comparing with listed companies with large financing constraints, for the listed companies with small financing constraints, there is a more significant role in promoting financial performance from green innovation. Therefore, companies should strengthen green investment and improve their green innovation capabilities; The government should optimize the green financing environment and ease corporate financing constraints.

Keywords: Green Innovation · Financial Performance · Financing Constraints

1 Introduction

With the increasingly serious environmental problems, countries in the world will pay more attention to environmental protection, and environmental problems have been attracted great attention from the government, enterprises and scholars. The report of the 19th National Congress of the Communist Party of China clearly put forward the strategy of promoting green development and building a beautiful China, emphasizing the need to establish and practice the development concept that it is invaluable asset for lucid waters and lush mountains During the 14th Five-Year Plan period, Chinese government will continue to use the results of green development to improve the quality of economic development, mobilizing the vitality of green technology innovation in enterprises, promoting the innovative development of ecological and environmental protection industries, and achieving the common development of economic, social and environmental benefits. At all levels, the department of government has issued a series of green industrial policies and green financial policies to force enterprises to implement green transformation. The green awareness of enterprises is gradually enhanced.

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The green responsibility is gradually deepened, green process innovation, green product innovation, and green organizational innovation continue to develop in depth. At the same time, the theoretical expert has also been studying the issue of green innovation. Now, the research on the impact of corporate green innovation on financial performance is developing continuously. Many research results believe that the corporate green innovation is conducive to improving financial performance. For example, the green innovation strategy can help improve the financial performance of industrial enterprises [7]. The corporate green technology innovation can promote the long-term performance improvement of enterprises [5]. The green process innovation has a significant positive impact on financial performance, especially cleaner production technology innovation has a more significant effect on financial performance [6]. The green entrepreneurship orientation can significantly improve corporate environmental performance and financial performance [1]. The green innovation is not conducive to improving financial performance. There are also a few studies that believe that the green innovation requires a large amount of capital investment, long research and development cycle, and high risk, which being conducive not to the improvement of financial performance. However, in terms of research methods, there is a lack of empirical research on green innovation in listed companies. Due to the difficulty in obtaining objective data such as green patents and green R&D, there are few studies using these objective methods to measure green innovation. Most of them using questionnaires to measure, it is weak and cannot accurately reveal the reality of green innovation objectively [4]. The paper uses green patents to measure green innovation, and take empirical methods to test the relationship between green innovation and financial performance of listed companies, and further test the moderating effect of financing constraints, which having certain innovations.

2 Research Hypothesis

2.1 Green Innovation and Financial Performance of Listed Companies

Green innovation refers to avoiding and reducing damage to the natural environment through the improvement of products, processes, technologies and systems, including green product innovation, green process innovation and green organizational innovation [3]. It is mainly reflected in the following aspects for the impact of corporate green innovation on financial performance. Firstly, green technologies and processes are conducive to reducing the consumption of resources and energy per unit of product, improving the efficiency of resource and energy utilization, increasing the efficiency of production and manufacturing, and reducing the unit cost of products. Secondly, green technology is conducive to energy conservation and emission reduction, and promoting the development and utilization of new energy and renewable energy. That is in line with china green industry policy, green financial policy and green tax policy, and is beneficial to enterprises to carry out green financing, obtain tax incentives, and promote the sustainable development of enterprises. Thirdly, that is that green products of enterprises are more in line with the needs of consumers, which better enhancing the competitiveness of products, shaping the competitive advantages of enterprises [2], and promoting the improvement of financial performance of enterprises. Fourthly, the improvement of green management capability will help enterprises to improve their comprehensive management level

and gain competitive advantages in cost control and benefit differentiation. Therefore, corporate green innovation is not only a requirement for high-quality macroeconomic development, the green transformation and development of the industry, but also for the sustainable development of the enterprise itself, and the need for the enterprise to improve its financial performance. So, the following assumptions are put forward:

H1: The financial performance of listed companies is positively correlated with green innovation. The stronger the green innovation capability, the better its financial performance.

2.2 Green Innovation, Financing Constraints and Financial Performance of Listed Companies

The survival and development of enterprise depends on the situation of financing. Effective financing can provide financial support for the operation of the enterprise, ensuring the normal circulation of funds, and avoiding the breakage of the capital chain [8]. However, many enterprises face financing constraints, which seriously affecting the development of enterprises [9]. Firstly, it is difficult for enterprise financing. Because it is difficult to obtain credit financing from financial institutions, and debt financing and equity financing from the capital market. Due to the lack of financial support, even if the enterprise has green production technology and green new products, it cannot make project investment and cannot generate economic benefits. Therefore, enterprise financing constraints inhibit the promotion of green innovation on financial performance. Secondly, the financing is expensive, and the financing cost being very high, which producing great pressure to repay the debt and interest to the business operation [11]. The investment income of green projects may not be able to make up for the financing costs, inhibiting the investment motivation of enterprises, resulting in the inability to implement green technologies and green processes, the development of green products, and the difficulty in implementing green management, which affecting the financial performance of enterprises finally. Therefore, the financing constraints weaken the promotion effect of green innovation on financial performance. So, the following assumptions are put forward:

H2: The financing constraints of listed companies have a negative moderating impact on the relationship between financial performance and green innovation.

3 Research Design

3.1 Sample Data

This paper takes the sample of the A-share listed companies on the Shanghai and Shenzhen Stock Exchanges from 2010 to 2019, which excluding financial companies, ST companies, *ST companies, and listed companies with missing related variables. Finally, we get 9250 observations after sorting. In addition, we use Python software to capture the green patent data of listed companies from the website of the State Intellectual Property Office, and other data from the Guotai'an database.

3.2 Variable Definition

3.2.1 Explained Variable

The explained variable is the return on equity of the listed company, namely the net profit divided by the average net assets.

3.2.2 Explanatory Variables

The explanatory variable is green innovation for listed companies, and the natural logarithm of the sum of the number of green invention patent applications of listed companies and “1” [10].

3.2.3 Moderating Variable

The moderating variable is financing constraint, which being measured by cash ratio and operating cash ratio. Through resulting on the practice of scholars such as Yang Le, the cash ratio is the increase in cash and cash equivalents/average total assets. Drawing on the practice of Yang Guozhong and other scholars, the cash ratio from operating activities is the net cash flow from operating activities/average total assets. The smaller the cash ratio is, the greater the financing constraints is, the smaller the operating cash ratio is, the greater the financing constraints is.

3.2.4 Control Variables

On the basis of fully learning from the existing research, the control variables are selected, including asset-liability ratio, cash-to-asset ratio, fixed asset ratio, operating income growth rate, equity concentration and industry competition. The specific definition of each variable is shown in Table 1.

3.3 Model Design

In order to test Hypothesis 1, we examine the impact of green innovation of listed companies on financial performance, models (1) and (2) are established.

$$ROE = \alpha + \beta_1 GIP + \epsilon \quad (1)$$

$$ROE = \alpha + \beta_1 GIP + \beta_2 control + \epsilon \quad (2)$$

To test Hypothesis 2, we examine the moderating effect of financing constraints on the relationship between green innovation and financial performance, and establish model (3).

$$ROE = \alpha + \beta_1 GIP + \beta_2 FC1(FC2) + \beta_3 GIP * FC1(FC2) + \beta_4 control + \epsilon \quad (3)$$

Table 1. Variable Definition

Variable Nature	Variable Name	Variable Symbol	Definitions
Dependent Variable	Return on Equity	ROE	Net profit divided by net assets
Independent Variable	Green Innovation	GIP	The natural logarithm of the sum of the number of green invention patent applications of listed companies and 1
Moderating Variable	Cash Ratio	FC1	Increase in cash and cash equivalents/average total assets
	Operating Cash Ratio	FC2	Net cash flow from operating activities/average total assets
Control Variable	Asset-Liability Ratio	ALR	Book value of liabilities at the end of the period/Book value of assets at the end of the period
	Cash-to-Asset Ratio	CASH	Cash and equivalents at the end of the period/total assets at the end of the period
	Fixed asset ratio	TP	Fixed assets/total assets at the end of the period
	Operating Income Growth Rate	GROR	(Operating income of the current period - operating income of the previous period)/operating income of the previous period
	Equity Concentration	SRTT	Shareholding ratio of the largest shareholder
	Industry Competition	HHI	The sum of the squares of the percentages of the total industry revenue of each market competitor in an industry.

4 Results and Analysis

4.1 Descriptive Statistics

It can be seen from Table 2 that the average ROE of listed companies is 0.0616, the minimum value being -7.2128 , and the maximum value being 1.0749; The mean value

Table 2. Descriptive statistics of main variables

	Number of Samples	Mean	Standard Deviation	Minimum	Median	Maximum
ROE	9250	0.0616	0.2062	-7.2128	0.0683	1.0749
GIP	9250	0.2811	0.7034	0.0000	0.0000	5.7589
FC1	9250	0.0082	0.0804	-0.7207	0.0037	0.6924
FC2	9250	0.0508	0.0776	-0.5617	0.0500	0.7686
ALR	9250	0.1430	0.1100	-0.0233	0.1135	0.8165
CASH	9250	0.2357	0.1746	0.0001	0.1995	0.9542
TP	9250	0.1820	1.6230	-1.3092	0.0865	84.9920
GROR	9250	55.1789	15.3861	1.3200	55.2200	100.9700
SRTT	9250	0.1228	0.1237	0.0184	0.0859	1.0000
HHI	9250	0.0616	0.2062	-7.2128	0.0683	1.0749

of green innovation is 0.2811, the minimum value being 0, and the maximum value being 5.7589; The average value of cash ratio is 0.0082, the minimum value being -0.7207, and the maximum value being 0.6924; The average value of cash ratio from operating activities is 0.0508, the minimum value being -0.5617, and the maximum value being 0.7686. The statistics of other variables are shown in Table 2.

4.2 Regression Analysis

In order to test the impact of green innovation of listed companies on financial performance, regression tests are carried out for models (1) and (2). The results are shown in columns (1) and (2) in Table 3. The regression results of model (1) show that the correlation coefficient between the financial performance of listed companies and green innovation is 0.0083, which being significant at the 1% level. The regression results of model (2) show that the correlation coefficient between the financial performance of listed companies and green innovation is 0.0121, which being significant at the 1% level. This result finds that the green innovation of listed companies has significantly promoted the improvement of financial performance. Therefore, listed companies should strengthen green technology R&D and innovation, green project investment, and reduce resource and energy consumption, pollution emissions. They should also improve production and manufacturing efficiency, and help to improve their financial performance ultimately. For control variables, there are significantly negatively correlated with financial performance about the asset-liability ratio and the ratio of fixed assets to total assets. But, there are significantly positively correlated with financial performance for the proportion of cash to total assets, operating income growth rate, and ownership concentration.

4.3 Moderating Effect Test

In order to test the moderating effect of the financing constraints of listed companies on the relationship between financial performance and green innovation, a regression

Table 3. Correlation analysis results

	(1)	(2)	(3)	(4)
	ROE	ROE	ROE	ROE
GIP	0.0083*** (2.7244)	0.0121*** (4.0464)	0.0120*** (3.9690)	0.0134*** (4.3055)
FC1			0.0000*** (5.8066)	
FC2				0.0000*** (6.6563)
GIP*FC1			0.0000*** (-3.4186)	
GIP*FC2				0.0000*** (-6.7507)
ALR		-0.1792*** (-16.5221)	-0.1876*** (-17.1475)	-0.1862*** (-17.1249)
CASH		0.0787 *** (3.7241)	0.0585*** (2.7403)	0.0745*** (3.5328)
TP		-0.0559*** (-4.4453)	-0.0531*** (-4.2195)	-0.0681*** (-5.3711)
GROR		0.0078*** (6.0681)	0.0076*** (5.9240)	0.0078*** (6.0944)
SRTT		0.0015*** (10.6752)	0.0014*** (10.2305)	0.0013*** (9.5007)
HHI		-0.0062 (-0.3640)	-0.0074 (-0.4358)	-0.0095 (-0.5544)

Note: ***, **, and * indicate that the coefficients are significant at the 1%, 5%, and 10% levels, respectively. Below the coefficients in columns (1)–(3) are the T values.

test was carried out based on model (3). The results are shown in columns (3) and (4) in Table 3. The results show that the multiplier coefficient of cash ratio and green innovation is significant at the level of 1%, and the multiplier coefficient of cash ratio of operating activities and green innovation is also significant at the level of 1%. So, the financing constraints of listed companies weaken the promoting effect of green innovation on financial performance, namely a negative adjustment effect. To Compare with listed companies with larger financing constraints, listed companies with smaller financing constraints have a more significant role in promoting financial performance from green innovation. Therefore, it will help listed companies to strengthen green project investment to optimize the financing environment and ease the financing constraints of listed companies. It will also promote the application of green technology, improving investment efficiency, profitability, and financial performance ultimately.

5 Conclusions

5.1 Research Conclusions

Through researching on green innovation, financing constraints, and financial performance, the paper gets the following conclusions:

Firstly, there is significantly positively correlation between the financial performance of listed companies and their green innovation capabilities. It will help to save energy and reduce emissions to improve the green innovation ability of listed companies, efficiency of resource and energy utilization, the efficiency of project investment, accelerating the development and utilization of new energy, and increasing financial performance finally. Therefore, it is not contradictory for the development and environmental protection of enterprise, On the contrary, it is conducive to environmental protection and helps enterprises obtain green financial policies, green tax policies, and green industrial policies to strengthen green innovation, using green technologies, green technological processes, and develop green new products. The support is conducive to the sustainable development of enterprises.

Secondly, the financing constraint of listed companies negatively moderates the relationship between financial performance and green innovation. Compared with listed companies with large financing constraints, listed companies with small financing constraints have a more significant role in promoting financial performance from green innovation. Therefore, enterprises should strengthen cash flow management and improve their ability to create cash, making full use of green credit policies, green bond policies, and green equity financing policies, controlling the scale of liabilities reasonably, increasing financing efforts moderately, controlling financing costs, and strengthening green project investment. To improve financial performance, they should use green innovation capabilities.

5.2 Policy Suggestion

Based on the above research results, we are put forward some following policy recommendations:

Firstly, enterprises should strengthen green investment and improve green innovation capabilities. The carbon neutral strategy is the only way for the high-quality economic development of china. In the context of increasingly prominent environmental problems, we could achieve high-quality and sustainable economic development by changing the mode of economic development and implementing green transformation. Enterprises should comply with the trend of green economic transformation, improving green awareness, assuming green responsibility, adhering to the concept of green development. They should also strengthen investment in green research and development, technological innovation in energy conservation, technological research and development of clean energy and renewable energy, circular economy research and emission reduction. The enterprise must improve the green technology level of the enterprise, changing the development mode of the enterprise, implementing the “green and innovative” development concept, and promote its sustainable development.

Secondly, Chinese government should optimize the green financing environment and ease corporate financing constraints. It should also develop and improve my country's green credit financing, green equity financing and green debt financing systems continuously. On green debt financing, the government must optimize the credit financing environment, guiding commercial banks to establish and improve green credit mechanisms. It must also support green credit through re-lending, financial discounts, guarantees and other mechanisms, implementing green credit policies, providing strong support for the financing of enterprises that meet the green credit conditions, simplifying the approval process, speeding up the approval speed, reducing the cost of green financing, supporting the green investment activities of enterprises, and creating a good credit financing environment for enterprises with strong green innovation capabilities. On bond financing, the government should strengthen the implementation of the green bond policy for energy conservation and emission reduction, pollution prevention, resource conservation, circular economy, clean energy, establish green channels, and improving green mechanisms. On the green equity financing, the government must arrange IPOs Preferentially, additional offerings, allotments, and preferred stock financing for listed companies in green environmental protection industries, and vigorously develop green equity funds.

Future research suggestions: Different types of green innovation activities, such as green process innovation, green technology innovation, green product innovation, green organizational innovation, etc., have further research on the impact and mechanism on the long-term and short-term financial performance of enterprises.

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