Can green technology innovation improve enterprise performance?

-- Intermediary role of market competitiveness

Zhaoran Guo

College of Management, Sichuan Agricultural University, Chengdu, China

1610821834@qq.com

Abstract. This paper uses 2015-2018 Shanghai and Shenzhen A-share listed companies and seven resource-based industries as the research objects, empirically tests the impact of green technology innovation on enterprise performance, and confirms the impact of market competitiveness as an intermediary variable. The results show that green technology innovation can significantly improve the performance of enterprises, which is reflected in financial performance and environmental performance. As a measure of the importance of enterprises in the market, market competitiveness also significantly affects the performance of enterprises. It can be seen that enterprises' improvement of green technology innovation ability is conducive to the unity of environmental protection and economic efficiency.

Keywords: Green technology innovation, Market competitiveness, Enterprise performance.

1. Introduction

In recent years, there have been more and more proposals on environmental protection in the two sessions, and in the government work report, environmental protection issues have been paid more and more attention by national leaders. In the 2015 government work report, the state proposed that "we should declare war on pollution as resolutely as we declare war on poverty", "environmental pollution is a scourge and pain of democracy, and we should treat it with an iron fist", indicating that the state attaches importance to environmental protection issues. Therefore, there are more and more researchers, research results and fields involved. Lu Yan and Wang Weiqiang (1994) mentioned that the green revolution led by environmental protection products is quietly rising .

Green development is a modern development mode with the goal of sustainable resources and environment and harmony between man and nature. It has become a new concept of overall development in China. The 2015 Paris climate conference attracted global attention. Climate warming poses a great threat. The only way for mankind to survive is a low-carbon economy. In 2016, the G20 summit approved the "G20 energy efficiency leading plan" to discuss the global energy efficiency improvement plan. As the problems of environmental pollution and resource depletion become more and more serious, people are increasingly pursuing the harmonious development with nature, and gradually realize the importance of green technology. In this context, green technology innovation has gradually become one of the research priorities in the field of technological innovation.

The contribution of this document is mainly reflected in the following aspects. First, this study mainly evaluates the impact of green technology innovation on energy conservation, emission reduction and green development, but the impact on enterprise performance is relatively small. Secondly, this paper discusses the impact mechanism of green technology innovation on enterprise performance from both theoretical and empirical perspectives, which provides a reference for further analysis of the impact channels of green technology innovation.

2. Theoretical analysis and research hypothesis

2.1 Theoretical analysis

Yao Zengfu (2020) pointed out that it is possible for domestic enterprises to improve their competitiveness in the international market . The proposition of Porter hypothesis is in sharp contrast to this.

The company can disclose the social responsibility report and the annual report at the same time. With the increasingly prominent environmental problems, green orientation is one of the important dimensions of corporate social responsibility, followed by enterprises to increase investment in green technology innovation, but some enterprises will think that investing in green technology R&D and innovation will increase the burden of enterprises, thereby reducing the performance of enterprises. However, many scientists still insist that green technology innovation can bring more benefits to enterprises and improve their competitiveness.

2.2 Research assumptions

Pollution prevention and control can reduce the discharge of pollutants and waste, with low-cost advantages. Therefore, based on the improvement of green technology innovation ability is conducive to enhance the market competitiveness of enterprises, this paper proposes hypothesis 1 (H1).

H1: green technology innovation of listed companies is positively correlated with market competitiveness.

Environmental management practice can improve enterprise innovation performance, and then improve financial performance. Therefore, based on the improvement of green technology innovation ability is conducive to improving enterprise performance, this paper proposes hypothesis 2 (H2).

H2: green technology innovation of listed companies is positively correlated with enterprise performance.

H2a: green technology innovation of listed companies is positively correlated with corporate financial performance.

H2b: green technology innovation of listed companies is positively correlated with enterprise environmental performance.

The main business competitiveness reflects the company's development strategy, including the rationality of the company's strategy, the key to the main business income and profit increase. The competitiveness of the main business directly determines the development of the enterprise and the future prospects of the company. Some studies also believe that the green technology innovation of enterprises is not directly transformed into enterprise performance, but there is an intermediate transformation path - market competitiveness. Therefore, based on the close relationship between the market competitiveness of enterprises and enterprise performance, this paper proposes hypothesis 3 (H3).

H3: The market competitiveness of listed companies is positively correlated with corporate performance, which plays an intermediary role.

H3a: the market competitiveness of listed companies is positively correlated with the financial performance of enterprises, and plays an intermediary role.

H3b: the market competitiveness of listed companies is related to the environmental performance of companies and plays an intermediary role.

3. Variable selection and data source

3.1 variable selection

3.1.1 green technology innovation

At present, the academic circles mainly measure green innovation from systematic evaluation or quantitative indicators. The system evaluation mainly includes whether the enterprise discloses the

social responsibility report and whether it has passed the ISO14001 environmental management system certification. Quantitative indicators include input and output. To measure electronic talents, the innovation output is measured by the number of patents applied by enterprises (innovation level) and the number of patent citations (communication level) or the market share of green new products.. Gong Huan (2019) believes that since patents have certain potential market value, it is reasonable to measure the innovation level of enterprises with patents . Because the grant of patents has a certain lag, the number of patent applications can better represent the innovation level of enterprises in that year.

3.1.2 enterprise performance

Lixiuzhen (2022) pointed out that enterprise environmental performance is included in the enterprise performance dimension . This study believes that the measurement of enterprise performance in the context of sustainability should pay attention to comprehensiveness, and divide enterprise performance into environmental performance represented by pollution reduction and energy conservation indicators and financial performance represented by sales growth, profit growth, return on assets and other indicators. Hu Quying (2012) sorted out and summarized the current measurement methods of environmental performance, mainly including the following categories: awards or punishments obtained due to environmental problems, environmental accidents and environmental problems litigation, toxic release list (US tri) and environmental management standard iso14001/EMAS, environmental certification and verification, ranking of environmental performance levels, etc .

This paper uses the natural logarithm of sewage charges as an indicator for measuring the environmental performance of enterprises. Choosing this method to measure environmental performance has two advantages. First of all, the pollution charge is an indicator that comprehensively reflects the pollution level of enterprises. Many listed companies pay the pollution charge. This method is applicable to all listed companies. At the same time, this method avoids the subjectivity of content scoring method. Referring to foreign researchers' use of pollutant emission level per unit output value to measure environmental performance, this method is scientific. In terms of enterprise performance, refer to the existing research and use the operating income measurement.

3.1.3 market competitiveness of enterprises

Different enterprises face different competition intensities and different potential profitability. Wei Zhihua and Zhu Caiyun (2019) pointed out that specifically, this paper uses the net trade credit (NTC) obtained by enterprises from suppliers to measure the product market competitiveness of enterprises . The calculation formula is as follows:

Net trade credit (NTC) = (advances received + accounts payable - accounts receivable - prepayments) / operating income

3.1.4 other variables

According to Zhang Changjiang, this paper selects the company size as the control variable. Some studies have pointed out that the size of companies is positively related to their green technology innovation research and development efforts, and larger companies are easier to vigorously develop green technology innovation, thereby improving their environmental performance.

3.2 Data source

This topic takes Shanghai and Shenzhen A-share listed companies as the research object, consulting relevant literature, and limits the industry to resource-based industries, including the following seven industries: oil and coke industry, chemical raw materials and chemical products processing industry, non-metallic mineral products industry, ferrous metal smelting and processing industry, non-ferrous metal smelting and processing industry, metal product industry and energy and heat generation and supply industry. Select the period from 2015 to 2018 (considering the reasons of the epidemic), and exclude: ① ST Listed Companies in that year, ② listed companies with missing

data of other indicators. The sewage charge data in this paper is collected and sorted out manually. The descriptive statistics of the data are shown in Table 1.

Table 1. Descriptive statistical analysis

variable	mean value	standard deviation	minimum value	Maximum value
GTI	4.750	3.033	0	12
CEP	15.99	1.570	12.05	18.13
CFP	23.59	1.527	18.93	25.09
MCP	0.0938	0.111	-0.244	0.379
SIZE	9.024	1.101	6.194	10.03

4. Empirical results and analysis

4.1 regression model

According to the previous theoretical analysis, in order to play an intermediary role to test whether green technology innovation can improve enterprise performance and market competitiveness, this paper constructs the model as follows.

$$CEP=\alpha10+\alpha11GIT+\alpha12SIZE+\alpha13ALR+\alpha14AGE+\varepsilon1 \quad (1)$$

$$CFP=\alpha20+\alpha21GIT+\alpha22SIZE+\alpha23ALR+\alpha24AGE+\varepsilon2 \quad (2)$$

$$MCP=\alpha30+\alpha31GTI+\alpha32SIZE+\alpha33ALR+\alpha34AGE+\varepsilon3 \quad (3)$$

$$CEP=\alpha40+\alpha41GTI+\alpha42MCP+\alpha43SIZE+\alpha44ALR+\alpha45AGE+\varepsilon4 \quad (4)$$

$$CFP=\alpha50+\alpha51GTI+\alpha52MCP+\alpha53SIZE+\alpha54ALR+\alpha55AGE+\varepsilon5 \quad (5)$$

Of which: α 10, α 20, α 30, α 40, α 50 represents the intercept term of regression; α 11, α 12, α 21, α 22, etc. represent the coefficients of explanatory variables and control variables; ε Represents the random term error.

4.2 Correlation analysis and regression test

Table 2. Correlation Analysis of main variables

variable	GTI	CEP	CFP	MCP	SIZE
GTI	1				
CEP	-0.213**	1			
CFP	0.506***	0.311***	1		
MCP	0.393***	0.283***	0.577***	1	
SIZE	0.394***	0.290***	0.953***	0.605***	1

Table 2 shows the Pearson correlation analysis of the main variables, in which the correlation coefficient between CFP and GTI, MCP and CFP, size and MCP, size and CFP is more than 0.5, and the correlation coefficient between other variables is less than 0.5. The correlation coefficient between MCP and GTI is 0.393, which is significant at the level of 1%, indicating that the higher the level of green technology innovation of enterprises, the stronger the market competitiveness of enterprises, which can verify H1. The correlation coefficient between CEP and GTI is -0.213, which is significant at the level of 5%, indicating that the higher the level of green technology innovation and the lower the sewage charge, the better the environmental performance of the enterprise, which can verify H2b. The correlation coefficient between CFP and GTI is 0.506, which is significant at the level of 1%, which can roughly verify H2a. The correlation coefficients of CEP and MCP and CFP and MCP are 0.283 and 0.577 respectively，which can verify H3 and H3a respectively.

The regression results are shown in Table 3. In the first column, the coefficient of GTI is -0.081. The smaller the CEP, the better the environmental performance. H2b is established. The coefficient of MCP is -1.548, which is significant at the level of 1%, which can demonstrate a positive link between the competitiveness of the market and the environmental performance of enterprises, and H3b is established. In the second column, the coefficient of GTI is 0.051, which indicates that the

green technology innovation of enterprises is positively related to the financial performance of enterprises, and H2a is established. The coefficient of MCP is 0.661. This is a positive result, which can help us improve the efficiency of the market and finance, and h3a is established.

Table 4. Regression analysis results of random effects

variable	CEP	CFP
GTI	-0.081***	0.051***
	(-10.96)	(7.06)
MCP	-1.548***	0.661***
	(-5.65)	(2.64)
SIZE	0.639***	1.297***
	(3.30)	(17.23)
Constant	10.751***	11.581***
	(6.14)	(17.13)
Observations	120	120
Number of code	30	30

4.3 Expansibility analysis

4.3.1 Regression analysis based on the difference of pollution degree

Considering that there are a large number of relisted companies in heavily polluting industries, resulting in greater pollution and high social concern, this paper further groups the sample companies according to the degree of pollution for regression analysis. The study found that: compared with listed companies in non heavy pollution industries, the positive correlation between environmental performance and financial performance of Listed Companies in heavy pollution industries is more obvious. In the heavy pollution industry group, the CEP coefficient is -0.081, and is significant at the level of 1%, indicating that the environmental performance of heavy pollution enterprises has a obvious positive influence on financial performance. However, in the non heavy pollution industry group, the CEP coefficient does not meet the statistical significance level, indicating that the environmental performance of non heavy pollution industry enterprises is not related to financial performance.

4.3.2 discussion on endogenous problems

High financial performance of enterprises means that enterprises have the strength to invest more resources in environmental governance. In addition, the model in this paper may have endogenous problems. In order to test the endogeneity of the model, this paper substitutes the explanatory variable financial performance (CFP) lagging by one period. The corresponding year of enterprise green technology innovation (GTI) is 2015-2018, and the corresponding year of CFP is 2016-2019. The results show that the coefficient of the explanatory variable GTI is significant at the level of 10%, which is consistent with the previous regression results. This further verifies the hypothesis. Therefore, the research conclusion is reliable.

4.3.3 robustness test

In order to further study and test the robustness of the above conclusions, the variable substitution method will be used to test its robustness. ROA and ROE are used as alternative indicators of enterprise performance, and whether pollutants meet the standard is used as alternative indicators of enterprise environmental performance ; The proportion of R&D investment in the current year's operating income is used as a substitute index for green technology innovation. The robustness test results are consistent with the empirical results, indicating that the model has good robustness.

5. Conclusion and management enlightenment

This paper examines the relationship between enterprise green technology innovation, performance of enterprise and enterprise market competitiveness. The conclusions of this paper are as follows.

First of all, there is a positive relevant between green technology innovation and corporate financial performance of Listed Companies. Secondly, there is a significant positive relevant between green technology innovation and environmental performance of Listed Companies in Shanghai and Shenzhen A-share resource-based enterprises. Enterprises with strong green technology innovation ability will have better environmental performance. Enterprise green technology innovation provides funds, systems and technical support for environmental protection, and has a direct impact on environmental performance.

Therefore, this paper puts forward the following political implications. First of all, existing green technology innovations can not only promote energy saving and emission reduction and green economic development from the macro level, but also improve business performance from the micro level. The active green technology development strategy enables enterprises to inject the concept of environmental protection into the operation and management of enterprises, and provides a lasting driving force for improving environmental performance. In this era of rapid development of high technology and deep-rooted concept of sustainable development, enterprises' vigorous development of green technology innovation will undoubtedly bring huge market competitiveness to enterprises. Local governments should focus on improving the green innovation level and enterprise performance of enterprises, and use fiscal, financial and other means to support green technology innovation of enterprises.

References

[1] Brawn E, Wield D. Regulation as a Means for the Social Control of Technology [J]. Technology Analysis &Strategic Management, 1994, 6(3):78-99.

[2] LV Yan, Wang Weiqiang Research on enterprise green technology innovation [j] Scientific management research, 1994 (04): 46-48.

[3] Yao Zengfu Convergence of environmental regulation, agricultural investment and agricultural environmental efficiency -- Analysis of Porter hypothesis and the integrated framework of investment adjustment cost [j] Statistical research, 2020,37 (08): 50-63.

[4] Li Xu Combing and Prospect of green innovation related research [j] Research and development management, 2015,27 (02): 1-11.

[5] Gong Huan Environmental protection pressure of stakeholders, green technology innovation and enterprise performance [d] Doctoral dissertation, Wuhan University of technology, 2019.

[6] Li Xiuzhen, Zhang Yun, Wang Xiangjin Credit allocation, environmental regulation and green technology innovation [j] Shanghai Economic Research, 2022 (01): 95-103.

[7] Hu Quying Research on the correlation between environmental performance and financial performance of listed companies [j] China population, resources and environment, 2012,22 (06): 23-32.

[8] Wei Zhihua, Zhu Caiyun Whether excess goodwill becomes the burden of enterprise operation -- an explanation based on the perspective of product market competitiveness [j] China industrial economy, 2019 (11): 174-192.