Frontiers in Economics and Management Volume 3 Issue 5, 2022
ISSN: 2692-7608 DOI: 10.6981/FEM.202205_3(5).0042

Environmental Protection Investment, Government Intervention and Breakthrough Innovation of Enterprises

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Abstract

This paper selects A-share listed companies in Shanghai and Shenzhen of China from 2010 to 2019 as research samples, and empirically tests the relationship between environmental protection investment, government intervention and breakthrough innovation of enterprises. The research shows that enterprises' investment in environmental protection can significantly promote the level of breakthrough innovation, and the government's intervention can regulate the relationship between them. Firstly, it is found that government subsidies can strengthen the promotion of environmental protection investment to the level of breakthrough innovation. Furthermore, it explores the regulating effect of market monopoly intensity on the relationship between them, and finds that in industries with high degree of monopoly, the promoting effect of environmental protection investment on the level of enterprise breakthrough innovation will be transformed into inhibiting effect, which shows the importance of government anti-monopoly measures between environmental protection investment and enterprise breakthrough innovation.

Keywords

Environmental Protection Investment; Government Subsidy; Degree of Market Competition; Breakthrough Innovation of Enterprises.

1. Introduction

In recent years, China has paid more and more attention to the protection of ecological environment. For the first time, the report of the 18th National Congress of the Communist Party of China has written "ecological civilization construction" into the party constitution and raised it to the national strategy. The 19th National Congress of the Communist Party of China also regards "adhering to the harmonious coexistence of man and nature" as one of the basic strategies for upholding and developing socialism with Chinese characteristics in the new era. In such a big environment, it is more and more important to protect the environment and invest in it. In terms of environmental protection, enterprises play an increasingly important role in it. This is because enterprises will waste resources and pollute the environment in the process of production and operation. Therefore, it is the key to protect the environment for enterprises to take the initiative in environmental governance. However, in the EPI report published by Yale University, China's achievements in environmental protection are not very significant. It can be seen that the investment in environmental protection is not obvious enough. This is mainly because although the investment in environmental protection can bring long-term benefits to enterprises, it will take up a lot of money at present, thus affecting the current business development of enterprises. Due to the short-sighted behavior of enterprises, most enterprises are reluctant to invest in environmental protection. However, the problem of environmental protection needs to be solved urgently, so the government has introduced a series of environmental subsidies and preferential tax policies to encourage enterprises to carry out environmental protection. However, starting from the enterprise itself, the environmental protection investment of the enterprise will indeed increase the burden of the enterprise, which

ISSN: 2692-7608 DOI: 10.6981/FEM.202205_3(5).0042

will affect the business activities and innovation activities of the enterprise in the short term. However, in the past, there have been studies that environmental protection investment can bring benefits to the production and operation activities of enterprises. For example, Wang Bingcheng believes that the spillover effect of environmental protection investment is not only reflected in technology, but also plays a role in the whole process of R&D and operation of enterprises, and promotes innovation in all aspects of enterprises. Therefore, starting from the benefits brought to enterprises themselves, enterprises can be better driven to invest in environmental protection. Innovation has always been the key for enterprises to improve their competitiveness and long-term development, and enterprises attach great importance to their innovation ability. The breakthrough innovation ability is the key for enterprises to open up new potential markets and applications and achieve longer-term development, which enterprises pay more attention to. The purpose of this paper is to explore the influence of environmental investment on enterprises' breakthrough innovation ability. In addition, government intervention, such as government subsidies and relevant government policies, is added as the adjustment variables, aiming to study whether the government can enhance the promotion effect of environmental investment on enterprises' breakthrough innovation. This will help the government to better promote the economic development, and at the same time contribute to the long-term development of enterprises.

2. Theoretical Analysis and Research Hypothesis

2.1. The Impact of Environmental Protection Investment on Enterprise Innovation

This paper mainly studies the impact of environmental protection investment on breakthrough innovation. In the past, there were many differences in the research on the impact of environmental protection investment on enterprises. Some studies thought that environmental protection investment would occupy enterprise funds and increase costs, thus reducing the innovation investment of enterprises. However, some studies also believe that the environmental protection investment of enterprises can produce spillover effect on enterprises and thus promote enterprise innovation. This paper holds that environmental protection investment will promote the breakthrough innovation of enterprises. First of all, although an enterprise's increased investment in environmental protection will take up the enterprise's funds, Porter's hypothesis holds that although environmental policy will increase the cost of the enterprise in the short term, it can promote the enterprise to carry out technological innovation, reform and achieve better development. Therefore, enterprises' increasing investment in environmental protection is conducive to transformation, upgrading and technological innovation. Secondly, the initiative of enterprises to invest in the environment belongs to the fulfillment of social responsibility. Katsiaryna Salavei Bardos, Mine Ertugrul and Lucia Silva Gao think that corporate social responsibility indirectly increases the value of enterprises by improving product market awareness. Domestic scholars Li Zhibin, Ruan Doudou and Zhang Tiesheng also believe that in the long run, enterprises' active social responsibility is the correct choice for enterprises to gain competitive advantage and long-term development. This paper holds that actively advocating green development and fulfilling social responsibility will help to establish a good corporate image, improve the competitiveness of enterprises and help enterprises to innovate. Therefore, this paper puts forward the following research hypotheses:

H1: Enterprises' investment in environmental protection will promote breakthrough innovation.

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2.2. The Regulatory Role of Government Subsidies

Government subsidy is an effective way for the government to encourage enterprises. Yao Dongzhi and Yongyi Zhu (2019) believe that financial subsidies can significantly promote enterprises' R&D investment. This paper argues that the promotion of government subsidies is mainly reflected in two aspects. First of all, resources are limited. From the inside of the enterprise, environmental protection investment will occupy part of enterprise funds to a certain extent, which may reduce part of R&D investment, thus failing to play its full role in promoting innovation. Government subsidies can provide funds for enterprises, thus making up for the problem of capital occupation caused by environmental protection investment. Innovation itself is a high-investment and high-risk project, and the financial support provided by government subsidies can also reduce the risks brought by enterprise innovation to a certain extent. Secondly, from the external point of view, Tuomas Takalo and Tanja Tanayama think that the government subsidy for enterprises can provide favorable information to market financiers, and external investors will be more optimistic about enterprises. In this way, investors will underestimate the risks of innovative projects, so that enterprises can raise more funds, thus helping enterprises to innovate better. Therefore, this paper puts forward the following assumptions:

H2a: If you get government subsidies when you invest in environmental protection, it will strengthen the role of environmental protection investment in promoting the breakthrough innovation of enterprises.

2.3. The Regulatory Role of Market Competition

Since the promulgation of the Anti-Monopoly Law, the state has attached great importance to the orderly operation of the whole market, and has repeatedly punished monopoly enterprises such as Alibaba for breaking market rules. This is because the degree of market competition is very important for the development of enterprises. First of all, the industries with a high degree of monopoly mean that the market transparency is weak, and some ordinary small enterprises have few opportunities in the market, little information, and it is even difficult to survive, and it is also difficult to master advanced technology, and enterprise innovation activities are even more difficult. Secondly, according to the theory of effective competition, when the market is in an effective competitive state, there is price sensitivity due to product quality differences in the market. As external competitors join and the direction of resource flow changes, and the market structure is constantly adjusted, enterprises are faced with great pressure caused by high price sensitivity of products and loss of external resources. Therefore, enterprises must improve products and production technologies and increase innovation. However, in the market with a high degree of monopoly, a high degree of monopoly will result in the solidification of interests, and the lack of peer competition will make enterprises satisfied with the current situation, and lack the motivation to improve technology and innovate. For the small enterprises that are struggling to survive in the monopoly market, they have been in the inferior position of the market for a long time, on the one hand, they do not have the strength to innovate and upgrade, and on the other hand, they lack the confidence and motivation to innovate. Therefore, for industries with weak competition, that is, high degree of monopoly, the harm caused by monopoly will make the environmental protection investment of enterprises have a negative effect on innovation. This paper puts forward the following assumptions:

H2b: The weaker the competition degree of the market, that is, the higher the monopoly degree, the promotion effect of environmental protection investment on the breakthrough innovation of enterprises will be transformed into inhibition.

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3. Research Design

3.1. Sample Selection and Data Source

The outbreak of the global COVID-19 epidemic in 2020 has had a great impact on the global economy. Many domestic enterprises' businesses have been greatly harmed, and environmental protection investment and innovation activities will be greatly affected. However, the data of environmental protection investment is only after 2009 in CSMAR database. Considering the completeness and feasibility of the data, this paper selects A-share listed companies in Shanghai and Shenzhen of China from 2010 to 2019 as research samples, and makes the following research samples. Treatment: (1) Eliminate the samples of ST companies; (2) Excluding the samples of financial industry and insurance industry; (3) In order to ensure the robustness and integrity of data, enterprises with incomplete required important variables and unknown information should be eliminated. In addition, in order to eliminate the influence of extreme values, the continuous variables are shrunk at the level of 1% before and after. All the environmental protection investment, government subsidies, market competition, R&D output of listed companies and other relevant information of enterprises in this paper come from CSMAR database.

3.2. Variable Definition

3.2.1. Explained Variable

The explained variables in this paper are the breakthrough innovation level (Patent) of enterprises. There have been many previous studies on breakthrough innovation, but most of the variables are measured by questionnaire survey, which is relatively complex and the results are special, and few data are obtained. Therefore, this paper draws on the practice of Jin Yang and Zhaolin Hou, and uses the natural logarithm of the number of enterprise invention patents to measure the breakthrough innovation level of enterprises.

3.2.2. Explanatory Variable

The core explanatory variable of this paper is the enterprise environmental protection investment (Eni), environmental protection investment partly because the project requires environmental protection standards and passive investment, but liu and wang, Changyong Xiang, Shilin Zheng think in 2006 the government implement environmental protection policy, which is the environmental performance into the performance appraisal scope, most of the enterprise is active environmental protection investment strategy. And most of the literature research enterprise environmental protection investment is measured by the total amount of environmental protection investment of enterprises, and is not carefully differentiated. For example, Xudong Yang, Yanjie Shen, Chenchen Peng will disclose the expenditure of environmental protection in the notes to the annual report. Yuqing Liu uses the natural logarithm of the total annual environmental protection investment to measure the level of environmental protection investment level. Therefore, this paper draws on Liu 's practice to measure the environmental investment level by the natural logarithm of the environmental investment amount provided in the CSMAR database.

3.2.3. Regulated Variables

This paper mainly takes government intervention as the adjustment variable, which is specifically divided into government subsidy (Subsidy) and market competition degree (HHI). Government subsidies are measured using the natural logarithm of government subsidies data for listed companies provided in the CSMAR database. The degree of market competition is measured by the industry Hepfendal index, the larger the index indicates that the higher the degree of monopoly, the weaker the degree of competition.

ISSN: 2692-7608 DOI: 10.6981/FEM.202205_3(5).0042

3.2.4. Controlled Variables

The control variables in this paper are mainly the following: equity concentration (Cr), the sum of the top ten shareholders; profitability (Roe), measured by the company's return on equity; corporate free cash flow (Cash), measured by corporate free cash flow divided by total assets. These control variables are added to control the influence of the characteristics on innovation, and finally the virtual variables of industry and year.

3.3. Model Construction

First, in order to test the impact of H1 enterprise environmental protection investment on breakthrough innovation, this paper establishes the following regression model:

$$Patent_{i,t+n}=\alpha+\beta_1 Eni_{i,t}+\beta_2 Cr_{i,t}+\beta_3 Roe_{i,t}+\beta_4 Cash_{i,t}+\Sigma Year+\Sigma Ind+\varepsilon_{i,t} \quad (1)$$

Secondly, in order to test the regulatory role of government subsidies in H2a, the interaction term of government subsidies and enterprise environmental protection investment is analyzed, and the following model is established:

$$Patent_{i,t+n}=\alpha+\beta_1 Eni_{i,t}+\beta_2 Subsidy_{i,}t+\beta_3 Eni_{i,t}*Subsidy_{i,t}+\beta_4 Cr_{i,t}+\beta_5 Roe_{i,t}+\beta_6 Cash_{i,t}+\Sigma Year+\Sigma Ind+\varepsilon_{i,t} \quad (2)$$

Finally, we test the regulatory effect of market competition degree in H2b on environmental protection investment on enterprise breakthrough innovation, add the interaction between market competition degree and enterprise environmental protection investment to analyze, and establish the following model for analysis:

$$Patent_{i,t+n}=\alpha+\beta_1 Eni_{i,t}+\beta_2 HHI_{i,}t+\beta_2 Eni_{i,t}*HHI_{i,t}+\beta_3 Cr_{i,t}+\beta_4 Roe_{i,t}+\beta_5 Cash_{i,t}+\Sigma Year+\Sigma Ind+\varepsilon_{i,t} \quad (3)$$

4. Empirical Analysis

4.1. Descriptive Statistics

Table 1. Descriptive statistics of the main variables

variable	N	mean	sd	min	p50	max
Patent	249	3.280	1.560	0	3.180	8.640
Eni	249	7.400	2.780	-0.920	7.810	18.17
Subsidy	249	16.19	2.030	7.600	16.24	21.78
HHI	249	0.130	0.120	0.0200	0.0800	0.650
Cr	249	59.22	15.03	17.65	59.17	88.36
Roe	249	0.0800	0.200	-2.790	0.0800	0.440
Cash	249	0.0100	0.110	-0.480	0.0300	0.360

The following table is the descriptive statistical results of the main variables. It can be seen from the table that the breakthrough innovation level of enterprises, namely the natural logarithm average of the number of invention patents applied for, is 3.280 and the median is 3.180, which is not much difference. Overall, the difference between enterprises is not very big. And environmental protection investment is the natural logarithm of the amount of enterprise environmental protection investment, so that the amount of environmental protection investment is not much, and the gap between the maximum value and the minimum value is large. On the whole, the amount of government subsidies is relatively stable, and most of them are at the average level, which shows that the government subsidies are relatively balanced and

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will not be much difference. For the Heffdal index, from the table the mean is 0.130 and the median is 0.0800. The larger the index, the stronger the degree of monopoly and the weaker the degree of competition, which shows that the overall industry competition level is relatively strong, which also reflects the effectiveness of the government's anti-monopoly policy in recent years.

4.2. Regression Analysis

Table 2. Regression analysis

variable	Patent		
	(1)	(2)	(3)
Eni	0.122*** (0.0425)	0.0725* (0.0415)	0.119*** (0.0423)
Subsidy		0.249*** (0.0505)	
HHI			-6.944* (3.820)
Eni*Subsidy		0.0272*** (0.00562)	
Eni*HHI			-0.761** (0.336)
Cr	-0.00678 (0.00728)	-0.00815 (0.00692)	-0.00745 (0.00725)
Roe	-0.359 (0.502)	-0.495 (0.477)	-0.154 (0.512)
Cash	0.900 (0.847)	0.890 (0.806)	0.774 (0.845)
Industry	control	control	control
Year	control	control	control
Observations	249	249	249
R-squared	0.366	0.435	0.377

*** p<0.01, ** p<0.05, * p<0.1.

Table 2 reflects the regression results of the relationship between enterprise environmental protection investment, government subsidies, market competition intensity and breakthrough innovation level. Column 1reflects the impact of enterprise environmental protection investment on breakthrough innovation. As can be seen from the table, the coefficient of environmental protection investment is 0.122 and is significant at the level of 0.01. Therefore, the hypothesis is H1, the environmental protection investment of enterprises will improve their breakthrough innovation ability. The function mechanism of enterprise environmental protection investment on enterprise innovation ability is mainly reflected in two aspects. First of all, enterprises invest in environmental protection. The green governance is mostly based on resource conservation and resource reuse as the starting point. Therefore, enterprises must develop new technologies or formulate new governance plans. In short, the existing technology or business model must be innovated. Followed by external effects, enterprise environmental protection investment not only conforms to the sustainable development requirements of the enterprise itself, also adapt to the national ecological civilization construction, meet the requirements of the public green life, can establish a good corporate image, improve the competitiveness of the enterprise, can produce certain positive effect on the overall

ISSN: 2692-7608 DOI: 10.6981/FEM.202205_3(5).0042

performance of the enterprise, can bring more financing for the enterprise, so as to promote enterprise innovation.

Column 2 is the regression result of the regulatory effect of government subsidies. As can be seen from the data in the table, the coefficient of environmental protection investment is positive and significant, and the hypothesis of H1 is further verified. The coefficient of the government subsidy is 0.249, and it is significant at the level of 0.01, so the government subsidy can promote the breakthrough innovation of enterprises, which also verifies the previous conjecture. However, the coefficient of the interaction term between government subsidy and environmental protection investment was 0.0272 and was significant at the level of 0.01, assuming that H2a was verified. It can be seen that government subsidies can adjust the impact of environmental investment on breakthrough innovation, and change the inhibitory effect of environmental investment into a promoting effect. Government subsidies can make up for the shortage of funds for environmental investments, and they can also send external signals that companies are favored, helping companies attract more investors and raise more money. Therefore, it can strengthen the promotion effect of environmental protection investment on enterprise breakthrough innovation.

Column 3 can see the regulation of the degree of market competition. Because the larger the heffindar index, the stronger the industry monopoly, so the weaker the competition. Table of the index and environmental protection investment interaction coefficient significantly negative correlation, thus with the increase of the index will make environmental protection investment in the promotion of enterprise breakthrough innovation into inhibition, that is to say, the stronger the market monopoly is the greater the competition, environmental protection investment negatively affect the breakthrough innovation level. Therefore, the government should strengthen the implementation of anti-monopoly measures, strengthen market supervision, and punish the enterprises that maliciously compete and disrupt the orderly operation of the market.

5. Conclusion

Based on the data of 2010-2019 China Shanghai A-share listed companies, this paper is the influence of environmental protection investment on breakthrough innovation level, because the enterprise increase environmental protection investment will have spillover effect on enterprises, prompting enterprises to make technology innovation, but also will have a positive impact on enterprise business activities to promote enterprise breakthrough innovation, and through the empirical analysis also verified this point of view. Next, this paper discusses the regulatory role of government intervention, which is mainly divided into government subsidies and market competition degree. Government subsidies can strengthen the role of environmental protection investment in promoting the breakthrough innovation of enterprises, which has also been verified through empirical data analysis. The weaker the intensity of market competition, the stronger the degree of monopoly will make environmental protection investment have an inhibitory effect on the breakthrough of enterprises. Therefore, in order to encourage enterprises to carry out environmental governance, the government should give as much as possible to subsidize enterprises for environmental protection investment, help enterprises to strengthen their innovation ability while making environmental protection investment, and make up for the lack of environmental protection investment, so as to give full play to their advantages. Moreover, the government should give full play to its supervisory function, strictly implement anti-monopoly measures, and maintain the safe and orderly operation of the capital market.

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