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Research on Enterprise Green Production under the Pressure State Response Model

Ziting Yao, Lijuan Liang

Institute of Finance and Economics, Henan Polytechnic University, Jiaozuo, China

Abstract

Realizing green production and promoting green transformation are important contents of green development. Based on the pressure state response model, this paper takes 155 industrial enterprises listed in Shanghai and Shenzhen from 2012 to 2018 as the research object, and establishes the enterprise green production evaluation system. The results show that in the seven years from 2012 to 2018, the pressure of green production of enterprises has increased year by year, especially after the promulgation of the "strictest environmental protection law" in the history of 2015. Although the government has put more and more pressure on enterprises' green production in recent years, the development speed of enterprises in green production is relatively slow.

Keywords

Pressure-state-response Model; Green Production.

1. Introduction

In China, general secretary Xi Jinping pointed out: "we must accelerate the reform of the ecological civilization system and build a beautiful China, and" promote green development "as the primary task of building a beautiful China. In addition, while emphasizing the promotion of green development, it also puts forward to speed up the establishment of the legal system and policy guidance of green production and consumption, establish and improve the economic system of green and low-carbon circular development, so as to promote the sustainable development of China's social economy. Enterprises are the main body of green production and should make contributions to the development of green economy in China. However, some enterprises have short-sighted behavior, do not pay attention to green production, still maintain the original production mode, discharge a large number of pollutants, predatory development and use of mineral resources, resource energy consumption is very serious, and paid a heavy price under the meager economic benefits. Therefore, in order to promote the green development of China's economy, it is very necessary to analyze the current situation of enterprise green production and ensure the process of sustainable development of China's social economy.

2. Literature Review

2.1. Enterprise Green Production

In the face of many increasingly acute social problems such as contemporary economy, technology, social environment and resource conditions, enterprises' development of green commodity production has attracted more and more social attention. Some scholars have studied the connotation of enterprise green production. For example, [1] redefined the green production behavior of enterprises from the perspective of energy conservation and emission reduction. The main manifestation is the green business philosophy of "source prevention" with the main goal of energy conservation and emission reduction, so as to effectively reduce the large amount of atmospheric pollutants to the greatest extent. [2] Based on the perspective

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of macroeconomics, applied "blockchain + production" to effectively promote the transformation of more enterprises to green production mode, giving full play to this market-oriented incentive mechanism, which can promote enterprises to spontaneously transform to the one side supporting green production mode. Through the above analysis, this paper believes that the green production of enterprises is that enterprises fully consider the greening of all links in the production process, which mainly reflected in product design, production process, application expansion and redevelopment and utilization of green environmental protection products, waste green treatment, etc. The influencing factors for enterprises to carry out green production generally divided into external and internal influencing factors. [3] research shows that government environmental regulations play an important role in reducing the additional emission of environmental pollutants by enterprises, controlling the number of polluting enterprises and encouraging technological innovation. [4] found that through the analysis of game theory, strengthening the law enforcement punishment of local governments and increasing economic stimulus policies and measures can significantly increase the development possibility of small and medium-sized enterprises to participate in green and safe production. The relevant research of Johansson and Winroth (2010) [5] also fully shows that the decision-making process of green production is often accompanied by the trade-off between environmental protection and economy. The progress of green production technology can improve energy efficiency and reduce cost, so as to improve the competitiveness of enterprises. [6] put forward in his article that the main goal of enterprises is the interest goal. The adoption of advanced industrial technology funds is an important link to promote Chinese enterprises to carry out green and clean industrial production. The national government needs to increase the investment of advanced technology funds to promote the stable and healthy development of green and clean production of Chinese enterprises. At the same time, the wide promotion and application of cleaner technology production management in enterprises will also directly promote the continuous improvement of the clean technology application environment. Green production of enterprises is an inevitable requirement for realizing the sustainable development of enterprises. Green transformation may increase the burden of enterprises in the short term, but it has great benefits in the long [7]. [8] put forward the application method of contemporary green supply chain management, the key of which is green production. That is to take the concept of green environmental protection as the basis, reduce energy consumption and reduce the emission of "three wastes" in the production of products as much as possible, achieve the purpose of reducing costs, and ensure that each product has the characteristics of environmental protection, green and safety, which can make every consumer feel at ease.

2.2. Pressure State Response Model

The pressure state response (PSR) conceptual model proposed by the United Nations OECD and UNEP. This conceptual model based on the psychological causal effect relationship, that is, human daily activities exert pressure on the environment to a certain extent, and the environment changes its original state, Human society has taken some corresponding measures to deal with these changes in order to restore the natural state of the environment. PSR model focuses on the causal relationship between environmental pressure and environmental degradation. The three links restrict and influence each other. It is the whole process of decision-making and countermeasures. At present, PSR model has been widely used in ecosystem research and evaluation, such as ecosystem health evaluation, ecological security evaluation, eco-environmental sustainable development index system and so on. [9] constructed a comprehensive evaluation and monitoring index system for safety risk early warning of the overall eco-environmental carrying capacity of Chang Zhu Tan megalopolis based on the PSR model.[10] believed that the subjectivity of data analysis in the application of traditional PSR model, and established a new set of national vulnerability level evaluation

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standard system with the improved PSR model as the theoretical framework. [11] Based on the pressure state response (PSR) model, explored the mechanism of high-quality development of sharing economy industry, analyzed the comprehensive driving mechanism of high-quality development of sharing economy industry, and put forward countermeasures and suggestions to promote the high-quality development of sharing economy industry from many aspects.

The green production of enterprises meets the strategic requirements of sustainable development, pays attention to the protection of the ecological environment, promotes the coordinated development between the enterprise itself and the ecological environment, and fully realizes the unity of enterprise interests, consumer interests, social interests and ecological interests. Previous studies on the significance of enterprise green production and the existing PSR model are rich, but few scholars combine the two. By summarizing the previous studies, this paper combines the enterprise green production behavior with the PSR model, and puts forward the research on perfecting the green production laws, regulations and policy orientation of Chinese enterprises.

3. Enterprise Green Production based on "PSR" Model

The PSR model follows the basic idea of "pressure state response" and has obvious causality. In this model, on the one hand, the production activities of enterprises consume a mass of natural resources and discharge waste to the environment. These behaviors exert pressure (P) on resources and environment, and then have a negative impact on resources and environmental conditions (s); On the other hand, in order to realize the sustainable development of society and respond to external regulatory requirements, enterprises make corresponding responses (R). These responses and measures will have a positive impact on the state of resources and environment (s). It can be seen that the interaction between human activities and nature constitutes a feedback cycle mechanism. The state of resources and environment (s) is the result of the influence of stress behavior and response behavior. In addition, if there is relevant information in the disclosure of enterprise information, 1 point will be given, if there are multiple, 2 points will be given, and no initial 0 point will be given.

The social survey data in this paper comes from cninfo.com and CSMAR official website. Firstly, it is located in the heavily polluting enterprises in all provinces. Secondly, it deletes the enterprises with missing data and incomplete data. Finally, according to the requirements of mathematical model establishment, it deletes the small and medium-sized polluting industries such as real estate industry and catering industry, so as to obtain 155 A-share listed companies (including mining, manufacturing, power, heat, gas and water production and supply) annual reports of enterprises from 2012 to 2018 and relevant information disclosure.

3.1. Pressure Index

In enterprise production, resources obtained from the environment. Resources are limited, and enterprise production activities will put pressure on resources. The production activities of enterprises discharge pollutants into the environment, and the discharged wastes will have a certain impact on the environment, resulting in pressure on the environment. In addition, the relevant requirements of laws and policies on the production of enterprises have produced pressure at the level of laws and policies.

3.2. Status Index

As the main body of production, the state of green production should reflect in the production process of the enterprise. Therefore, we select the following indicators to describe the status. Whether the enterprise has formulated an environmental protection plan, whether the enterprise discloses important pollutants, the types, quantity and destination of pollutants, whether the pollutant discharge meets the standard, the recycling and utilization of waste, and

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whether the enterprise pays pollution discharge fees, resource taxes and various environmental treatment fees according to law.

As the main body of production, the state of green production should reflect in the production process of the enterprise.

3.3. Response Index

In the process of green production, enterprises can make efforts from the aspects of green production technology, environmental protection investment, production training and resource conservation. For the response measures of green production, enterprises can update production technology to improve the utilization rate of resources and the recycling rate of waste. Enterprises can also increase investment in environmental protection, such as purchasing environmental protection equipment to respond to the call of green production. Enterprises can also carry out environmental protection training and education for employees, publicize the concept of environmental protection, and improve employees' awareness of environmental protection. In addition, enterprises can also do some public welfare activities related to environmental protection in the society, which is in line with the concept of green production and environmental protection. Whether the enterprise has formulated an environmental emergency plan and whether the enterprise has environmental self-test equipment is also a response to green production.

4. Empirical Analysis

4.1. Entropy Method

The common methods to determine the index weight mainly include principal component analysis, analytic hierarchy process, AHP, entropy method, etc. the entropy method used to calculate the index weight. Entropy method is a kind of objective assignment method, that is, the weight of the index determined by the value of the index itself. The concept of entropy from thermodynamics, and later used in information theory to reflect the disorder degree of the system. The smaller the entropy, the greater the amount of information, the greater the certainty and the higher the degree of order. On the contrary, the larger the entropy, the smaller the amount of information, the smaller the certainty and the higher the degree of disorder.

In this calculation, for the positive indicator, the larger the calculated weight value, it indicates that the enterprise has relatively less information to disclose and process this indicator. On the contrary, the smaller the weight value, it indicates that the enterprise attaches more importance to the relevant information represented by this indicator and discloses more information. For the negative indicators, the opposite is true. Since the data collected this time are judgment values and do not contain physical units, data standardization will not be carried out in this calculation. The calculation process is as follows.

(1) Calculate the proportion of index, as shown in formula (1).

$$Y_{ij} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}} \tag{1}$$

(2) Calculate the information entropy of index, as shown in formula (2).

$$e_j = -k\sum_{i=1}^{m}\left(Y_{ij} \times \ln Y_{ij}\right) \tag{2}$$

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(3) Calculate information entropy redundancy, as shown in formula (3).

$$d_j = 1 - e_j \tag{3}$$

(4) Calculate the weight of indicators, as shown in formula (4).

$$W_i = \frac{d_j}{\sum_{j=1}^{n} d_j} \tag{4}$$

4.2. Analysis of Index Weight

We calculated the relevant index data of 155 enterprises from 2012 to 2018, and obtained the overall situation of green production level of these 155 enterprises in recent seven years and the index weights at all levels under the pressure state response system, as shown in Table 1.

From the above data, we can see that among all the positive indicators in the pressure layer, the enterprise environmental credit rating "enterprise environmental credit evaluation measures" has the highest weight, indicating that the enterprise does not pay much attention to this indicator and the corresponding information disclosed is also very little. The index of environment-friendly enterprise has the lowest weight, indicating that this index has the greatest pressure on enterprises, which enterprises attach great importance. Among them, the only negative indicator is the punishment for violation of environmental regulations. The weight value of this indicator is also relatively large, indicating that the punishment of environmental regulations is a great pressure on enterprises. From the information in the state layer, we can see that although most enterprises can well meet the pollutant emission standards and disclose the expenses related to environmental pollution, they do not pay much attention to the disclosure of pollutants, as well as the quantity, type and destination of pollutants. In the response layer, we can see that enterprises have paid great attention to green production technology, energy conservation technology and environmental protection investment, and made a good response, while the response of other indicators is not high.

4.3. Analysis of Time Series Characteristics

In the previous calculation, we can calculate the overall situation of these 155 enterprises in the seven years from 2012 to 2018, but the summary is somewhat one-sided. With the continuous improvement of our green production laws and regulations, the green production status of enterprises is also different every year. Therefore, we used the entropy method again to calculate the stress state response index weight of 155 A-share listed companies in each of the seven years from 2012 to 2018, as shown in Table 2.

According to the above scoring data, we can see that the green production level of enterprises has been rising in the past seven years, indicating that China's laws and regulations on green production have played a crucial role in improving the green production level of enterprises. At the same time, we can also see from 2014 to 2015 in this stage, the enterprise green production level score appeared a large rise, thanks to come into effect on January 1, 2015, the revised new environmental law, namely the "environmental protection law of the People's Republic of China, the history of the law is the strict environmental protection law, New environmental law reflects the unprecedented environmental protection from multiple angles, regulation, law increased from 47 to 70, such as fog haze governance into laws, "according to the daily penalty" system design for the first time, red line clear ecological protection, expand the main body of environmental public interest litigation, etc., after the overhaul of the environmental law

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attaches to the illegal cost is low, environmental protection consciousness weak, such as environmental ills, It also plays a great role in promoting the green production of enterprises.

Table 1. Evaluation index weight results of enterprise green production level

Primary index	Weight	Secondary index	Type	Weight
Pressure (P)	0.5186	Environmental management system (P1)	Positive	0.1062
		Environment friendly enterprise (P2)	Positive	0.0402
		Pollutant discharge permit (P3)	Positive	0.1404
		Three simultaneous acceptance system (P4)	Positive	0.1374
		Enterprise environmental protection credit rating (P5)	Positive	0.2441
		Honor of environmental protection (P6)	Positive	0.0915
		Penalties for violation of environmental regulations (P7)	Negative	0.2399
state (S)	0.2167	Environmental protection plan formulated by the enterprise (S1)	Positive	0.1395
		Disclosure of major pollutants (S2)	Positive	0.2361
		Quantity, type and destination of pollution discharge (S3)	Positive	0.2622
		Whether the pollutant discharge meets the standard (S4)	Positive	0.0882
		Various environmental management expenses (S5)	Positive	0.0938
		Recycling and comprehensive utilization of waste (S6)	Positive	0.1800
Response (R)	0.26452	Environmental pollution emergency plan (R1)	Positive	0.1826
		Enterprise green production training (R2)	Positive	0.1690
		Environmental self-inspection (R3)	Positive	0.1985
		Disclosure of corporate social responsibility report (R4)	Positive	0.0902
		Environmental protection public welfare activities (R5)	Positive	0.2423
		Green production technology (R6)	Positive	0.0556
		Environmental protection investment (R7)	Positive	0.0614

Table 2. Weight changes of enterprise stress state response indicators from 2012 to 2018

Year	Pressure	State	Response
2012	0.46970	0.24973	0.28056
2013	0.48548	0.23954	0.27497
2014	0.49618	0.22695	0.27686
2015	0.50862	0.22709	0.26429
2016	0.53456	0.20416	0.26126
2017	0.57646	0.18535	0.23817
2018	0.59763	0.16539	0.23696

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5. Policy Recommendations

In terms of government, build a complete legal system, clear encouragement and preferential policies for green manufacture and the enterprise production in violation of the relevant laws and regulations of punishment, to a certain extent, increase the intensity of punishment, in violation of the law requires the enterprise, must be seriously dealt with relevant institutions to form a certain deterrent of deterrence.

Green production the whole process in enterprise, enterprise products starting from the design research and development, has been to product production, sales, and after the use of recycling and utilization of the entire product life cycle are related to green standards, so as to realize the green production of the enterprise, to save resources, protect the environment, energy conservation and emissions reduction, etc.

In the social aspect, increase publicity efforts, enhance the social awareness of environmental protection. In addition, a public service platform for green production will be built, on which enterprises must disclose the whole process of green production for the supervision and supervision of social personnel.

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