Research on the correlation between green finance and solid waste disposal based on grey correlation

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Abstract: In this paper, from the current concern of solid waste treatment and disposal, considering the early stage of China's green finance development, less data years and inconsistent statistical caliber, the relationship between green finance and solid waste treatment and disposal is studied as a grey system, and the grey correlation model is used to analyze the green finance and solid waste There is a strong correlation between the treatment and disposal of solid waste, so as to verify the importance of the development of green finance for the treatment and disposal of solid waste.

Key words: Grey correlation, green finance, solid waste, treatment and disposal

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1. Introduction

The concept of green finance comes from green civilization. Green civilization is a kind of civilization that pursues the harmonious survival and development of environment and human beings. Since the industrial revolution in the 18th century, human industrial civilization has reached an unprecedented height, but at the same time, there are some problems, such as environmental pollution, resource depletion, ecological imbalance and so on. Mankind is faced with grim facts.

In China, with the continuous development of industrial production, the rapid increase of natural resources consumption and waste production leads to the increasing consumption of some natural resources in the world and the serious accumulation of solid waste. With the development of economy, China is facing more and more pressure on resources and environment. At the same time, unreasonable resource allocation and inappropriate management mechanism have led to a substantial increase in waste, and the phenomenon of "garbage siege" continues to occur. With the improvement of the production speed of solid waste in China, domestic researchers have done a lot of research on the recovery and utilization of solid waste. The recovery of solid waste mainly includes solid waste recovery, comprehensive treatment and cooperative reaction. Speeding up the process of resource recovery will be an important means to change China's mode of economic development and build a resource-saving society.

Green finance refers to the development of green industries such as environmental protection, energy conservation, clean energy and transportation through a series of financial services and financial products. Green finance mainly emphasizes the use of financial means to support environmental protection. As the development of green finance in China is still in the early stage, there are many problems such as few data years and inconsistent measurement caliber mentioned above, which makes it impossible for us to use common relationship analysis econometric models such as regression which require high

numerical sequence. Therefore, this paper uses the grey relational analysis method to study the correlation between green finance and solid waste recycling, in order to determine the correlation and the degree of correlation between them, and provide a theoretical basis for the better development of green finance in the future.

2. Empirical study on the correlation between the development of green finance and the level of air pollution

Grey relational analysis is the basis of grey system theory and a systematic analysis method. The grey correlation analysis is judged according to the similar situation of the development and change situation of each factor of the research object, distinguishes according to the similarity degree of the geometric shape of the time series, and determines the correlation order through the correlation degree and the correlation matrix. it is a quantitative analysis method of the development trend of the dynamic process among various factors.

This method is also applicable to the number of samples and whether the samples are regular or not, so it makes up for the problems caused by the method of mathematical statistics in system analysis, and has been widely used in many fields.

2.1 Index selection and data sources

The grey relational analysis model requires the selection of data sequences that can reflect the behavioral characteristics of the system. Green credit is a kind of financial tool with rapid development of green finance in China, while the discharge and resource rate of solid waste is the problem of air pollution that we pay close attention to. Therefore, this paper chooses four indicators: the development of green credit, the emission level of major atmospheric pollutants, the development level of carbon finance and the level of carbon emissions for correlation analysis.

According to the relevant data and statistics of China from 2013 to 2018, the relationship between green financial development and solid waste emissions is taken as the analysis object, that is, the benchmark sequence y_0. In order to verify the relationship between the development of green finance and the level of air pollution. This paper selects the total green loan (GD) to measure the green credit development, the unit of the green credit loan is billion yuan; the national solid waste discharge (SWE) to measure the solid waste emission level, the unit of the national solid waste discharge is billion ton; the green credit resource recycling project investment (RI) and the green credit waste disposal and pollution prevention project investment (WI) to measure the direct action level of special financial projects in green credit, the units of them is billion yuan; the comprehensive utilization of solid waste (CU), Storage (WS) and disposal (WD) are used to measure the treatment level of solid waste in different disposal methods, the units of them is billion ton. The above indicators are used as analytical factors. Thus, y_0 and y_i constitute the basic analysis series of association analysis, as shown in Table 1.

2.2 Grey Relational Analysis between the Development level of Green Finance and the level of solid waste disposal

The specific calculation steps of grey relational analysis are as follows:

① Dimensionless of variables

There is a huge difference in the measurement unit of the original data, so the first step is to conduct dimensionless processing of the data to eliminate the error comparison caused by such difference.

$$x_i(j) = y_i(j)/y_i(1)$$

original data, the correlation coefficient

② Calculate the correlation coefficient

After dimensionless processing of the

Table 1 Original data of grey correlation analysis

Years	y_i	2013	2014	2015	2016	2017	2018
GD	y_1	5198.31	6012.83	7006.61	7504.69	8500	9660
RI	y2	84.85	111.09	131.88	161.26	170	193.2
WI	y3	183.46	236.14	269.51	278.57	340	386.4
SE	y4	2.38	1.92	1.91	1.48	1.31	1.55
CU	y5	1.47	1.2	1.18	0.86	0.77	0.86
WS	y6	0.2	0.26	0.34	0.55	0.73	0.81
WD	y7	0.71	0.48	0.44	0.38	0.31	0.39

* The data come from 《The National solid waste Bulletin of large and medium-sized cities》 issued by the Ministry of Ecology and Environment and 《The Green Credit Statistics of 21 Major domestic Banks》issued by the Banking and Insurance Regulatory Commission.

between x_0 and x_i （i=1,2,3，…，n） at point j is:

$$\zeta_i(j) = \frac{\min\limits_i \min\limits_j x_0(j) - x_i(j) + \rho \max\limits_i \max\limits_j x_0(j) - x_i(j)}{x_0(j) - x_i(j) + \rho \max\limits_i \max\limits_j x_0(j) - x_i(j)}$$

In the formula, $x_0(j) - x_i(j)$ is expressed as the absolute difference at j point between the x_0 sequence and the x_i sequence, marked as $\Delta_i(j)$; $\max\max\Delta_i(j)$, $\min\min\Delta_i(j)$ expressed as the maximum and minimum values of the x_0 sequence and the x_i sequence, respectively. ρ is the resolution coefficient, which is generally taken as 0.5.

③ Calculate the correlation degree.

The correlation degree is the average of the sum of the correlation coefficient $\zeta_i(j)$:

$$r_i = \frac{1}{m}\sum_{j-1}^{m} \zeta_i(j)$$

The following results can be obtained by calculation, as shown in Table 2:

Table 2 Statistical table of correlation degree

Correlation degree	Total solid waste production	Comprehensive utilization of solid waste	Solid waste storage capacity	Solid waste disposal quantity
Total green loans	0.60	0.58	0.64	0.62
Green loan funded resource recycling project quota	0.58	0.55	0.72	0.59
Green loan to subsidize garbage disposal and pollution prevention projects	0.62	0.59	0.67	0.64

2.3 Main conclusions

Through the analysis of the calculation results, it can be seen that the correlation coefficient between the total amount of green loans and the total production, comprehensive utilization, storage and disposal amount of solid waste in China is all greater than 0.5, which means there is a significant correlation. The results show that the development of green finance in China is closely related to the level of solid waste pollution and disposal.

The specific analysis of the statistical results shows that the correlation between the amount of funded resource recycling projects and the amount of solid waste storage is stronger than that between the amount of funded waste treatment and pollution prevention projects and the amount of solid waste storage, while the correlation between the amount of funded waste treatment and pollution prevention projects and the amount of solid waste comprehensive utilization and solid waste disposal is stronger than that of the amount of funded resource recycling projects and the amount of solid waste comprehensive utilization and solid waste disposal. This result shows that the proportion of the amount of resource recycling projects funded by green loans has a more direct and obvious effect on reducing the storage of solid waste. At the same time, it also reflects that the resource utilization of solid waste is not the main way of disposal of solid waste in our country, and a large proportion of green loans are used for the treatment and disposal of solid waste rather than resource utilization.

In a word, the grey correlation analysis proves that there is a strong correlation between green finance and the output, storage and disposal of solid waste. There is also a strong or weak correlation between the quota of the green loan project for resource recycling and the quota of the project for waste treatment and pollution prevention and control and the comprehensive utilization, storage and disposal of solid waste. However, there is no doubt that due to the strong correlation between green finance and the treatment and disposal of solid waste, the development and innovation of green financial products will inevitably bring certain influence to the treatment and disposal of solid waste.

3. Countermeasures and suggestions

① To establish and improve the legal system of green finance and promote the standardization and standardized operation of the green financial market.

We will step up efforts to promulgate laws and regulations on green development and green finance at the national level. On the one hand, the content of "green finance" can be added to the existing laws, such as the Environmental Protection Law of the people's Republic of China. The current Environmental Protection Law only stipulates that "the state encourages the insurance of environmental pollution liability insurance", which only involves a very small part of green finance. We can consider adding provisions such as "the state encourages financial institutions to carry out green financial business". On the other hand, financial management departments should make great efforts to promote the improvement of the legal system of green finance, gradually formulate and improve green financial products and their standards, such as green credit, green bonds, green funds, green insurance, etc., and provide unified policy implementation standards for local governments and market subjects, so as to promote the standardized operation of

China's green financial market.

② Enrich and innovate green financial products and green financial service system

Green financial products and services are the direct carriers to support green technological innovation. We should actively encourage and guide the willingness of financial institutions to innovate financial products. We should promote the green transformation of traditional credit instruments and continue to play the main role of banking financial institutions in supporting green development. We will speed up the development of the green bond market and broaden the low-cost financing channels for the green industry. Enrich the variety of green insurance products, and use the market-oriented mechanism to effectively control the environmental risk of green projects. Develop various forms of green funds and participate in the investment and financing of green projects.

At the same time, a multi-level green financial policy support system should be established. Establish a fiscal discount system for green credit and green bonds. Establish a guarantee mechanism for the operation of green projects, and set up professional green guarantee institutions to provide guarantees for green projects to obtain green loans from banking financial institutions and issue green bonds. The PPP mode green industry fund should be established by the combination of government public finance and private capital, and the organization form, government participation form and exit mechanism of the industrial fund should be set up reasonably. Give full play to the guiding and exemplary role of financial funds to social capital and pry private capital equity investment and enhance the economies of scale of the development of green industry.

③ Strengthen international cooperation and pay attention to risk control

The innovative development of green finance not only brings new investment and financing modes, but also brings risks. Financial institutions and relevant regulatory bodies should pay attention to new risk points, make good use of comprehensive risk management, and actively identify and control risks. In international cooperation, it should be noted that transnational business often brings more risks. In addition to the exchange rate risk, political risk and other risk points that need the attention of domestic institutions, we should also pay attention to the default risk of domestic enterprises.

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References

[1]Chen Jianpeng, LI Zuojun. China's air pollution Control situation and existing problems and some policy Suggestions [J]. Development Research, 2013, 10:4-14

[2]Dong Zhanfeng, YUAN Zengwei. Investment and Financing Demand and impact of air Pollution Prevention Action Plan (2013-2017) implementation [J]. China Environmental Management, 2016, 02:25-40

[3]G20 Green Finance Research Group. G20 Green Finance Synthesis Report [R]. Hangzhou: G20 Summit, 2016
[4]Liu Xiaodong, Pan Wenhui. A review on the causes and Countermeasures of greenhouse effect [J]. Journal of Mianyang Normal University, 2013, 05:91-94
[5]Li Xiaoyan, Wang Linping, Zheng Hairong. Comparison of green finance and its related concepts [J]. Science, Technology and Industry, 2007, 07:82-85
[6]The United Nations Environment Programme Financial Action Agency. Green financial products and services [R]. United Nations website: 2008
[7]Li Bingjun, Zhu Chunyang, Zhou Jie. Effect of dimensionless processing of raw data on grey relational sequence. Journal of Henan Agricultural University, 2002, 06:19-202
[8]Liu Sifeng, Guo Tianbang. Grey System Theory and its Application [M]. Beijing: Science Press, 1999
[9]Wu Jingye, Shi Benshan. Analysis of the influence of evaluation model on evaluation reliability. Systems Engineering Theory and Practice, 1993, 13(3) : 11-15