Research on the dynamic relationship between environmental finance and ecological environment-Based on PVAR model

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Abstract. The correct understanding of the positive role of environmental finance in the ecological environment is an important prerequisite and guarantee for the rational allocation of environmental financial resources and the correct formulation of environmental financial policies. Selecting the data of 31 provinces (municipalities, autonomous regions) in China from 2009 to 2015, this paper uses PVAR model to empirically analyze the dynamic relationship of environmental finance and ecological environment. The empirical results show that: (1) From a national perspective, the development of environmental finance and ecological environment presents 'low-high' character represented by Xinjiang, 'high-low' character represented by Shanghai, 'High-High' character represented by Zhejiang and the 'low-low' character by Tibet; (2) As a whole, the development of environmental finance has a significant correlation with the ecological environment; (3)The development of environmental finance can promote the improvement of the ecological environment, and the ecological environment will affect the development of environmental finance under certain lag period.

1. Introduction

In recent years, sustainable development has become an important consensus in China. The report of the 19th National Congress of the Communist Party of China clearly stated that it is necessary to implement the concept of sustainable development, not to engage in major development or to make a big leap forward. It is necessary to achieve a fundamental improvement in the quality of the ecological environment by 2035 and basically achieve the important goal of beautiful China. In order to make better use of environmental financial means to manage the increasingly urgent ecological and environmental problems, environmental finance can better serve the improvement of the ecological environment. Exploring the impact of environmental finance on the ecological environment is particularly important. China is a big country with uneven development. The ecological environment between the provinces is not the same but they are interrelated and mutually influential. The significance of this paper is to explore the role of environmental finance in promoting the ecological environment and to achieve effective and targeted distribution of environmental financial resources.

2. Literature review

I Many scholars study on the relationship of environmental finance and ecological environment and its related areas. Xiangli Chen and Sangqi Ding (2010, et al) [1]. Based on the Grey System theory and vector projection principle, the gray relational projection model of ecological environment quality evaluation including natural, economic and social aspects is constructed. The model was used to evaluate the ecological environment quality of Sichuan in the three years before and after the construction of the ecological province. Jun Han (2016) [2]. The ecological environment of Gansu Province was evaluated by weighted average method considering climate change, land degradation, vegetation cover, water environment and environmental quality. Jun Mai and Xufeng Hong (2015) [3]. Based on the survey data of China's commercial banks, Using joint analysis to study the

influencing factors of green finance. The research shows that: on the whole, the effect of green finance on financial institutions is not high; financial institutions have certain motivation to implement green finance, but the enthusiasm is not high, and the repayment ability of enterprises is still the primary factor considered by financial institutions. The external supervision of green finance is imperfect, and there is no strong incentive or constraint on the implementation of green finance in financial institutions. Xiaohong Dong and Yong Fu (2018) [4]. Based on the economic data of 30 provincial administrative units in China from 2008 to 2016, the coupling degree model is used to empirically analyze the dynamic coupling relationship between green finance and green economy in China and compare regional spatial differences. The results show that China's green development level shows an overall upward trend, green finance and green economy development are in a state of highly coordinated and coupled development, and there is no mutual inhibition. The green finance and green economy in the eastern region have a higher degree of coupling, followed by the central region and the lower regions in the western and northeast regions.

3. Variable description and data source

Ecological environment assessment index. The eco-environmental quality index is a comprehensive indicator reflecting the urban natural resource security conditions and environmental support level, and has become one of the factors for measuring the level of urban development and development. When selecting environmental indicators, both natural resources (A1) and pollution (A2) and pollution control (A3) should be considered. Considering the above situation, this paper selects per capita water resources, forest coverage, cultivated land area/district area, industrial waste gas emissions/regional GDP, industrial waste water discharge/regional GDP, desertified land area/district area, and total environmental pollution investment. Soil erosion control area/area area, nature reserve area/area area as evaluation indicators for water resources (B1), forest resources (B2), land resources (B3), air pollution (B4), water pollution (in each province) B5), land desertification (B6), environmental pollution control (B7), soil erosion control (B8), and natural environmental protection (B9) were evaluated, and an ecological environment assessment index was constructed.

According to China Statistical Yearbook, Guotaian Database, WIND Database, China Green Finance Network, etc., the provincial data of the nine indicators required for this paper from 2008 to 2015 can be obtained.

For each evaluation index of the ecological environment, because the evaluation index is not in an order of magnitude in most cases, the dimension of each indicator value of the original data is not necessarily the same. If it is not processed, the direct comparison has no practical significance. In order to ensure the reliability of the empirical results, it needs to be normalized, that is, dimensionless. Common processing methods include range conversion, initial value transformation, and mean transformation. In this paper, the normalized variation is used to obtain the normalized matrix.

Measurement of the level of environmental finance development. The research in this paper argues that environmental finance refers to financial services provided in the areas of supporting environmental improvement, coping with environmental degradation, supporting environmental science and technology innovation, and improving ecological structure. Environmental finance includes direct environmental finance and indirect environmental finance. Direct environmental finance refers to the financial method in which funds are not directly injected into the relevant fields of the ecological environment through bank deposit-oriented financial institutions. Conversely, indirect environmental finance refers to the financial method in which funds flow from the surplus of funds to the demand side of funds in the relevant fields of ecological environment through bank-type deposit-taking financial institutions. Or it can be studied from the micro-subjects that can be invested and produced by the market. The ways in which enterprises obtain environmental financial resources mainly include debt financing and equity financing. Therefore, this paper divides environmental finance into debt-based environmental finance and equity-based environmental finance: credit-based environmental finance refers to market micro-enterprises obtaining environmental financial resources through debt collection, including initial public offering of raised funds, additional

issuance of funds, and allotment of shares. Equity-based environmental finance refers to the fact that the market onlookers obtain environmental financial resources by transferring the company's equity, including the short-term, medium-term and long-term liabilities of the enterprise.

Based on the above research, this paper studies the development level of environmental finance from the perspective of enterprises. Taking into account the characteristics of the selected enterprises and the availability of data, the environmental protection of the A-share market and the New Third Board market are selected. Enterprises and companies involved in the environmental protection industry are the research objects. Specifically involved in the concept sector: 1025 companies including 48 sectors including beautiful China, wind power, green transportation, charging piles, new energy vehicles, carbon finance, sewage treatment and air treatment. This paper studies the capitalization of the funds obtained by these companies through debt-based environmental finance and equity-based environmental finance according to the province's provinces as a measure of the province's environmental financial portrayal (For space consideration, the development level of environmental finance is not present here).

4. Empirical analysis

4.1. Grey Relational Degree Model Based on Analytic Hierarchy Process

(i = 1, 2, ..., n; k = 1, 2, ..., m) is the kth index value of the i-th object to be evaluated. In this paper, in the comprehensive consideration of the referenceability of the data and the individual and special values are not an order of magnitude, all the evaluation samples are selected. The optimal index is selected and the reference sample is established. (k=1, 2,...,m) is the reference sample set. To form a reference sequence by evaluating the dimensionless values of the sample: . Form a comparison series with the dimensionless values of ideal samples: . The correlation coefficient is calculated as follows：

$$\varepsilon_{ik} = \frac{\min\limits_{i}\min\limits_{k} |X_{0K} - X_{ik}| + \rho\max\limits_{i}\max\limits_{k} |X_{0K} - X_{ik}|}{|X_{0K} - X_{ik}| + \rho\max\limits_{i}\max\limits_{k} |X_{0K} - X_{ik}|}$$

（1）

In the expression: Indicates the second smallest difference, Indicates the second largest difference, Represents the resolution factor, The range of values is ， According to experience, we generally take . The correlation coefficient values are calculated according to the formula to form a correlation coefficient matrix.

For the non-dimensional data of the original data of 31 provinces (except Taiwan Province of China, Hong Kong Special Administrative Region of China, and Macao Special Administrative Region of China) from 2008 to 2015, the dimensionless data is obtained, and the correlation coefficient matrix of each province and the optimal value is calculated.

We use the Analytic Hierarchy Process (AHP) to calculate the ecological environment comprehensive evaluation indicator matrix (For space consideration, the comprehensive evaluation index of ecological environment is not present here).

4.2. PVAR model

Panel unit root test. In order to ensure the stability of the model estimation, the panel unit root test is performed before the estimation. The test results in Table 1 show that the horizontal values of each variable are stationary variables, indicating that there is no unit root in the sample data, which is smooth panel data.

Choice of lag period. According to the AIC, BIC and HQIC guidelines, the eco-environmental evaluation index and the environmental financial development index data are judged by lag period. The results of each criterion test show that the optimal lag order is 3 orders.

Granger causality test. This paper conducts a Granger test of the ecological environment and environmental finance. The test results are shown in Table 1. The test results in Table 1 show that

under the 1% significance level, environmental finance is the Granger cause of the ecological environment, and the ecological environment is also the Granger cause of environmental finance.

Table 1 Granger causality test

Causal direction	Test result	P-value
Lnfdev to eenv	Yes	0.0000
Eenv to lnfdev	Yes	0.0000

Impulse response analysis. In order to test the dynamic relationship between environmental finance and ecological environment, this paper uses the impulse response function to test the impact of an environmental financial impact on the ecological environment during the zero period. The test results are shown in Figure 1. The test results in Figure 1 show that from the impulse response map of environmental finance to the ecological environment, the ecological environment has a significant positive impact in the current period, reaching the highest point in the fourth period, and then rapidly declines and gradually converges, indicating environmental finance. Promote the improvement of the ecological environment, but from the cumulative effect of the 20th period, overall, environmental finance has a relatively positive effect on the ecological environment.

From the impulse response diagram of the ecological environment of Figure 1 to environmental finance, it can be seen that the impact of the ecological environment on environmental finance lags behind, and there is no effect on the ecological environment in the zero period. From the first phase, the ecological environment has a positive impact on environmental finance. The effect, after the fourth period of this effect reaches the maximum value, gradually weakens and gradually converges to the zero axis. In the long run, the ecological environment will have a certain positive impact on environmental finance, but this effect is weak.
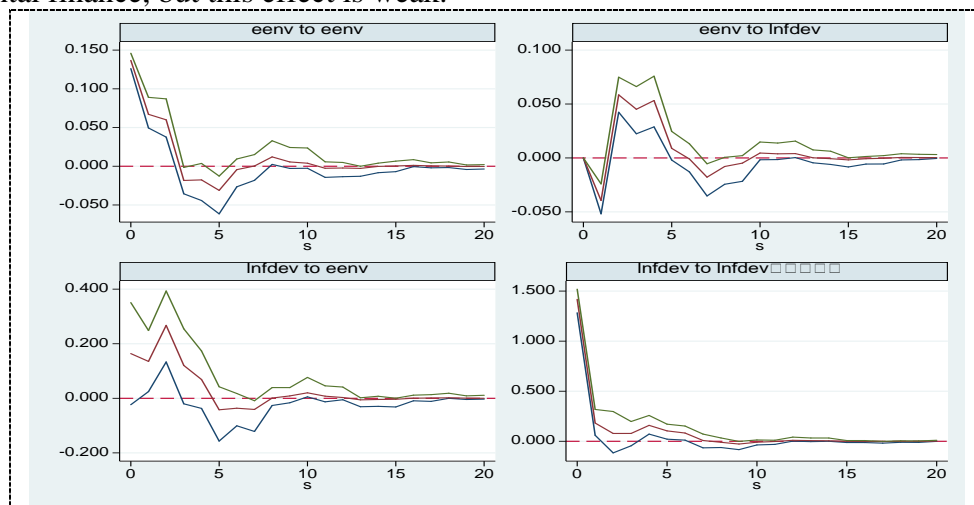

Figure 1. Impulse response diagram.

Panel variance decomposition. In order to more accurately analyze the degree of interaction between the ecological environment and environmental finance, the contribution of structural shock to each variable fluctuation can be analyzed by the variance decomposition method. The results of the variance decomposition are shown in Table 2. It can be seen from Table 2 that the results of the ecological environment variance decomposition indicate that the changes in the ecological environment are mainly affected by the impact of the self-impact, reaching 98.7% in the second period, followed by a trend of decreasing with time, and the decline is large, to the 20th period. It is only 34.3%. The contribution rate from the impact of environmental finance to the ecological environment was only 8.6% in the second period, and it has also risen slowly since then, rising to 20.3% in the 20th period. Therefore, environmental finance contributes to the changes in the ecological environment. This shows that changes in environmental finance have a positive effect on the changes in the ecological environment, but they do not play a decisive role. The change in environmental finance was also mainly affected by itself. It was 91.4% in the second period, and then

gradually reduced by its own influence. By the 20th period, it was affected by its own effect of 79.7%. In the second period, the fluctuation of environmental finance was affected by the ecological environment by 1.3%, and then rapidly rose to the level of 60%-70%. This indicates that changes in the ecological environment have long-term stable effects on environmental finance changes under certain lag periods.

Table 2 Variance decomposition results of variables in different prediction periods

	period	eenv	lnfdev
eenv	2	0.987	0.013
lnfdev	2	0.086	0.914
eenv	5	0.386	0.614
lnfdev	5	0.209	0.791
eenv	10	0.389	0.611
lnfdev	10	0.192	0.808
eenv	20	0.343	0.657
lnfdev	20	0.203	0.797

5. Conclusions

Selecting on the annual data of 31 provinces (municipalities, autonomous regions) in China from 2009 to 2015, this paper uses the panel VAR model to empirically analyzes the dynamic relationship of the environmental finance and the ecological environment. The conclusions are as follows:

From the provincial level, the development of environmental finance and ecological environment presents different regular patterns, namely 'low-high' character represented by Xinjiang, 'high-low' character represented by Shanghai, 'High-High' character represented by Zhejiang and the 'low-low' character by Tibet. As a whole, the development of environmental finance has a significant correlation with the ecological environment; (3)The development of environmental finance can promote the improvement of the ecological environment, and the ecological environment will affect the development of environmental finance under certain lag period.

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