An Empirical Study on Green Finance Promoting Industrial Structure Upgrading Based on Econometric Model

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Abstract: In recent years, with the rapid development of economy, global warming, ecological environment deterioration and other problems are becoming more and more serious. This paper uses the econometric model to quantitatively analyze the green finance. Based on the analysis of the action mechanism of green finance on the development of industrial structure and the development status of green finance and industrial structure, this paper points out the problems existing in the development process of green finance, and uses Granger causality test to make an empirical study on whether green finance has an impact on the development of industrial structure.

1 INTRODUCTION

In recent years, with the increasingly serious environmental problems such as global warming and air pollution, most countries in the world pay more and more attention to green finance. Green finance refers to the establishment of a green, low-carbon and circular economic system through the scientific use of financial instruments such as green credit, funds and securities, combined with the development law of market economy. Green finance is a financial activity that supports environmental improvement and effective utilization of resources, that is, it provides relevant financial services such as project investment and financing, project operation, risk management and so on. Industrial structure is the focus of China's supply side reform, and China's industrial structure adjustment is inseparable from green finance. The government continues to launch green finance policies to guide funds from high energy consumption and high pollution industries to green industries, encourage and support enterprises to increase investment in green industries, which can not only improve their competitiveness in the industry from the perspective of enterprise development, it can also promote the development of green finance and the upgrading and optimization of industrial structure from a macro perspective (Ma, 2016). Therefore, based on the analysis of the current development status of China's green finance and industrial system structure, this paper points out the problems existing in the development of China's green finance, further studies how green finance affects the industrial structure, makes an empirical analysis, and puts forward policy suggestions to optimize the industrial structure through the development of green finance.

2 AN EMPIRICAL ANALYSIS OF THE IMPACT OF GREEN FINANCE ON INDUSTRIAL STRUCTURE

2.1 Selection of Empirical Methods

Vector Autoregressive Model is a model based on the statistical nature of data. It is a model constructed by the regression of current variables to lag variables. It is used to explain the impact of various economic shocks on economic variables. This paper studies the impact of Green Finance on the development of industrial structure, so VAR is more appropriate here. The mathematical expression of model VAR(p) is as follows:

$$yt = \phi yt - 1 + \cdots + \phi pyt - p + Hxt + \varepsilon t, t = 1,2, \cdots, T \quad (1)$$

In Formula (1), Ky_t represents the k-dimensional endogenous variable column vector, Xt represents the

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column vector of d-dimensional exogenous variables, p represents the lag order, T represents the number of samples, and K∗k-dimensional matrix $\phi 1,\ldots,\phi p$ and $k * d$ dimensional matrices H refer to the coefficient matrix to be estimated. ε_t represents the k-dimensional perturbation column vector, and the relationship between them can be correlated at the same time. However, it is not related to their own lag value, and it is not related to the variables on the right side of the equation. Suppose Σ is the covariance matrix of $\mathcal{E}_t$, which is a positive definite matrix of k∗k. The expansion of equation 1 can be expressed as:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{kt} \end{pmatrix} = \phi_1 \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \\ \vdots \\ y_{kt-1} \end{pmatrix} + \cdots + \phi_p \begin{pmatrix} y_{1t-p} \\ y_{2t-p} \\ \vdots \\ y_{kt-p} \end{pmatrix} + H \begin{pmatrix} x_{1t} \\ x_{2t} \\ \vdots \\ x_{dt} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{kt} \end{pmatrix}, T = 1, 2, \cdots, T. \tag{2}$$

That is, the VAR(p) model with k time series variables consist of k equations (Ma, Wang, Dong, 2007; Gao, Gan, 2012).

2.2 Index Selection and Data Source

Here, we choose the green credit of financial institutions to measure the scale of China's current green financial development. Since the CBRC has only disclosed the green credit situation of 21 major financial institutions since 2013, which is updated every half year, the selected range of data here is from 2013 to 2020. We take the ratio of the green credit balance of 21 Financial Institutions disclosed by the CBRC to the RMB loan balance as an indicator to measure the scale of green financial development in China. The symbols and specific meanings of green finance indicators and industrial structure upgrading indicators are shown in Table 1. The industrial classification methods mentioned in the above theory mainly include the intensive degree classification of production factors and the traditional three industrial classification. Because the data acquisition required by the intensive degree classification of production factors is difficult, and the traditional three industrial classification can more intuitively and clearly reflect the evolution of industrial structure, and the data acquisition is less difficult. Therefore, the traditional three industry classification method is adopted here, and the proportion of the added value of the secondary industry and the tertiary industry in GDP is selected to measure the development of China's overall industrial structure.

Table 1: Empirical indicators and their symbols and meanings.

Variable type	Variable name	Symbol	Specific meaning
Green financial indicators	Green credit ratio	GF	Green credit balance/ RMB loan balance
Industrial structure upgrading index	Industrial structure upgrading	TID	（Added value of secondary industry + Added value of tertiary industry） /GDP

3 AN EMPIRICAL TEST OF GREEN FINANCE PROMOTING INDUSTRIAL STRUCTURE UPGRADING

3.1 Unit Root Test

The stability test of variables GF and TID is the premise of empirical test, while ADF test is widely used in China with high accuracy. Therefore, this paper uses ADF test to test the stability of green financial indicators and industrial structure indicators. The results are shown in tables 2 and 3 below.

Table 2: Test results of GF stationarity of variables.

Method	Statistic	Prob**
ADF-Fisher Chi-square	10.4576	0.0054
ADF-Choi Z-stat	-2.55170	0.0054

Intermediate ADF test results D(GF,2)

Series	Prob	Lag	Max Lag	Obs
D(SER01,2)	0.0054	0	0	6

Table 3: Test results of variable TID stationarity.

Method	Statistic	Prob**
ADF-Fisher Chi-square	19.37804	0.0001
ADF-Choi Z-stat	-3.83853	0.0001

Intermediate ADF test results D(TID,2)

Series	Prob	Lag	Max Lag	Obs
D(SER02,2)	0.0001	0	0	6

The results of stationarity test show that the ADF statistical value of the second-order difference of GF vector and TID vector is lower than 1%, which indicates that the second-order difference of GF vector and TID vector is significant at the 1% level, and the

negation of the original assumption at the 99% confidence level indicates that it is a stable sequence.

3.2 Determining The Lag Order

After the stationarity test, the lag order of each variable needs to be determined. The operation results of EViews are shown in Table 4. According to Akaike information criterion (AIC) and Schwarz criterion (SC), AIC, SC and HQ are the minimum when the lag order is 2, so it can be determined that the optimal lag order is 2.

Table 4: EViews operation results of variable lag order.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	78.76521	NA*	1.03e-12	-21.93292	-21.94837	-22.12393
1	86.39534	8.720150	4.08e-13*	-22.97010	-23.01646	-23.54313
2	92.23880	3.339124	4.43e-13	-23.49680*	-23.57407*	-24.45186*

3.3 Stability Test

The stability test of VAR model is the premise of impulse response function analysis. According to the stability analysis of VAR model constructed by the above variables, the results in Figure 1 show that the reciprocal of unit eigenvalue of VAR model is in the unit circle, indicating that the VAR model is stable.

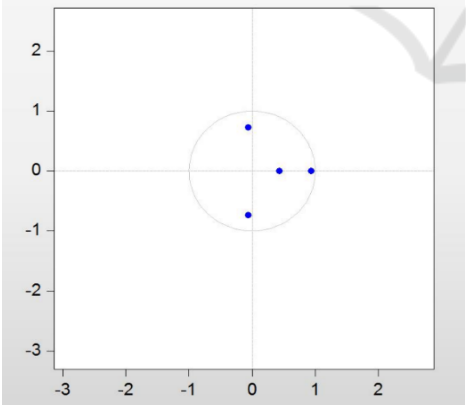

Figure 1: Inspection diagram of AR root.

3.4 Impulse Response Function Analysis

Figure 2 shows the impulse response function of industrial structure upgrading to green finance. Through the observation of the function diagram, it can be found that after the external impact of a standard deviation is applied, the pulse response characteristics of industrial structure upgrading to green finance are as follows:

From the beginning to the third period, the impact of industrial structure upgrading on green finance gradually increased and reached the peak in the third period. From the third period to the fifth period, it showed a downward trend, and from the fifth period, it showed a first upward and then downward trend again.

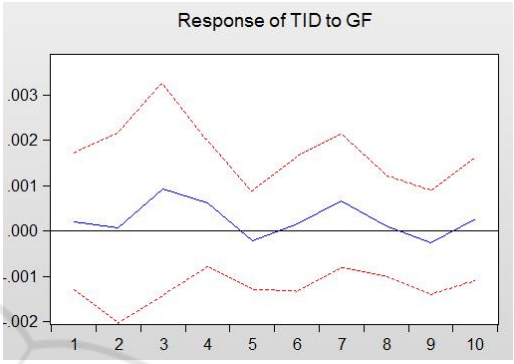

Figure 2: Impulse response function of TID to GF.

4 CONCLUSION

Through theoretical analysis, it is concluded that green finance mainly affects industrial institutions through capital formation mechanism, capital-oriented mechanism and information disclosure mechanism. Through data collection and analysis, the current situation of China's green finance development and industrial structure development is revealed, and on this basis, the problems faced by green finance to promote the development of industrial structure are obtained. The empirical research shows that there is a significant causal relationship between the development of green finance and the upgrading and optimization of industrial structure. That is to say, China can promote the optimization of industrial structure through the implementation of green finance policies, thus making the economic development model change from the traditional extensive model to the energy saving and environmental protection model. On this basis, the specific policies and opinions on the development of green finance to promote the upgrading of industrial structure are given from 4 aspects, including the understanding of green finance at a higher level, the improvement of green financial system, the establishment of incentive and restraint

mechanism, and the increase in the training of green financial professionals.

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