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Evaluation of the Effect of Green Finance on Low-carbon Development in the Context of "Dual Carbon"

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Abstract: The "dual carbon" goal is a major strategic decision based on the responsibility of building a community with a shared future for mankind and the inherent requirements of achieving sustainable development. In the process of achieving the goals of "carbon peaking" and "carbon neutrality", "green finance" and "low-carbon economy" are important means and ways of integrating two sides. On the one hand, green finance and low carbon economy have a good driving effect on economic growth, environmental protection, etc. On the other hand, low carbon economy will promote the development and improvement of green finance mechanism, and the development of green finance will promote the transformation of low carbon economy. Therefore, it is more necessary to study the internal relationship between the two and put forward new development requirements. Based on the analysis of the impact mechanism of green finance on low-carbon development, this paper measures the development level of low-carbon economy and green financial development system based on the entropy TOPSIS method using the carbon emission data of various provinces in China from 2017 to 2020.

Keywords: Double carbon target, Green finance, Low carbon developmentm Evaluate.

1. Introduction

The background of "double carbon" originates from the goals of "carbon peak" in 2030 and "carbon neutralization" in 2060 explicitly proposed by China in 2020, which is the latest requirement of ecological civilization ideology to guide China's ecological civilization construction, and reflects the internal logic of China's green and low-carbon development path. Gao Shiji and Yu Min (2021) studied the theoretical mechanism and targeted path of digital economy for high-quality development of China's economy [2].

Low carbon development is a model innovation based on traditional development. It is a new development model that takes environmental protection as the pillar of sustainable development under the constraints of ecological environmental capacity and resource carrying capacity. Green finance has the functions of capital support, resource allocation and social supervision. By increasing the supply of green funds, reducing the investment and financing costs of green projects, guiding the flow of funds and standardizing the environmental behavior of enterprises, it can promote economic growth, promote industrial transformation and help environmental protection, so as to achieve low-carbon development.

In recent years, more and more scholars have paid attention to the internal relationship between green finance and low-carbon development in the research of green finance on low-carbon development. Yuan Xiangfei and others (2018) analyzed the motivation and mechanism of green finance supporting green development [3]. Fu Jingyan and Liu Yingping (2019) explored the mechanism of green finance to promote high-quality economic development from the perspective of full allocation of green finance to promote resources [4].

To sum up, the literature on green finance and low-carbon development mostly focuses on qualitative analysis, and the research on how green finance drives low-carbon development is less. In terms of empirical analysis, the existing literature has not empirically tested the comprehensive effect of green finance driving low-carbon development from the perspective of panel data space. This topic will measure the development level of green finance through five aspects of green credit, green securities, green insurance, green investment and carbon finance indicators, and measure the comprehensive effect of green finance driving low-carbon development through three dimensions of economic growth, industrial transformation and environmental protection.

2. Index and Model Construction

2.1. Index Construction

Based on the panel data of 30 provinces from 2017 to 2020, the research and analysis are carried out. The measurement index is green finance divided into four dimensions: green credit (X_1), green securities (X_2), green investment (X_3) and green insurance (X_4).

2.2. Model establishment and solution

(1) Establishment of entropy weight TOPSIS evaluation model. This paper synthesizes green credit (X_1), green securities (X_2), green investment (X_3), and green insurance (X_4), uses entropy weight method to give weight to each indicator, and calculates the weight value of each indicator. Then the weight value of the index is substituted into the TOPSIS algorithm to calculate the relative closeness and score the overall scheme [5].

(2) Algorithm introduction. Entropy weight method is an objective comprehensive evaluation method for multiple objects and indicators. According to the variation degree of each index, the entropy weight of each index is calculated by information entropy, and then the weight of each index is modified by entropy weight, so as to obtain more objective

index weight [9].

① Normalization. Normalize k indicators X_1, X_2, ... , X_k. Since all indicators are positive indicators, the following calculation formula is used:

$$Y_{pq} = \frac{X_{pq} - \min(X_p)}{\max(X_p) - \min(X_p)} \quad (1)$$

② Calculate the proportion Z_{pq} of the index value of the p scheme under the q index. The calculation formula of Z_{pq} is as follows:

$$Z_{\mathrm{pq}} = Y_{pq} / \sum_{p=1}^{n} Y_{pq} \quad (2)$$

③ According to the definition of information entropy in information theory, calculate the information entropy value E_q of the qth index. E_q is calculated as follows:

$$E_{\mathrm{q}} = -\ln(n)^{-1} \sum_{p=1}^{n} Z_{pq} \ln Z_{pq} \quad (3)$$

④ Calculate the information entropy redundancy, i.e. G_p=1-E_q.

⑤ According to the calculation formula of information entropy, the information entropy of each index is calculated as E_1, E_2, ... , E_k. The weight of each indicator is calculated through information entropy. The calculation formula is as follows:

$$W_q = \frac{G_p}{\sum_{q=1}^{m} G_q} (q = 1,2,\cdots,k) \quad (4)$$

TOPSIS is a method for multi-objective decision-making. This method can make full use of the information of the original index data, and sort by calculating the distance between the evaluation object and the optimal solution and the worst solution.

FL_j, MY_j, JY_j and MJ_j (j=2017, 2018, 2019, 2020) are respectively used to represent the situation in different years, and a, b, c and d are respectively used to represent the weight coefficients of green credit, green securities, green investment and green insurance, so the entropy method environmental protection evaluation model is established as follows:

$$WH_{\mathrm{j}} = aFL_j + bMY_{\mathrm{j}} + cJY_j + dMJ_j \quad (5)$$

Then, the weight of each index is substituted into the distance formula of topsis algorithm, and the relative proximity is calculated to complete the measurement scoring.

3. Empirical Analysis

According to the weight value of secondary index factors determined by the improved entropy weight method and the evaluation grade subordination matrix obtained, a green finance index factor evaluation modelis constructed [7], which is recorded as B=W*V. Where, Wi={W1, W2, ..., Wn}. According to the secondary index evaluation factor model, the evaluation score of the primary index is calculated as S=B*R_t, where R_t is the transposition matrix of the evaluation set. After all the results are obtained, select the score [8]. The calculation results are as follows:

$$S = (0.1862, 0.5562, 0.1429, 0.1147) * \begin{pmatrix} 0.4532 & 0.3532 & 0.1468 & 0.0468 \\ 0.1719 & 0.2638 & 0.2707 & 0.1160 \\ 0.2838 & 0.3000 & 0.1994 & 0.1709 \\ 0.3028 & 0.2562 & 0.2534 & 0.1653 \end{pmatrix} * R^t = 88.8675 \quad (6)$$

Since the least squares estimate of the parameter is $\hat{\beta} = (x^T x)^{-1} x^T y$, the estimated value of y is $\hat{y} = x\hat{\beta}$.

If the residual vector is recorded as $e = y - \hat{y} = y - x\hat{\beta}$, the least squares estimate [9] of random error variance δ^2 is as follows:

$$\hat{\delta} = \frac{e^T e}{n - k - 1} \quad (7)$$

If the original hypothesis H_0: $\beta_i = 0 (i = 0,1,2,3)$ and alternative hypothesis H_1: $\beta_i (i = 0,1,2,3)$ are not all 0, then when the hypothesis is true, the test statistics are as follows:

$$F = \frac{SSR / k}{SSE / (n - k - 1)} \sim F(k, n - k - 1), \quad n = 3, k = 1,2,3, \quad (8)$$

Where $SSR = \sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2$ is the sum of regression squares; $SSE = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$ is the sum of squares of the residuals. For a given significance level ∂, the rejection field $F > F_{\partial}(k, n - k - 1)$ of the test.

4. Conclusions and Suggestions

4.1. Conclusions

The concept of "green finance" has provided a path for people to develop low-carbon economy. Environmental protection, natural resources, etc. are used as capital in financing and investment activities, aiming to promote the transformation of production mode of enterprises, promote the adjustment of industrial structure, and lay a good foundation for the better implementation of sustainable development strategy. At present, green securities and green investment are of high weight, which represents the role of green finance in promoting low-carbon development.

4.2. Suggestions

We should fully understand the importance of green finance for economic and social development and economic

structure transformation, and promote the country to achieve the dual carbon goal; Open the channel for green finance to promote the realization of the "double carbon" goal and serve the transformation and development of green and low carbon.

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