Research on Green Economic Efficiency of the Pearl River-Xijiang Economic Belt

Hui Liu, Junjie Liu

School of Economics and Management, Guangxi Normal university, Guilin 541000, China

Abstract: It is the theme of today to develop green economy and improve green economic efficiency. This paper first uses the Super-SBM model with undesired output to measure the green economic efficiency of the Pearl River-Xijiang Economic Belt from 2011 to 2020, and analyses it from the two dimensions of time and space, and then analyses the redundancy and deficiency of input and output. The results show that : (1) There are significant temporal and spatial differences in green economic efficiency in the Pearl River-Xijiang Economic Belt. Overall, from a temporal perspective ,the green economic efficiency of the Pearl River-Xijiang Economic Belt shows a upward trend , compared with 2011, the green economy efficiency of the four cities in Guangdong decreased in 2020, while the seven cities in Guangxi are the opposite, from a spatial perspective, it has obvious regional differences, showing a spatial pattern of high in the east and low in the west .(2) From the perspective of input redundancy, capital > energy > labor. As a measure of undesired output, GDP has a redundancy of 0. The redundancy of industrial wastewater discharge, industrial SO2 discharge and industrial soot discharge is high.

Keywords: Green Economic Efficiency; Pearl River-Xijiang Economic Belt; Super-SBM Model

1. Introduction

Over 40 years of the reform and opening up, China has made great achievements in economic and social development, while at the same time bringing about serious problems such as environmental pollution and resource depletion. (Yuan,2022). According to the World Bank, China has become the largest energy consumer and energy producer, accounting for 33 % of global CO_2 emissions in 2021, and the situation of carbon emission reduction is becoming increasingly severe. In this context, how to balance economic development and environmental protection, and realize the sustainable development of the green economy, is a problem that needs to be solved urgently.

2. Literature review

If the evaluation of urban development level only considers the level of economic development, without considering the ecological environment and resource endowment, it is obviously not in line with the concept of sustainable development. As a comprehensive index to measure economic growth, resource conservation and environmental protection, green economic efficiency can effectively evaluate the development level of a city. British economist Pierce (1989) first proposed the green economy. He believed that economic development should not blindly destroy the ecological environment and waste production resources for the growth of GDP. At the same time, it should not prevent economic growth because of resource shortage and ecological environment deterioration. Since then, many researchers have carried out a lot of research on green development. At present, the research on green development mainly focuses on the measurement of green economic efficiency and the analysis of influencing factors. With regard to green economic efficiency measurement, Yuan(2022) constructed a green economy efficiency evaluation index system containing 23 indicators, and calculated the green economy efficiency value by the entropy method, and the results showed that green economy efficiency has maintained a steady improvement in the timeline, regions have shown a “multi-peak-polycentric” hierarchical structure.

Zhang (2014) measured the resource and environmental efficiency of 285 cities in China, and found that technical efficiency is the main factor affecting the efficiency of urban source environment in China, and there is a U-shaped relationship between urban income level and resource and environmental efficiency. In terms of the research on the influencing factors of green economy efficiency, a large body of literature focus on the impact of factors such as level of economic development, foreign direct investment, level of urbanization, energy intensity and industrial structure on the green economy efficiency.

This paper takes the Pearl River-Xijiang River as the research object, uses the Super-SBM model containing undesirable outputs to measure the green economic efficiency, and analyzes it from the two dimensions of time and space, and then analyzes the redundancy and deficiency of input and output. Finally, according to the research conclusions, corresponding countermeasures are put forward to improve the green economic efficiency.

3. Research methods, index system construction and data sources

3.1 Research methods of green economic efficiency

This paper selects the Super-SBM model proposed by Tone (2002) to measure the green development efficiency of the Pearl River-West River. Basic expressions refer to Tone's literature.

3.2 The evaluation index system construction

Capital input, labor input and energy input are selected as input indicators, and capital input is measured by fixed asset investment in the whole society, labor input is expressed by the number of employees in urban units at the end of the period, energy input is expressed by electricity consumption of the whole society. For the output indicators, this paper selects the GDP as the expected output indicators, industrial wastewater discharge, industrial SO_2 discharge, industrial soot discharge as undesirable output indicators.

3.3 Data sources

The data of each index are derived from the China Urban Statistical Yearbook, Guangdong Statistical Yearbook , Guangxi Statistical Yearbook.

4. Temporal-spatial pattern analysis of green economic efficiency

4.1 Analysis of time characteristics of green economic efficiency

The time trend of green economic efficiency in the Pearl River-Xijiang Economic Belt is shown in Figure 1. It can be seen from Figure 1 that from 2011 to 2020, the green economic efficiency of the Pearl River-Xijiang Economic Belt on an upward trend from 2011 to 2020, indicating that the coordination between economic development and ecological environment protection in the Pearl River-Xijiang Economic Belt is getting higher and higher. Among them, the gap between the four cities in Guangdong and the seven cities in Guangxi is obvious. The green economic efficiency of the four cities in Guangdong is significantly higher than that of the seven cities in Guangxi. The green economic efficiency of the four cities in Guangdong in 2020 is lower than that in 2011, and the overall trend is downward, while the change trend of the seven cities in Guangxi is the opposite.

4.2 Analysis of spatial characteristics of green economic efficiency

With the help of Arcgis10.8, the green economic efficiency of each city in the Pearl River-Xijiang Economic Belt from 2011 to 2020 was visually analyzed. The natural discontinuity classification method was used to group the green economic efficiency into five categories : high efficiency, high efficiency, medium efficiency, medium and low efficiency and low efficiency. The spatial and temporal Map of Green Economy Efficiency was drawn in 2011 and 2020. From Figure 1, it can be seen that the distribution characteristics of high-efficiency and low-value cities of green economy are obvious, showing an olive-type distribution pattern of large in the middle and small at both ends, that is, there are fewer cities in the high-efficiency and low-efficiency echelons, while there are more cities in the middle echelons. The high-efficiency cities of green economy are mainly concentrated in Guangdong Province, especially Guangzhou City. The efficiency of green economy is always at a high efficiency level, which is located on the production preface. Low-value cities are mainly distributed in the west of Guangxi, mainly Nanning, Liuzhou and Baise, among which Baise has the lowest green economic efficiency. From 2011 to 2020, the overall green economic efficiency of the Pearl River-Xijiang Economic Belt is developing in the direction of improvement. The number of cities in the low efficiency group is reduced from 3 to 0, but the

changes between cities are different. Foshan City fell from the high efficiency group to the medium efficiency group, Zhaoqing City and Chongzuo City fell from the higher efficiency group to the medium efficiency group, Yunfu City and Laibin City rose from the medium efficiency group to the higher efficiency group, Nanning City, Liuzhou City and Baise City rose from the low efficiency group to the medium and low efficiency group, and other cities remained unchanged.

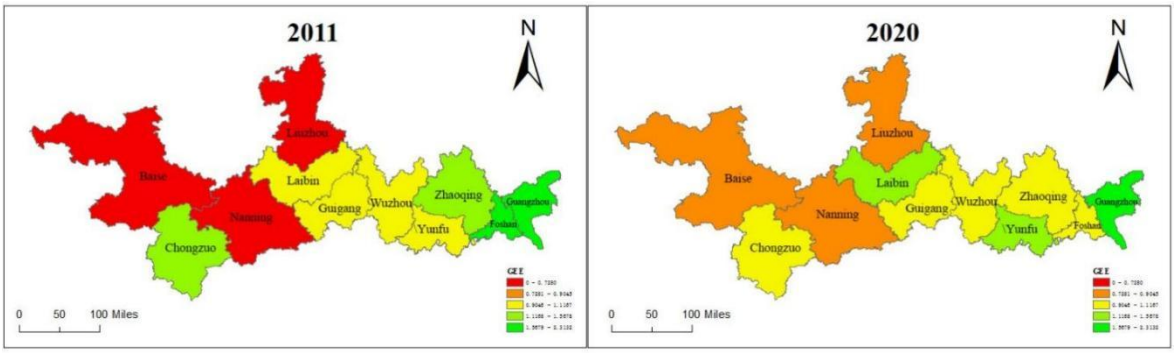

Figure 1 Spatial and Temporal Map of Green Economy Efficiency

5. Analysis of input-output redundancy and deficiency in Pearl River-Xijiang Economic Belt

Redundancy and deficiency reflect the gap between input-output variables and the target value of optimal allocation. The analysis of redundancy and deficiency provides a scientific direction for the improvement of green economic efficiency and the rational distribution of future productivity in 11 cities of the Pearl River-Xijiang Economic Belt. By calculation, the redundancy of labour input in 2011 and 2022 is 4.37% and 3.44 respectively, the redundancy of capital input is 11.19% and 15.13 respectively, the redundancy of energy input is 2.29% and 11.40% respectively, the redundancy of industrial waste water emissions is 3.96% and 14.03% respectively, the redundancy of industrial SO_2 emissions were 16.44% and 21.33% respectively, and industrial soot emissions were 18.34% and 17.08% respectively. The degree of inadequacy of expected output is 0.

In 2020, the input and undesired output of the Pearl River-Xijiang Economic Belt are redundant, and the expected output slack is 0. From the perspective of investment resources, the redundancy of capital investment is the highest, indicating that the Pearl River-Xijiang Economic Belt has the problem of excessive capital investment, that is, too much government investment, and government investment will squeeze private investment and personal consumption, which is not conducive to economic development. The second redundancy is energy input, indicating that the proportion of high energy-consuming industries in the Pearl River-Xijiang Economic Belt is still high, and the consumption of energy is more. It is necessary to promote the adjustment of industrial structure, cultivate new green industries, and promote the construction of innovative cities. Labor input ranks last in redundancy, and its redundancy is 11.69 % lower than capital input, indicating that the labor utilization efficiency of the Pearl River-Xijiang Economic Belt is high, which is closely related to the improvement of labor productivity in recent years. For the expected output, the GDP deficit of the Pearl River-Xijiang Economic Belt is 0, and the 11 cities of the Pearl River-Xijiang Economic Belt have realized the maximization of economic output, indicating that the current overall development model of the economic belt is still pursuing the maximization of economic output. We should shift from pursuing economic aggregate to pursuing economic quality and achieving high-quality economic development. From the perspective of undesirable output redundancy, the redundancy of industrial wastewater discharge, industrial sulfur dioxide discharge and industrial soot discharge is relatively high, indicating that the emphasis on the environment is relatively low, and the phenomenon of excessive discharge of pollutants is more serious.

From the perspective of time series changes, from 2011 to 2020, the redundancy of labor input, capital input, energy input, industrial wastewater discharge, industrial sulfur dioxide discharge and industrial soot discharge is in a fluctuating dynamic adjustment process. Compared with 2011, the redundancy of labor input and industrial soot emissions in 2020 decreased by 21.28 % and 6.87 % respectively. The redundancy of capital input, energy input, industrial wastewater discharge and industrial SO_2 discharge increased by 35.21 %, 397.82 %, 254.29 % and 29.74 % respectively. It can be seen that in the development process of the Pearl River-Xijiang Economic Belt, the utilization rate of labor force is high, but the government investment is relatively large, which inhibits private

investment to a certain extent and is not conducive to economic development.

6. Conclusion and suggestion

6.1 Conclusion

Based on the above research, the main findings of this paper are as follows:

(1) From the perspective of time, the green economic efficiency of the Pearl River-Xijiang Economic Belt is a fluctuating dynamic adjustment process, which presents upward trend. From the perspective of space, the green economic efficiency presents a spatial pattern of high in the east and low in the west .

(2) From the perspective of the redundancy and deficiency of input and output, the input redundancy of the Pearl River-Xijiang River Economic Belt ranks first as capital input, the redundancy of energy input ranks second, the redundancy of labor input is relatively low, the expected output redundancy of the economic belt is 0, and the redundancy of the three types of undesirable outputs of industrial wastewater discharge, industrial SO_2 discharge and industrial soot discharge is relatively high.

6.2 Suggestion

Based on the findings, this paper presents the following measures and suggestions for improving the green economy efficiency in the Pearl River-Xijiang Economic Belt.

(1) Improve the efficiency of resource utilization, change the mode of economic development. In the future development, the government should rationally allocate fixed asset investment and reduce the redundancy of capital investment. At the same time, cities should change the mode of economic development, and pursue low energy consumption production mode.

(2) Strengthen ecological environment construction and promote urban green development. Government should formulate a strict environmental regulation system, improve the corresponding laws and regulations, establish a strict supervision system, strictly abide by the ecological red line, improve the performance evaluation of green economic development, and help the high-quality economic development.

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