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Research on Rural Carbon Emission Performance under Green Development

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Abstract

Based on the agricultural carbon emission data of 30 provinces and cities in China from 2014 to 2020, this paper first refined the input variables and divided them into industrial carbon sources, domestic carbon sources and ecological carbon sources. Then, the SBM model is used to calculate the corresponding carbon emission performance, and the panel unit root test method is used to compare the indicators. Finally, the paper puts forward relevant policy recommendations to achieve an effective combination of green development and rural carbon emissions.

Keywords

Carbon emission performance; SBM model; Random convergence.

1. Introduction

In recent years, a series of phenomena, such as global warming, glacier melting, sea level rise, haze weather, etc., indicate that climate change brought about by the greenhouse effect is seriously affecting the future survival and development of mankind. Due to the constant acceleration of industrial and agricultural development and rural economic process, under the promotion of carbon neutral and green development policies, the problem of urban industrialization carbon emissions has been better solved and concerned. However, the sustainable and low-carbon development in rural areas has always lacked sufficient awareness, and investment in rural ecological environment and development is relatively small. In the report of the 19th National Congress of the Communist Party of China, the General Secretary put forward the strategy of rural revitalization and development, and the solution of the "three rural issues" should be the top priority of the Party's work. Therefore, we must strengthen the regulation of carbon emissions of agricultural products. In this environment, the study of China's agricultural carbon dioxide emissions and the corresponding analysis of its convergence will help to formulate scientific agricultural emission reduction strategies, thus laying the foundation for the realization of rural economic development and sustainable social development. In this paper, the SBM Undesirable model is used to calculate the agricultural carbon emission performance, and the panel unit root test method is used to test the total amount and performance. The input variables are more refined and divided into industrial carbon sources, living carbon sources and ecological carbon sources.

2. Research Design

2.1. Calculation of total agricultural carbon emissions

In this paper, agricultural carbon sources are divided into three categories: first, industrial carbon sources, including pesticides, fertilizers, agricultural film, rice field methane, intestinal fermentation methane of livestock and poultry breeding, and methane and nitrous oxide in the process of manure treatment; Second, domestic carbon sources, including rural housing, gasoline, liquefied petroleum gas, natural gas and electricity; Third, ecological carbon sources, including infrastructure (public buildings and productive buildings), roads and coal. The total amount of agricultural carbon emissions is the sum of carbon emissions caused by various carbon sources.

2.2. SBM model

In the research of carbon emission performance measurement, most of the research methods are DEA and SFA methods, which can simultaneously solve a number of input-output evaluation problems, and can ensure the objectivity and fairness of the conclusions by analyzing the weight. The evaluation in DEA mode is based on the premise of optimal income, and the highest income is obtained with the lowest investment, but this is in contradiction with China's low-carbon environmental protection strategy. The SE-SBM model based on the non radial and non angular model SBM proposed by Tone can include both expected output and unexpected output. Therefore, this study uses SE-SBM model to measure the agricultural carbon emission performance.

Based on the existing research and measurement results, this paper divides the input in agricultural production activities into three parts: industrial carbon source input, domestic carbon source input, and ecological carbon source input. The output is divided into expected output and unexpected output.

(1) Input variable. ① Industrial carbon source input. Industrial carbon source input includes pesticide, agricultural film and chemical fertilizer; Methane in rice fields; Diesel oil consumed during production; Methane and nitrous oxide in intestinal fermentation and feces treatment of livestock and poultry. ② Input of domestic carbon sources. Domestic carbon sources include rural housing, gasoline, liquefied petroleum gas, natural gas and electricity. ③ Ecological carbon source input. Ecological carbon source investment includes infrastructure, roads and coal.

(2) Output variables. ① Expected output. The expected output is the disposable income of rural residents. ② Unexpected output. Unexpected output includes carbon dioxide emissions (million tons) and agricultural chemical oxygen demand (tons).

2.3. Random convergence check

Different from the traditional concept of convergence, the stochastic convergence in this case is not limited to the absolute difference in growth rate, but is a measure of whether a country's economic development level can maintain a relatively stable trajectory. In recent years, some domestic researchers have studied the development of regions using the theory of stochastic convergence. Therefore, this paper uses the stochastic convergence method to study the rural carbon emission performance in different regions of China.

3. Calculation Results and Analysis

3.1. Calculation results and analysis of total agricultural carbon emissions

In order to analyze the change of China's agricultural carbon emission performance, the total agricultural carbon emissions calculated by the corresponding data of each province in 2011-2020 are used to obtain the change of China's agricultural carbon dioxide emissions. At the same time, according to the relevant impact factors, the country is divided into five regions: the east, the middle, the west, the north and the south, so as to compare the carbon dioxide emissions of each region, and then calculate the average of the total carbon emissions of each region on this basis.

(1) From the overall trend, China's total agricultural carbon emissions in the 2011-2020 period are generally rising. Taking 2011 as the base period, the average annual growth values of the

five major regions of the east, middle, west, north and south are 0.024%, 0.007%, -0.041%, 0.029% and 0.003% respectively. Except the western region, which showed a decreasing trend, the rest of the regions showed an increasing trend, and the northern region had the highest growth rate, reaching 0.029%.

(2) From the perspective of the link growth rate, in the decade of 2011-2020, the link growth rate of the five major regions is relatively slow, and in 2013 and 2020, the link growth rate of a wide range is negative. Especially in 2020, the link growth rate of the five major regions in the east, middle, west, north and south is negative, -0.034%, -0.075%, -0.047%, -0.043% and -0.064%, respectively. According to the collection of relevant original data, the reasons for the reduction of carbon emissions in 2013 may be as follows: the Third Plenary Session proposed to "protect the ecological environment with systems"; The "National Ten Rules" launched the battle to control haze. The judicial interpretation of the "two highs" strictly cracked down on environmental crimes, and reduced the total amount of carbon emissions to a certain extent by institutional means. It can be seen that the country attaches great importance to the governance of environmental issues. In 2020, China clearly proposed the goals of "carbon peak" by 2030 and "carbon neutral" by 2060, which pointed out the direction for China's carbon emission development and had a certain impact on China's carbon emission growth rate.

3.2. Measurement results and analysis of agricultural carbon emission performance

After a simple calculation and analysis of agricultural carbon dioxide emissions, this paper makes an in-depth discussion on China's agricultural carbon dioxide emissions. The SE-SBM model is selected to measure the agricultural carbon emission performance of various regions in China.

The results show that the carbon dioxide emissions of 11 regions in 30 provinces and cities have improved significantly in the past decade, which indicates that they have gradually achieved optimization in a sense, and can achieve the control of carbon dioxide emissions on the premise of ensuring agricultural development. These 11 provinces are Henan, Anhui, Hunan, Shanxi, Zhejiang, Fujian, Sichuan, Liaoning, Shandong, Shaanxi and Guizhou, of which the central region accounts for the largest proportion. Perhaps because the central region is mostly agricultural industry, it did not pay attention to carbon emissions before 2011. In recent years, with the introduction of policies and systems, the improvement of science and technology, and the enhancement of people's ecological awareness, such problems have been better improved.

3.3. Random convergence test

In this paper, ADF Fisher, PP Fisher and KPSS panel unit root test methods are used to test the stochastic convergence of China's agricultural carbon emissions and performance. If the results pass the test at a given significance level, it is proved that there is stochastic convergence.

(1) The result of convergence test of total randomness. Three different panel unit root test methods, ADF Fisher, PP Fisher and KPSS, are used to test the random convergence of China's total agricultural emissions. If the results pass the test at a given significance level, it is proved that there is random convergence. First, the test results of the random convergence of the total amount are analyzed. The initial assumption of ADF Fisher and PP Fisher is that there is a unit root, while the original assumption of KPSS is that there is no unit root. From the test results, the P value in the ADF Fisher test is 0.263, greater than 0.05, and the original hypothesis can be rejected, that is, there is no unit root. The P value in the PP Fisher test is 0.480, less than 1, and the original hypothesis can be rejected, that is, there is no unit root. The P value in the KPSS test is 0.259, not equal to 0, and the original hypothesis can not be rejected, that is, there is no unit root. The results show that there is no unit root in the panel data of total agricultural carbon emissions nationwide, That is, there is stochastic convergence. From the regional perspective,

ADF Fisher and KPSS in the eastern region cannot reject the original hypothesis, while PP Fisher can reject the original hypothesis. Through comprehensive judgment, it is known that there is stochastic convergence in the eastern region; The ADF Fisher test value in the western region is 0.999, which rejects the original hypothesis. The PP Fisher test value is 1.000, which cannot reject the original hypothesis. The KPSS test value is 0.055, which cannot reject the original hypothesis, indicating that there is stochastic convergence in the western region; The ADF Fisher test value in the central region is 0.002, and the original hypothesis cannot be rejected. The PP Fisher test value is 0.002, and the original hypothesis cannot be rejected. The KPSS test value is 0.399, and the original hypothesis cannot be rejected, indicating that there is stochastic convergence in the central region; The ADF Fisher test value in the southern region is 0.088, rejecting the original hypothesis, the PP Fisher test value is 0.245, rejecting the original hypothesis, the KPSS test value is 0.402, and the original hypothesis cannot be rejected, indicating that there is stochastic convergence in the southern region; The ADF Fisher test value in the northern region is 0.990, which cannot reject the original hypothesis. The PP Fisher test value is 0.987, which rejects the original hypothesis. The KPSS test value is 0.033, which cannot reject the original hypothesis. According to the principle that the minority is subordinate to the majority, it indicates that there is stochastic convergence in the northern region. To sum up, there is stochastic convergence in the five regions. As time goes on, the gap in agricultural carbon emissions between the country and regions can maintain a relatively gentle path, indicating that the overall emission reduction development tends to rise.

(2) Random convergence test results of performance. The ADF Fisher, PP Fisher and KPSS three different panel unit root test methods were used to test the random convergence of China's agricultural carbon emission performance. If the results pass the test at a given significance level, it is proved that there is random convergence. The test results of random convergence of performance are analyzed. The initial assumption of ADF Fisher and PP Fisher is that there is a unit root, while the original assumption of KPSS is that there is no unit root. From the test results, the P value in ADF Fisher test is 0.321, greater than 0.05, and the original hypothesis can be rejected, that is, there is no unit root; the P value in PP Fisher test is 0.339, less than 1, and the original hypothesis can be rejected, that is, there is no unit root; the P value in KPSS test is 0.501, not equal to 0, and the original hypothesis can not be rejected, that is, there is no unit root. To sum up, It is believed that there is no unit root in national agricultural carbon emission performance panel data, that is, there is stochastic convergence. Analysis from the national and regional perspectives shows that there is stochastic convergence, which indicates that the current promotion of carbon neutral policy is very effective. In the process of developing agriculture in different regions, more and more attention is paid to the maintenance of resources and environment, so as to achieve the goal of emission reduction, which is conducive to environmental protection.

4. Conclusions and Suggestions

4.1. Conclusions

From the overall trend, the national agricultural carbon emissions showed an overall growth trend from 2011 to 2020. In addition to the decreasing trend in the western region, the other four regions show a growing trend, and the northern region has the fastest growth rate. The average annual total agricultural carbon emissions in the central region are higher than those in the other four regions, and the differences between the five regions tend to gradually decrease. From the measured performance results, it is found that the agricultural carbon emission performance of the central, eastern, western, northern and southern regions is indeed different, and the difference fluctuates greatly. Only the western region has generally stable carbon emission performance, which is generally about 1.000. The eastern, northern and southern regions have obvious fluctuations in performance, and the most obvious is the southern region. After the random convergence test of the total amount and performance respectively, the results are close to each other. In terms of total amount, whether from the national perspective or regional single analysis, there is stochastic convergence. The performance results show the same results.

4.2. Suggestions

Based on the above research results, this paper gives the following opinions:

(1) Promote carbon emission reduction with scientific and technological progress. China should take scientific and technological progress as the engine for reducing carbon emissions in rural areas, not only to reduce carbon dioxide emissions, but also to ensure the output of agricultural products and improve the living standards of farmers. To achieve this goal, we must rely on the development of science and technology. The popularization of technology will promote the construction of green villages and energy conservation and emission reduction. The focus of the research is on agriculture, such as how to reduce carbon emissions of no tillage technology in the process of land planting. These technologies are only suitable for large-scale agriculture and are not suitable for large-scale application. In addition to production, new technologies and technologies must also be introduced into people's daily life to reduce carbon dioxide emissions, so as to improve people's satisfaction with the environment and reduce carbon dioxide emissions.

(2) Promote carbon emission reduction with policy guidance. Take relevant measures to encourage farmers to use more clean resources to replace high carbon consumption. For example, reduce the consumption of traditional energy such as coal and oil, use more liquefied petroleum gas and natural gas, and improve their utilization in rural areas. Make use of relevant subsidy policies to actively promote them nationwide. While natural gas has become the main energy in rural areas, some mature and well developed regions can also introduce relevant support measures, such as solar cells. It is possible to study and formulate agricultural product emission reduction policies that are coordinated between different regions but in China, reducing the cost of formulation in a sense, and narrowing the gap in agricultural product emissions between the five regions.

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