Measurement of the Impact of Fiscal Decentralization on Carbon Emission Based on STIRPAT

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Abstract. Fiscal decentralization is an important factor impacting on carbon emission. Based on model and the SPIRPAT model, the impact of fiscal decentralization on carbon dioxide emission in China is discussed. Four indicators reflecting the degree of fiscal decentralization are adopted respectively to evaluate the influence. The results show that all of four different indicators characterizing the degree of fiscal decentralization have a significant positive effect on carbon emission. As the improvement of local government fiscal autonomy, the government has to sacrifice public goods with positive environmental externalizations to support the development of the high carbon industries.

Introduction

Since the reform and opening up, China has entered a period of rapid development and made remarkable economic achievements. However, the extensive economic development results in uncontrolled emissions of greenhouse gases and the destruction of the ecosystem. With the development of China's economy, the disposable expenditure of local governments increases gradually, and local finance gradually has higher authority. But at the same time, local government officials need to be assessed by the central government, and the assessment results become an important indicator of personal promotion. Therefore, faced with the environmental protection policies issued by the central government and the personnel system with economic growth as the main assessment index, local governments are easily encouraged to choose the development strategy to promote local economic growth, while ignoring local environmental problems.

There are few studies on the effect of fiscal decentralization on carbon emissions in China. Yang Ruilong (2007) first started to study this field, based on the provincial panel data from 1999 to 2006 and using dynamic panel data model, he had found that the improvement of fiscal decentralization can result in a decline in the quality of the local environment. Huang Guobin and Zhou Yan (2014) introduced "the degree of fiscal autonomy" indicator; Zhang Xinyi (2014) had discussed the government behavior and environmental pollution under the fiscal decentralization. It found that the competition of the local government in our country has an inhibitory effect on the environmental pollution to some degree, while the system of central transfer payments didn't has a positive effect on the improvement of environmental pollution in the background of fiscal decentralization. In order to improve the effectiveness of the regression parameter estimation, this paper takes into account the factors of fiscal decentralization on carbon emissions from four indicators and analyzes the impact in a more comprehensive way.

Variables Selection and Construction of STIRPAT

Variables Selection

Local governments can make targeted investment attraction according to the characteristics of local economic structure, so as to increase the regional fiscal revenues rapidly, thereby strengthening environmental management, such as increasing the introduction of high carbon enterprise low carbon
equipment, research and development and technical personnel training, so as to reduce carbon emissions level. Then the meanings of the variables are shown in Table 1:

Table 1. Variables and the meanings.

| Variables                      | Variables Symbol | Meanings                                                                 |
|--------------------------------|------------------|-------------------------------------------------------------------------|
| Fiscal decentralization        | ln(fde1)         | Provincial general budget revenue at the corresponding level/General fiscal revenue at the local level in the central budget |
|                                | ln(fde2)         | Provincial general budget expenditure at this level/General fiscal expenditure at the level of central budget |
|                                | ln(fde3)         | Provincial general budget revenue at the corresponding level/General budget expenditure |
|                                | ln(fde4)         | Provincial per capita fiscal expenditure/Per capita central fiscal expenditure |
| Carbon emissions               | ln(ce)           | Per capita carbon emissions in each province                            |
| Economy growth                 | ln(gdp)          | In order to obtain the real value of per capital GDP, the GDP per capita of each province from 2003 to 2016 is reduced by using the GDP index of each province. |
| Investment in fixed assets     | ln(inv)          | The fixed assets investment from 2003 to 2016 in each province are used and the fixed assets investment price index is used to reduce. |
| Industry structure             | ln(is)           | In order to promote the development of local economy rapidly, local governments tend to develop the secondary industry and promote the growth of local economy. |
| Foreign direct investment      | ln(fdi)          | FDI is characterized by the completed amount of foreign direct investment (FDI) in each province and the final regional GDP is reduced by the index of regional GDP to offset the effects of price changes. |
| Investment in technology       | ln(it)           | The number of government investment in technology, including the potential modification of enterprises and local fiscal expenditure on science and technology indicators are used to represent the data. |
| Foreign trade                  | ln(ft)           | Use the volume of total import and export of each province to show the degree of opening |
| population                     | ln(po)           | The total population data at the end of the year is from the website of the National Bureau of Statistics of China. |

Construction of STIRPAT

Taking the logarithm of the basic STIRPAT model on both sides and introducing a variety of economic and social explanatory variables, the static balance panel data model is set as:

\[
\ln \text{ce}_t = \beta_1 \ln \text{gdp}_t + \beta_2 \ln^2 \text{gdp}_t + \beta_3 \ln \text{fde}_t + \beta_4 \ln \text{is}_t + \beta_5 \ln \text{inv}_t + \beta_6 \ln \text{gdp}_t + \beta_7 \ln \text{fdi}_t + \beta_8 \ln \text{ft}_t + \beta_9 \ln \text{po}_t + \mu_t + \varepsilon_t
\]

Regression Results and Analysis of the Model

First of all, the selection of panel data model is tested, and the results of Housman test and the regression are shown in Table 2.
Table 2. Results of test and the regression.

|                | Model 1 | Model 2 | Model 3 | Model 4 |
|----------------|---------|---------|---------|---------|
| F-statistic    | 61.12   | 60.69   | 61.91   | 61.08   |
| Housman statistic | 32.84   | 31.48   | 30.61   | 32.64   |
| ln(fde1)       | 0.1619**|         |         |         |
| ln(fde2)       |         | 0.1723* |         |         |
| ln(fde3)       |         |         | 0.3564***|         |
| ln(fde4)       |         |         |         | 0.1588***|

Note: *, **, *** mean significant at 1%, 5% and 10% respectively.

It can be seen from the regression results that the degree coefficient of financial power is positive in the four models. Comparing the four models, the model 3 has the highest degree of goodness of fit. So the results of STIRPAT model is:

\[
\ln ce_{it} = -5.33 \ln gdp_{it} + 0.39 \ln^2 gdp_{it} + 0.35 \ln fde_{it} + 0.36 \ln is_{it} + 0.19 \ln inv_{it} - 0.10 \ln it_{it} \\
+ 0.084 \ln fdi_{it} - 0.09 \ln ft_{it} - 0.70 \ln po_{it}
\]

The higher the ratio of subsidies, the more the part of regional fiscal revenues can be used for the fiscal expenditure at this level and the lower dependence on the central government, so the higher the fiscal autonomy of the region. In addition, the regression coefficient values of fis1, fis2 and fis4 are significantly lower than the repression coefficient values of the fis3, indicating that the ration of the central fiscal revenue and expenditure and the local fiscal revenue and expenditure to show the regional fiscal decentralization is weaker in the calculation. Although the four models use different fiscal decentralization indicators, the conclusions we obtained are consistent, that is, the degree of fiscal decentralization has a noticeable positive impact on regional carbon emissions. It can be indicated that under the existing fiscal system in China, the increase in the degree of decentralization will have an inhibit effect on environmental improvement to some degree.

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