A TEST OF SPATIAL SPILLOVER WITH ECONOMIC CONCENTRAYTION ON CHINA'S SMOG POLLUTION

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Overview

The National Development and Reform Commission clearly pointed out in the "Key Tasks of New Urbanization Construction in 2019" to accelerate the development of urban-rural composition and narrow the gap between urban and rural development. At the same time, the rapid urbanization process has also led to a series of environmental problems. Population agglomeration and economic concentration have caused increasingly serious smog pollution, posing a major threat to human health. Analysis of the factors affecting the degree of smog pollution in the process of economic development has practical significance for the control of haze. Our paper adopts the spatial panel data measurement model. Based on $PM_{2.5}$ concentration data in 27 provinces of China from 2007 to 2016, and taking into account direct effect and spatial spillover effect of smog pollution. We have innovatively added the Theil index as a measure of economic concentration to study the relationship between regional development imbalances and smog pollution due to regional economic concentration.

Methods

Anselin (1988) proposed a spatial econometric model, which was later widely used in the study of the relationship between economy and environment (Grossman&Krueger, 1991. Zhang Xiao, 1999). The dynamic spatial panel data model was used to study the dependencies among variables in order to explore the spatial effects of cross-regional smog pollution (Elhorst, 2012. Shao Shuai et al., 2016). Building on the concept of dynamic spatial panel data model, this paper aims to explore the determinants of smog pollution in China. The measurement model is set as follows:

$$PM_{it} = E_{it} + S_{jt} - S_{it}$$

E_i is the actual emission of PM2.5 in Region i, S_j represents the amount of PM2.5 diffused from other regions; S_i indicates the amount of PM2.5 emitted locally but diffused to other regions, which therefore has no impact on smog pollution locally. t is the year. In [3], $S_{jt} - S_{it}$ indicates the dependence of spatial effect. When static panel data is used, $S_{jt} - S_{it} = \rho \sum_j w_{ij} PM_{jt}$; the spatial error is characterized by $S_{jt} - S_{it} = \mu_{it} = \lambda \sum_j w_{ij} \mu_{it} + \varepsilon_{it}$.

Under the characteristics of spatial dependence and spatial error, the measurement model is as follow

$$PM_{it} = \alpha X_{it} + \rho \sum_j w_{ij} PM_{jt} + u_{it}$$

$$PM_{it} = \beta X_{it} + \lambda \sum_j wi_j \mu_{it} + u_{it} + \varepsilon_{it}$$

And our paper used the Theil index to measure the income gap between regions. As a measure of regional disparity, the Theil index describes the degree of regional disparity by calculating the degree of economic aggregation within a region. The Theil index is calculated as follows:

$$Y_K = \frac{X_K}{\sum_{K=1}^{L} X_K}$$

$$Y_{Ki} = \frac{X_{Ki}}{X_K}$$

Where, Y_K and Y_{Ki} respectively represent the total economic of Region K and the economic share of Individual *i* in the region's total; X_K and X_{Ki} represent the total income of Region *K* and the income of Individual *i* in the region; *L* indicates the number of regions studied.

And then, the spatial spillover effect can be expressed as:

$$\alpha_j \sum_{q=1}^{\infty} \rho^q = \frac{\alpha_j \rho}{1-\rho}$$

Where, *q* is the number of regions adjacent to Region *i*. The total effect is the sum of direct effect and spatial spillover effect:

$$\alpha_j + \alpha_j \sum_{q=1}^{\infty} \rho^q = \frac{\alpha_j}{1-\rho}$$

With equations [9] and [10], we can determine the direct effect, spatial spillover effect and total effect of different determinants of PM2.5 concentration in different regions.

Results

Our paper calculates the Theil index of all provinces in China. Then, based on the spatial panel data measurement model, the calculations are used to explore the impact of regional economic concentration on smog pollution. This paper also calculates the direct effect and spatial spillover effect of smog determinants The empirical research results show that (1) The regional development imbalance has a significant negative effect on $PM_{2.5}$ emissions. So we believe that accelerating urbanization and increasing regional economic concentration are conducive to the improvement of environment. (2)In addition, the inverted "U" relationship between smog pollution and economic development has not been confirmed in our paper. There is no environmental Kuznets curve inflection point in China.(3)But economic development is negatively correlated with $PM_{2.5}$ concentration, as per capita GDP increases, the level of smog pollution continues to decline. (4)The higher the proportion of secondary industry output to regional GDP, the more serious smog pollution in the region.

Conclusions

So,promoting industrial upgrading and optimizing industrial structure are important measures to control smog pollution. At the same time, reducing the consumption of coal and increasing the proportion of R&D personnel in the region can effectively reduce the concentration of $PM_{2.5}$. As the culprit of smog pollution degree, $PM_{2.5}$ presents significant spatial positive correlation in China at present. Highly polluted areas are mainly concentrated in the central and eastern parts of the north. Spatial spillover effects account for a higher proportion of total effects, so if we want to reduce the level of regional smog pollution, we need joint management in the surrounding areas.

And considering that smog has a significant spatial spillover effect, air quality can be improved only when coordinated cross-regional measures for smog control are adopted. Different regions should speed up efforts to reach a consensus on smog control and jointly formulate environmental control programs to address air pollution. Only with coordinated programs and concerted efforts to promote ecological civilization can China make sound progress in smog control.

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