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Impact and spatial spillover effect of transport infrastructure on urban environment

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Abstract

This paper expounds the influence of transport infrastructure on environment as spatial agglomerative, economic growth, innovation and technology diffusion effects. Within the STIRPAT model, we use a spatial Durbin model to estimate the impact of transport infrastructure on the environment in 281 Chinese cities during 2003−2013. The results show that transport infrastructure, technical progress, and energy intensity have negative direct effects on urban environment. Additionally, we find an inverted U-shaped curve relationship between GDP per capita and urban environment. As spatial effect, transport infrastructure has negative impacts, while technical progress has a positive effect.

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Keywords: transport infrastructure; STIRPAT model; urban environment; spatial spillover effect

1. Introduction

Since its reform and opening up policy, China has made great achievements in the construction of transport infrastructure. However, with the advance of urbanization and industrialization in China, environmental pollution problems cannot be ignored. As amassing spaces for both population and industry, cities are also facing environmental pollution in this process of construction and development. Although transport infrastructure construction reduces transportation costs, promotes the centralization of population and economy, spatial agglomeration of population and economy, and urbanization also has impacts on the urban environment. Therefore, the effect of transport infrastructure and its channels of influence on urban environment need to be determined.

Currently, scholars mainly study the influence of transport infrastructure on economic growth, total factor productivity, and agglomeration. For example, Zhang [1] finds that transport infrastructure

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investment has positive impacts on economic growth. Bronzini and Piselli [2] discover that the improvement of transport infrastructure has a positive effect on total factor productivity of the region. Liu [3] argues that transport infrastructure would cause agglomeration effects in cities.

Current research on energy and environment is primarily focused on the impact of energy consumption and energy structure. For instance, Xu et al. [4] decompose energy consumption into the effects of energy structure, energy intensity, and industrial structure. Wang et al. [5] find that there is a bidirectional causality between energy consumption and CO_2 emission. Zheng et al. [6] identify that the increase of energy caused by road transport would lead to greenhouse gas emission.

Recently, the STIRPAT model has been widely used in energy environment research as follows. Shi [7] finds that population change was the main factor affecting global carbon emissions, and Fan et al. [8] find that the impact of different income levels on carbon emissions was significantly different. Moreover, Wang et al. [9] study the urbanization, economic development, and industrialization levels with positive effects on carbon emissions in Beijing. Liu et al. [10] study the driving factors of China's industrial pollution emissions, and the results support the environmental Kuznets curve (EKC) hypothesis.

Although many scholars at home and abroad have conducted in-depth research on the economic effects of transport infrastructure, there are limited studies on the environmental effects of transport infrastructure. As such, this paper is based on the STIRPAT model, using data on 281 Chinese cities during 2003-2013. First, we elaborate the mechanism of transport infrastructure influence on environment. Second, we analyze the spatial correlation of the urban environment in China. Subsequently, we use a spatial Durbin model to estimate transport infrastructure on urban environment and its spatial spillover effects.

2. Mechanism analysis

This paper reviews the economic effect of transport infrastructure and highlights that transport infrastructure affect urban environment as follows (see Figure 1). First, regarding the spatial agglomerative effect, Krugman [11] believes transportation cost reduction would concentrate the industry in a region, forming a "center periphery" model and generating spatial agglomeration. However, the impact of agglomeration on environmental pollution is still controversial. The agglomeration of economic activity will lead to crowding, and increase environmental pollution [12]. Agglomeration is conducive to reducing the level of pollution in the unit [13].

Second, the economic growth effect shows that the new economic geography theory [14] points out that improvement of transport infrastructure would generate economies of scale through trade expansion within regions, and economic growth effects. Furthermore, transport infrastructure investment also has positive impact on economic growth [1]. The relationship between economic growth and environmental pollution take the shape of an “inverted U.”

Third, innovation and technology diffusion effect. Transport infrastructure construction has a significant positive impact on total factor productivity [3], which enhances the technical level as well. Meanwhile, technical progress exhibits strong “path dependence” [15].

3. Model and data

3.1. Model specification

Dietz and Rosa [16] reformulate the IPAT model in a stochastic form. The specification of the STIRPAT model is:

$$I_i = aP_i^b A_i^c T_i^d e_i , \quad (1)$$