Study on the Economic Impact of the Opening of High-speed Rail on First-Tier Cities Based on Fixed Effect Model and Stata15.0 Model Processing Software

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Abstract

High-speed rail plays an important role in promoting the flow of economic factors and promoting urban economic development. Taking the Beijing Guangzhou railway, which runs the longest in the world and connects five first-tier cities, as an example, this paper studies the economic impact of the opening of high-speed railway on first-tier cities. In this paper, the fixed effect model of panel data and Stata15.0 model processing software are used for data processing and analysis. Through the national and urban statistical yearbook, the data of economic development, labor force, industrial structure, and government intervention degree of five first tier cities along the Beijing Guangzhou high-speed railway from 2008 to 2017 are collected and sorted. The panel data are processed through Stata15.0 model processing software. Through the analysis of the results, the hypothesis of random effect model is rejected, the fixed effect model is used to study the economic impact of the opening of high-speed rail on first-tier cities. Through the above data processing, it is concluded that the opening of Beijing Guangzhou high-speed railway improves the accessibility between first-tier cities, improves the quality of economic development, has no significant impact on the labor process of first-tier cities, and has a positive and significant impact on the economic development of first-tier cities. Put forward relevant suggestions according to the research conclusions to promote China's overall economic development.

Keywords- *opening of high-speed railway; economic development Panel data; Fixed effect model; Stata15.0 model processing software*

1. INTRODUCTION

The opening of high-speed railway will promote the flow of resources in cities along the line and have a certain impact on economic development. High speed rail has become an important driving factor in urban economic development. First tier cities are the cities that built high-speed rail earlier in China, and their more developed urban strength is the premise of building high-speed rail. At the same time, the opening of high-speed rail has brought rich flow of economic factors, which has a certain impact on the economic development of the city. Beijing Guangzhou high speed railway is one of the high-speed passengers dedicated lines in operation in China. It has become the longest high-speed railway in the world. From Beijing West Railway Station, Beijing Guangzhou high-speed railway passes through first tier cities such as Zhengzhou, Wuhan, Changsha, and Guangzhou. Among them, Beijing and Guangzhou are first tier cities, and Zhengzhou, Wuhan and Changsha will be designated as new first tier cities in 2020. As important high-speed railway lines in China, its operation and opening will have a certain impact on the economic development of first tier cities along the line.

The opening of high-speed railway generally has obvious siphon, polarization, and diffusion effects on the cities along the line, especially the first-tier cities. Therefore, the opening of the high-speed railway does not only have a positive driving effect on the flow of economic factors and economic development of the first-tier cities along the line.

The development of the first-tier cities along the Beijing Guangzhou high-speed railway is at different levels and stages, and the economic development level is not quite similar. The economic factors in the first-tier cities will show different reactions to the opening of the high-speed railway. According to the above situation, this paper takes Beijing Guangzhou high-speed railway as an

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example to study the impact of high-speed railway operation on the economy of first tier cities along the line?

By summarizing the research background and problems, this paper understands the relationship between the opening of Beijing Guangzhou high-speed railway and the economic development of first tier cities, studies whether the opening of high-speed railway will have an impact on first tier cities and the degree of impact, and provides relevant suggestions according to the results: 1. Understand the impact of the opening and operation of high-speed railway on the economic development of first tier cities; 2. Analyze whether the impact of the opening of high-speed rail on the economy of first tier cities is positive or negative, and the specific impact degree; 3. According to the research results and relevant literature, provide relevant suggestions for the first tier cities along the line to make full use of the opening conditions of high-speed rail for development.

This paper selects the Beijing Guangzhou high-speed railway, which passes through many first-tier cities and plays an important role in China. Based on this situation, this paper makes a more specific empirical research, hoping that the research results will provide relevant suggestions for the first-tier cities to make efficient use of the resources brought by high-speed rail, to promote the economy of first tier cities to achieve a higher level of development under the action of high-speed rail.

2. Literature Review

High speed railway is an important driving force for China's national economic development and urban connection, and plays an important role in economic and social development. Through reading the existing literature, it is found that scholars have studied the relationship between the opening of high-speed railway and urban economic development, but the research conclusions have not been reached. The research conclusions mainly include the impact and no impact of the opening of high-speed railway on urban economic development.

2.1. The Opening of High-speed Railway Has an Impact on Urban Economic Development

The opening of high-speed rail can promote the economic development of cities along the line. By improving the accessibility between cities, it can promote the flow of various economic elements between cities and optimize the time and space allocation of resources, to drive economic development. You, S. B. and Zheng, L. C. collected panel data from 12 medium-sized cities in Hunan Province from 2005 to 2013. Through empirical analysis, they found that high-speed rail may promote economic growth by increasing tourism and attracting tourists. The opening of high-speed rail has played a significant positive effect on the GDP growth of medium-sized cities in Hunan Province [1]. Dong, Y. M., Zhu, Y. M. proposed that the opening of high-speed railway construction directly or indirectly affects regional employment and wages, to expand the space for economic development, reshape China's economic space, and promote economic growth by promoting urban and regional employment. Some scholars have found that high-speed rail has different effects on the economic development of different levels of cities [2]. Through the research on British railways, Héctor, S., Martínez, S.M., Moshe, G. found that the construction of high-speed railway will be affected by political factors to a large extent, which will have an adverse impact on the surrounding small cities, weaken the geographical advantages, and lead to negative economic development [3].

2.2. The Opening of High-Speed Railway Has No Impact on Urban Economic Development

Some scholars believe that the opening of high-speed rail has no significant impact on urban economic development. Using the data of 287 prefecture level cities and above in China from 2006 to 2010, Wang, Y., Nian, M. empirically tested that the opening of high-speed rail has not played a leading role in promoting the development of cities and regions along the line under the background that China's overall economic development has entered a slowdown stage [4]. Chen, C., Tiziana, D., Guo, H. X., Jiang, C. M. studied the development of China's high-speed rail from 2003 to 2014. Through analysis, it is found that the expansion of high-speed rail lines tends to be low altitude, densely populated, and economically developed, and has a low impact on economically backward areas [5].

2.3. Literature Review

At present, some scholars in China have studied the impact of the opening of high-speed railway on urban economic development, but there are some differences in the research results. Some scholars believe that after the opening of high-speed railway, it will drive the development of related industries through economic factors, to promote economic development; Other scholars believe that the opening of high-speed rail has no significant impact on economic development in the short term. Most of the existing studies have studied the economic development of cities at different levels or cities in a certain region along the high-speed railway, and there is no targeted study on the economic situation of cities with a certain level. Based on the existing articles, this paper selects the Beijing Guangzhou high-speed railway running through the north and south of China to study the impact of the opening of the line on the economic development of the first-tier cities along the line, to make the research results more targeted and improve the credibility.

3. An Empirical Analysis Of The Impact Of Yhe Opening Of Hgh-speed Rail On The Economy Of First Tier Cities

The Beijing Guangzhou high-speed railway was successively opened from Wuhan Guangzhou section, Zhengzhou Wuhan section and Beijing Zhengzhou section. The Wuhan Guangzhou section of the south section was first opened to traffic on December 26, 2009. The Zhengzhou Wuhan section was opened to traffic on September 28, 2012, and the Beijing Zhengzhou section was put into operation on December 26, 2012. The Beijing Guangzhou high speed railway was put into operation on December 26, 2012. This paper takes the first-tier cities along the Beijing Guangzhou high-speed railway as the research object. The first-tier cities in the stations where the Beijing Guangzhou high-speed railway passes include Beijing, Zhengzhou, Wuhan, Changsha, and Guangzhou. Taking these five cities as the object, this paper collects the economic development status from 2008 to 2017, and analyzes the impact of the opening of high-speed railway on the economic development of these five first tier cities.

3.1. Data Collection and Variable Selection

The economic data used in this paper are from the "National Statistical Yearbook 2008-2017" and the statistical yearbook of the corresponding year of the studied city. Based on the relevant literature, and considering the availability of data, this paper uses per capita GDP as the explanatory variable to measure the economic development of the study area. In the selection of control variables, the main factors determining the level of economic development in Cobb Douglas production function are adopted. After combining with the actual situation, three variables are selected: "the number of labor force invested", "industrial structure" and "the degree of government intervention". In order to eliminate heteroscedasticity, the logarithm of per capita GDP is taken to make the regression results more accurate as far as possible. See table 1 for specific variable selection.

TABLE 1. VARIABLE DESCRIPTION

Variables	Variable description	Variable processing method and description
LnperGDP	The per capita GDP is taken as the natural logarithm	The real per capita GDP of each first-tier city is taken as the natural logarithm
G	High speed rail factor	Take 1 after the Beijing Guangzhou high speed railway is put into operation, otherwise take 0
Labor	Labor level	City year-end employees / City year-end resident population
Structure	industrial structure	Output value of tertiary industry / output value of secondary industry
Government	Degree of government intervention	Government expenditure of first tier cities / GDP of the whole city

The above table clearly describes the selection of variables and processing methods.

After sorting out the collected data, it is found that there are some differences in various variables among the five first tier cities, among which the difference in industrial structure is the largest, and the difference between the maximum value and the minimum value is 3.55 units, indicating that even if they are the same first tier cities, there are differences in economic development structure; The difference in the degree of government intervention is small, and the difference between the maximum and minimum is 0.17 unit, indicating that the government plays a certain role in the first tier cities. To sum up, there are some differences in economic development levels between first tier cities. Under the same development level but different development levels, there is a more obvious comparison in the research on the economic impact of the opening of high-speed rail, and the research results are more authentic and credible.

3.2. Model Design

The data of different variables in five first tier cities in different years are collected to form panel data, that is, multiple variables are selected in the time series, and the sample data composed of sample observations are selected among these variables. If the cross-sectional data or time series data alone cannot meet the needs of analysis, the two are combined to a certain extent, Make full use of as much sample information as possible.

According to the characteristics of panel data, intercept panel data model is constructed, which includes fixed effect and random effect. The specific models are

as follows. This paper will deal with the fixed effect and random effect of panel data model respectively.

$$LnperGDP_{it} = \alpha_i + \beta_i G_{it} + \theta_i X_{it} + \mu_{it} \quad (1)$$

$$i = 1, \dots, n \qquad t = 1, \dots, t$$

i represents each year, t represents each city, $LnperGDP_{it}$ represents the natural logarithm of the per capita GDP of the first-tier cities in the i-th year, G_{it} is the high-speed rail data of the t first tier cities in the i-th year. It is 1 after the high-speed rail is put into operation and 0 before it is put into operation, X_{it} is the control variable data of the t first tier cities in the i-th year, μ_{it} stands for the error term.

3.3. Results and Analysis

According to the grade of stations and cities along the Beijing Guangzhou high-speed railway, five first tier cities of Beijing, Zhengzhou, Wuhan, Changsha, and Guangzhou are selected, the data of 2008-2017 before and after the opening and operation of the high-speed railway are selected, and stata15.0 is used for data processing to analyze the economic impact of the opening of the Beijing Guangzhou high-speed railway on the first-tier cities along the line.

Through stata15.0 model processing software, the type of panel data model related to economic development and the opening of high-speed railway is determined by Hausman test. Its principle is to compare whether there is difference in parameter estimation under random effect and fixed effect. If the difference is significant, it is considered that fixed effect should be used, and robust priority should be given. If it is not significant, it is considered that random effect should be used. After treatment, at the significance level of 1%, the p value of Hausman test result = 0.0000 < 0.01, rejecting the original hypothesis, that is, the model is random effect and selecting fixed effect.

Stata15.0 model processing software is used to process the data related to economic development and the opening of high-speed rail from 2008 to 2017. The results are shown in table 2.

TABLE 2. FIXED EFFECT RESULTS OF ECONOMIC DEVELOPMENT AND HIGH-SPEED RAILWAY OPENING DATA

VARIABLES	Model
G	0.252***
	(0.0744)
Labor	-0.605*
	(0.327)
Structure	-0.168
	(0.165)
Government	10.67***
	(2.632)
Constant	10.36***
	(0.304)
Observations	50
Number of cities	5
R-squared	0.754

Note: *, * * and * * * respectively indicate that they have passed the significance test at the level of 10%, 5% and 1%.

After processing, the fixed effect of the panel data on economic development is 0.754, and the correlation coefficient between economic development and explanatory variable is 0.252, which passes the significance test at the level of 1%; F test is 31.44, $Prob > F = 0.0000$, indicating that the model is significant. Through the above analysis, the opening of high-speed railway is positively correlated with economic development. The opening of Beijing Guangzhou high-speed railway will increase the economy of first tier cities along the line by 0.252%, that is, the opening of high-speed railway will promote the economic development of first tier cities.

3.4. Heterogeneity Analysis

The heterogeneity analysis in this paper mainly regresses and compares the research on the opening of high-speed rail and economic development in five cities. The results are shown in table3.

TABLE 3. MODEL RESULTS OF FIVE CITIES

VARIABLES	Beijing	Zhengzhou	Wuhan	Changsha	Guangzhou
G	0.0229	0.123	0.0807	0.350***	0.0304
	(0.0710)	(0.0767)	(0.0823)	(0.0460)	(0.155)
Labor	-10.74*	-0.558	5.698**	11.83***	0.205
	(4.382)	(0.517)	(1.591)	(1.512)	(0.349)
Structure	1.139**	-0.316	0.239	1.506***	0.581**
	(0.409)	(0.490)	(0.214)	(0.188)	(0.218)

Government	-4.095	12.37***	6.890	7.878**	3.417
	(4.017)	(2.919)	(4.682)	(2.438)	(5.122)
Constant	14.00***	9.970***	6.643***	1.806	9.897***
	(1.765)	(0.258)	(0.516)	(0.941)	(0.628)
Observations	10	10	10	10	10
R-squared	0.970	0.974	0.989	0.993	0.930

Note: *, * * and * * * respectively indicate that they have passed the significance test at the level of 10%, 5% and 1%.

It can be seen from the above table that the economies of the five cities have increased to a certain extent under the influence of the opening of high-speed railway, but the growth rates are different: Changsha has the highest economic growth degree affected by high-speed railway, while Beijing has the lowest. After analysis, this paper believes that the impact of the opening of high-speed rail on the economic development of first tier cities is related to the development degree of the city itself: when the city develops to a high degree, although high-speed rail still promotes economic growth, the effect will be weak; When the urban economic development level is slightly low, the driving effect of the opening of high-speed railway on economic development is more obvious.

4. Conclusions And Recommendations

On the basis of summarizing and learning the research results of domestic and foreign scholars, this paper collects and sorts out the panel data of five first tier cities along the Beijing Guangzhou high-speed railway from 2008 to 2017, establishes a fixed effect model, processes the data with stata15.0, studies and analyzes the impact of the opening of high-speed railway on the economic development of first tier cities according to the results, and obtains relevant conclusions and suggestions.

4.1. Main Research Conclusions

The opening of Beijing Guangzhou high speed railway has significantly improved the accessibility between the first-tier cities along the line, facilitated exchanges in all aspects, improved accessibility between cities along the line, facilitated exchanges between first tier cities, further strengthened the core position and role of first tier cities, and promoted the flow and efficient use of information, technology, capital, labor, and other factors. The opening of high-speed rail has strengthened the exchanges between the stations and cities along the line, especially the first-tier cities have relatively perfect resources, which has a siphoning effect on the economic development of surrounding cities. The opening of Beijing Guangzhou high speed railway will improve the level of tertiary industry agglomeration along the line, promote the upgrading of industrial structure of first tier cities along the line, and ensure the quality of economic development. The opening of Beijing Guangzhou high speed railway has a certain impact on the labor flow of first tier cities along the line, but the degree of impact is not obvious.

4.2. Relevant Suggestions

Strengthen the construction of transportation infrastructure represented by high-speed rail. Promote the construction of urban supporting service facilities and improve the utilization rate of factors. Reasonably carry out industrial layout planning and optimize the industrial structure along the high-speed railway. Build an intercity rapid development channel and expand the radiation effect of high-speed rail.

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