Influence of Opening High-Speed Railway on Economic Growth

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Abstract: In this paper, 280 cities on the eight vertical and eight horizontal high-speed railway lines in China are taken as samples, and the GDP and other related economic indicators of each city before and after the opening of high-speed railway from 2000 to 2019 are selected to study the impact of the opening of high-speed railway on urban economic growth through regression analysis. Moreover, the data are grouped according to city level and region and the heterogeneity test is carried out, which enriches the conclusion of this paper. The final empirical results show that the opening of high-speed rail has a positive role in promoting urban economic growth.

1 INTRODUCTION

With the rapid development of China's economy and society, high-speed rail has become an important engine of local economic development and an important choice for people to travel. The opening of the high-speed railway not only promotes the development of local economy, but also is an important opportunity for local economic development. With the improvement of China's social and economic situation, the opening of high-speed rail has promoted the division of labor and cooperation among various industries, realized the industrial upgrading and structural adjustment of urban construction, and made positive contributions to the development of cities in China. Throughout the history of high-speed rail development, it can be found that the opening of high-speed rail has an important impact on the development of a city or region. China has classified the construction of high-speed rail as an important part of national construction, and at present, it has initially formed a "four vertical and four horizontal" rapid passenger transport network. High-speed rail plays an important role in China's economic and social development.

Judging from the policies issued by the state and the overall development trend, China pays more and more attention to "high-speed rail economy". China's high-speed railway not only shows China's speed and technology to the world, but also accelerates its pace of going abroad. In recent years, China's high-speed railway has achieved rapid development. In the past 12 years, China has built the world's largest high-speed railway network with a length of 18,000 kilometers. With its advanced technology and brilliant achievements, China High-speed Railway has won the recognition of the world, made great contributions to the construction of the belt and road initiative, and has become a beautiful business card made in China.

This paper studies the impact of China's high-speed railway on urban economic growth, from both theoretical and empirical aspects. First of all，it analyzes the theory of the impact of high-speed railway on urban economic growth, and then makes a regression analysis of the impact of high-speed railway on urban economic growth. Through the analysis, it is known that the opening of high-speed rail has a positive role in promoting urban economic growth.

2 LITERATURE REVIEW AND THEORETICAL ANALYSIS

Dong Yanmei and Zhu Yingming (2016) used PSM-DID method to study the impact of high-speed rail on China's economic growth in 2010-2014, pointing out that high-speed rail is an important

measure to promote efficiency and fairness.However, some scholars believe that the opening of high-speed rail has negative effects on urban economic growth. In the research of Zhang Ke Zhong (2016), he proposed that in terms of the economic structure of cities with and without high-speed rail, the opening of high-speed rail can cause changes in the flow and direction of production factors，such as the labor and other factors. Therefore, under the action of agglomeration, the economic gap between cities that have opened high-speed rail and those that have not will continue to widen.

In this paper, the literature review of the economic impact of the opening of high-speed rail is comprehensive, and only the favorable literature is reviewed without avoiding the important ones. Therefore, it can effectively provide relevant support for the following empirical analysis and test.

The main analysis of this paper is based on the theories of investment pulling effect and agglomeration effect. Based on the above literature review and theory, we put forward the hypothesis:

H1: The opening of high-speed rail has a positive role in promoting the growth of urban economy.

3 RESEARCH DESIGN

3.1 Data Source

The data in this paper come from CSMAR and high-speed railway network, and the model is checked by Excel and Stata15.0. Based on the layout of eight vertical and eight horizontal high-speed railway lines, the cities along the high-speed railway lines from 2000 to 2019 were selected as samples. Excluding the cities with incomplete and missing sample data, a total of 5035 groups of valid sample data were obtained from 280 cities along the route.

3.2 Variable Definition

The explained variable in this paper is the GDP of each prefecture-level city at the end of each year, and the GDP of each prefecture-level city at the end of each year can better represent the economic growth of each prefecture-level city.

The core explanatory variable of this paper is the opening of high-speed railway (HW). As for the value of high-speed rail opening variable, this paper deals with it as follows: if the high-speed rail is opened for the first time in a certain place in a certain year, the explanatory variables of that place in that year and the following years are all set to 1, otherwise, the value is 0.

This paper selects the following control variables: (1) Population growth rate (PR), which is measured by the year-end population growth rate of each prefecture-level city; (2) Foreign investment level (FI), measured by the amount of foreign investment at the end of each prefecture-level city; (3) The amount of capital growth (FA), measured by the new fixed asset investment of each city; (4) The size of the government (Fin), measured by the fiscal expenditure in the general budget.

Table 1: Variable definition.

Type	Variable	Variable explanation	Calculation method
Explained variable	GDP	Gross Domestic Product	Gross domestic product of prefecture-level cities at the end of each year
Explanatory variable	HW	Opening of high-speed railway	Open =1, not open =0
Control variables	RP	Population growth rate	Year-end population growth rate of prefecture-level cities
	FI	Foreign investment level	Amount of foreign investment at the end of each prefecture-level city
	FA	Capital appreciation	New investment in fixed assets in each city
	Fin	Government scale	General budgetary expenditure

3.3 Econometric Model

$$GDP_{it} = \beta_0 + \beta_1 HW_{it} + \beta_2 PR_{it} + \beta_3 FI_{it} + \beta_4 FA_{it} + \beta_5 Fin_{it} + \gamma_t + \mu_i + \varepsilon_{it}$$

GDPit represents the GDP of T city I in the year, HWit is the opening event of high-speed rail, PRit is the growth rate of urban population, FIit is the level of foreign investment, FAit is the amount of capital growth, Finit is the scale of government, γ_t is the fixed effect of time, μ_i is the fixed effect of prefecture-level cities, and ε_{it} is the random error term.

4 EMPIRICAL REGRESSION

4.1 Descriptive Statistics

From the Table 2, it can be seen that the data has a wide range of values, the standard error is too large, the dispersion trend of the data is also large, and the representativeness of the mean value is poor, which may lead to errors in the results.

Table 2: The outcome of descriptive statistics.

Var	Obs	Mean	SD	Min	Max
GDP	5035	1396.47	2575	3.242	38155.32
HW	5035	0.281	0.419	0	1
RP	5035	5.774	4.732	-16.5	49.25
Fin	5035	2672014	4976076	33050	83515400
FI	5035	63629	162622	0	3082563
FA	5035	8500756	12779148	49835	174400000

4.2 OLS Regression Results

The GDP of each city is the explanatory variable, the opening of high-speed railway is the explanatory variable, and the control variable is added for model regression.

Table 3: Regression analysis results.

Var	Coefficient
HW	245.21*** （7.36）
RP	-6.196** （-2.44）
FI	0.003*** （22.04）
FA	0.00005*** （26.47）
Fin	0.00031*** （53.71）
Constant	213.266*** （10.11）
N	5035
R^2	0.8977

Note: *** indicates a significant correlation at the 0.01 level (bilateral).

The regression result of the model is remarkable, with the highest fitting value of 0.8977, The coefficient of the independent variable (HW) is 245.2058, which is significantly positive at the level of 1%, indicating that the impact of HW on GDP is positive and significant; The opening of high-speed rail can promote the increase of domestic cities' GDP.

Among the control variables, the coefficients of foreign investment level (FI) and capital growth (FA) are 0.003 and 0.0001 and both of them are significantly positive at the level of 1%. This result indicates the influence of foreign investment level and capital growth on GDP is significantly positive. This may shows that the employment and other resources are increasing in the cities.

The coefficients of population growth rate (PR) and government size (Fin) are -6.1960 and 0.0003 and both of them are significant at the level of 1%, indicating that the influence of government size on GDP is significantly positive, while that of population growth rate is significantly negative. It shows that too fast population growth is not conducive to economic development, because overpopulation will bring huge employment pressure, sufficient labor market, reduced investment in human capital, and decreased income.

4.3 Expand Analysis

4.3.1 Heterogeneity Analysis of Urban Grades

According to the administrative level, our cities can be divided into first-class cities, second-class cities, third-class cities and other cities. Cities across the country are divided into different grades according to certain standards. According to the grades of cities, this paper studies the effects of the opening of high-speed rail on the economic growth of the first, second, third and other cities respectively.

The coefficient of each level city is significantly positive, Among them, the opening of high-speed rail has the greatest impact on the economic growth of first-class cities, and its impact on other cities decreases according to their grades. Because the higher the grade, the more developed the city economy, the larger the city scale and the greater the

Table 4: Urban grade heterogeneous regression results.

	First-class city	Secondary city	Third-level city	Other city
HW	8732.8*** （13.75）	3571.51*** （15.91）	2431.81*** （15.08）	1049.11*** （40.21）
Constant	3168.72*** （6.75）	1213.93*** （8.57）	1613.32*** （15.74）	591.30*** （54.27）
N	320	495	478	5270
R^2	0.3728	0.3391	0.3232	0.2348
Adj R^2	0.3708	0.3378	0.3218	0.2347

Note: *** indicates a significant correlation at the 0.01 level (bilateral).

demand for foreign economic exchanges, the local government is more inclined to invest in the development of fixed assets such as high-speed rail. After the opening of high-speed rail, it will greatly promote the flow of production factors between cities and regions, especially the rapid flow of labor, talents, information and other factors.

4.3.2 Regional Heterogeneity Analysis

According to the interpretation of the National Development and Reform Commission, the division of China's eastern, central and western regions is a policy division, not an administrative division, nor a geographical concept division. Therefore, the eastern region refers to the region that first implemented the coastal open policy and has a high level of economic development; Central China refers to the economically less developed areas; The western region refers to the economically underdeveloped western region. This provides a grouping basis for studying the economic impact of the opening of high-speed rail on different regions.

Table 5: Regional heterogeneous regression results.

	East region	Midland	West region
HW	3753.60*** （23.23）	1535.82*** （23.99）	1967.95*** （24.54）
Constant	1309.14*** （13.89）	699.11*** （21.63）	474.80*** （17.60）
N	2012	2001	2552
R^2	0.2117	0.2235	0.1911
Adj R^2	0.2113	0.2232	0.1908

Note: *** indicates a significant correlation at the 0.01 level (bilateral).

The coefficient of the eastern region is 3,753.602, that of the central region is 1,535.818, and that of the western region is 1,967.95, among which the coefficient of the eastern region is the highest, indicating that the opening of high-speed rail has the greatest impact on the economic development of the eastern region, followed by the western region,

which has the smallest impact on the central region. Because the development of economics in eastern region makes the transportation cost lower, the transportation time shorter and the promotion. For example, the operation of Beijing-Shanghai high-speed railway will closely link the economic circle around Bohai Sea in Shandong Peninsula and the Beijing-Tianjin-Tangshan economic circle in which Beijing is located, with the most prosperous and economically developed Yangtze River Delta in China, forming an integrated Beijing-Shanghai metropolitan belt. It promotes the exchanges among various regions of the three economic circles and deepens the links among the three economic circles.

4.3.3 Municipal Analysis

At present, there are four municipalities in China, namely, Beijing, Tianjin, Shanghai and Chongqing. Anhui, Fujian, Guangdong, Hebei, Henan, Hunan, Jiangsu, Jiangxi and Zhejiang are almost all provinces with high-speed trains, and their provincial capitals are Hefei, Xiamen, Guangzhou, Shijiazhuang, Zhengzhou, Changsha, Nanjing, Nanchang and Hangzhou.

Table 6: Municipal analysis regression results.

	Municipal city	Almost all provincial capitals are opened.	Other city
HW	14588.58*** （10.67）	5503.30*** （9.67）	2357.87*** （46.30）
Constant	5231.74*** （5.16）	1279.22*** （3.96）	726.61*** （30.28）
N	80	180	6485
R^2	0.5934	0.3480	0.2485
Adj R^2	0.5882	0.3443	0.2484

Note: *** indicates a significant correlation at the 0.01 level (bilateral).

Through the analysis of municipalities directly under the central government, provincial capitals of almost all provinces that have opened high-speed

rail and other cities except municipalities directly under the central government, it can be seen that the opening of high-speed rail has a positive and significant impact on economic growth, among which the highest coefficient of municipalities directly under the central government is 14,588.58, followed by the provincial capitals of almost all provinces that have opened high-speed rail, which is 5,503.296, and the lowest coefficient of other cities except municipalities is 2,357.8730. It shows that compared with other developed cities, the opening of high-speed rail in municipalities directly under the central government has the greatest impact on economic development, probably because municipalities directly under the central government are transportation hubs, and the opening of high-speed rail makes its transportation more developed, promotes population mobility, and promotes economic development.

5 CONCLUSION

High-speed railway shortens the space-time distance between cities, accelerates the flow and agglomeration of production factors, and produces a huge "space-time convergence" effect. The regression results show that the opening of high-speed rail has played a significant positive role in the economic growth of cities along the line. In the further analysis of model one, some common factors of years and cities that cannot be captured are added, and the impact of high-speed rail on economic growth reflected by empirical regression becomes more accurate. It is found that the introduction of control variables can improve the explanation degree of high-speed rail opening on economic growth, which further confirms that the event of high-speed rail opening will affect economic development. After a series of extended analysis, firstly, we divided the samples into four categories: first-class cities, second-class cities, third-class cities and other cities according to the city grades. The results showed that the opening of high-speed rail had the greatest impact on the economic growth of first-class cities, and its impact on other cities declined according to the grades. Secondly, according to the level of economic development, the samples are divided into three categories: eastern, central and western regions. Finally, through the analysis of municipalities directly under the Central Government and other cities, it is concluded that the opening of high-speed rail has the greatest impact on the economic growth

of municipalities directly under the Central Government, followed by the provincial capitals of almost all provinces that have opened high-speed rail, and the lowest in other cities except municipalities directly under the Central Government.

Some suggestions are put forward：some small and medium-sized cities should not blindly pursue the high-speed rail, and should objectively analyze the advantages and disadvantages of its opening. Secondly, avoiding the phenomenon of excessive concentration of central cities caused by the high-speed rail promoting the further concentration of population and capital in central cities. Finally, strengthen the scientific management of high-speed rail operation, and make overall arrangements for the proportion of passenger trains with various speeds and the stopping stations and frequencies of high-speed trains.

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