Research about the impact of transportation infrastructure on economic growth in a transportation power

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Abstract—This paper selected the 2008-2018 panel data of 31 provinces, cities, autonomous regions throughout the country, adopted fixed effects model and used moderating effect to study the influence of traffic infrastructure on economic growth. And the research has found: From the national perspective, roads perform better than railways on economic growth and railway's leading role of the economy increases gradually; In terms of regulating effect, the effect of railway on economy is more restricted by the level of urbanization, and the higher the level of urbanization, the more significant the effect; In terms of control variables, labor input and investment level significantly promote economic growth.

1 INTRODUCTION

Transportation is the foundation and development of the country, and transportation infrastructure is the foundation of the development of transportation, which is related to the future and destiny of the implementation of China's transportation strategy. In recent years, the investment and construction of China's transportation infrastructure have been continuously increased, and the total number of people and goods transported has been increasing. However, according to the latest China new infrastructure research report released by Evergrande research institute in 2020, China's road and railway density, railway service efficiency, road quality score and other indicators are still significantly behind the developed countries such as the United States and Japan, and there is still a certain gap between China and a transportation power. Under the new normal of economy, the party and the country pay more attention to the construction of transportation power. In his report to the 19th national congress of the communist party of China, general secretary Xi Jinping clearly proposed that the construction of a transportation power should be regarded as an important part of the construction of a modern socialist country, and it should be incorporated into the national development strategy for the next few decades to provide a strong support for the construction of a modern socialist economic system^[1]. In September 2019, the central committee of the communist party of China and the state council further issued the outline for the construction of a transportation power in order to coordinate and promote the construction of a transportation power, and put forward various requirements and policies on transportation development. Therefore, the main problem of this paper is to find out the impact of transportation infrastructure on economic growth in China under the background of transportation power,

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and then put forward relevant countermeasures and Suggestions.

This paper creatively finds that the transportation infrastructure does not always have a positive impact on the economic growth of a certain place which provides help for the scientific planning and construction of transportation infrastructure in different regions at different development stages according to local conditions.

2 LITERATURE REVIEW AND THEORETICAL HYPOTHESIS

As an important part of China's infrastructure construction, transportation infrastructure plays a crucial role in economic development. Different scholars have explored and discussed the impact of transportation infrastructure on economic growth from different perspectives. Cai et al. used C-D model and panel data, and Xu concluded that transportation infrastructure plays a significant positive role in driving economic growth through theoretical and factual analysis^{[2][3]}. Foreign scholars Jacoby and Minten compared the impact of transportation costs and profits of transportation infrastructure in different regions, and believed that it could promote economic growth by reducing transportation costs of enterprises^[4]. Duranton studied the impact of U.S. interstate highways on local and international trade and found that transportation infrastructure can positively affect the economy in a way that strengthens market integration and regional trade. But other scholars hold different views^[5]. Feng et al. believed that the large investment in transportation infrastructure construction and the long construction cycle tend to lag behind economic development, which is not conducive to economic growth^[6]. Further, Zhang and Lu studied the coupling coordination degree of transportation infrastructure and urbanization based on expressway and

high-speed railway, and concluded that expressway and high-speed railway are affected by urbanization in different regions and have different effects on economic growth in regions with different development degrees^[7]. Huang and Zhu and Tang et al. demonstrated the impact of urbanization on transportation infrastructure and economic growth and the different views of different types of transportation infrastructure on economic growth respectively through the breakpoint regression and spatial panel model^{[8][9]}.

Based on the above literature review, the following hypotheses are proposed in this paper:

H₁: different types of transportation infrastructure have different effects on economic development.

H₂: urbanization has different effects on economic growth of different types of transportation infrastructure.

3 PREPARE MODEL SETTING, VARIABLE SELECTION, DATA SOURCE AND PROCESSING

3.1 Model setting

In this paper, we explore the relationship between transportation infrastructure and economic growth, based on the above analysis and assumptions, this article selects the panel data of 31 provinces and cities nationwide, reference Xu and Pan (2019) research model and regression model are constructed respectively the basic panel, containing regulating effect of panel regression model and panel regression model with lag effect.

3.1.1 Basic spatial panel regression model

$$eco_{it} = \beta_0 + \beta_1 trans_{it} + \beta_2 X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

In type (1), i and t , respectively were observed in different provinces and year, eco_{it} represents economic growth level and this paper uses the GDP deflator based on 1978 to calculate the actual per capita GDP; $trans_{it}$ is on behalf of the transport infrastructure level, and $road_{it}$, $rail_{it}$ represent annual road density and annual railway density; β_0 is a constant term, and β_1 represents the impact of transportation on economic growth. $\beta_1 > 0$, traffic has a positive effect on economy. $\beta_1 < 0$, traffic has a negative effect on economy; μ_i is an unobservable individual fixed effect, reflecting the random influence of individuals; ε_{it} represents the random error term; X_{it} represents various control variables, including: $open_{it}$, thi_{it} , lab_{it} , lr_{it} and fix_{it} . Among them, $open_{it}$ represents the degree of provinces opening to the outside world, thi_{it} represents the level of provincial industrial structure and is expressed by the proportion of the added value of the tertiary industry in the three primary industries, lab_{it} represents provinces and cities in the annual labor input, lr_{it} represents annual manufacturing

agglomeration degree and is expressed by the locational entropy index, fix_{it} represents provinces and cities of the annual investment level and is expressed by the logarithm of the total social fixed asset investment in each region ,

3.1.2 Spatial panel regression model with moderating effect

At present, most cities in China are in the stage of rapid development of urbanization, which has a large demand for transportation. In places with perfect transportation, the flow of personnel, materials and other factors is accelerated, thus further stimulating economic growth. Therefore, taking the urbanization rate as the regulating variable. Highway density and railway density were used to represent the level of transportation infrastructure, and a spatial panel regression model with moderating effect was attempted to be constructed. The specific form of which is shown in equation (2).

$$eco_{it} = \beta_0 + \beta_1 trans_{it} + \beta_2 X_{it} + \beta_3 urban_{it} +$$

$$\beta_4 trans_{it} * urban_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

In equation (2), the interaction term of the level of transportation infrastructure and urbanization represents the regulating effect of model (2). The greater the absolute

value of β_4 , the greater the regulating effect of

β_4 represents the level of urbanization. Therefore, $\beta_4 > 0$

is the positive regulatory effect. $\beta_4 < 0$ represents a negative moderating effect. Other variables and subscripts have the same meaning as in equation (1).

3.1.3 Spatial panel regression model with hysteresis effect

Perfect transportation will promote regional economic growth, and economically developed regions will also have more funds for the construction of transportation infrastructure. Therefore, there may be a two-way causal relationship between transportation infrastructure and economic growth, and equations (2) and (3) fail to take this relationship into account. In addition, the traffic infrastructure construction and work time is longer, to reduce endogenous model, enhance its persuasive, reference Tang (2018) model, this paper constructs the contain lag variable space panel regression model for robustness in this paper, the empirical results of the inspection, the concrete form to see type (3) type (4).

$$eco_{it} = \beta_0 + \beta_1 trans_{i(t-1)} + \beta_2 X_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

$$eco_{it} = \beta_0 + \beta_1 trans_{i(t-1)} + \beta_2 X_{it} + \beta_3 urban_{it} +$$

$$\beta_4 trans_{i(t-1)} * urban_{it} + \mu_i + \varepsilon_{it} \quad (4)$$

In equations (3) and (4), $t - 1$ represents the time lag of one year, and $trans_{i(t-1)}$ represents the traffic base of

the region i in year of $t - 1$. Other subscripts and variables have the same meaning as those in equations (1) and (2).

3.2 Data source and processing

The data of each indicator in this paper are the panel data of 31 provinces and autonomous regions (excluding Hong Kong, Macao and Taiwan) from 2008 to 2018. In addition to other indicators such as the level of opening-up and the level of investment, the relevant data are all from China's statistical yearbook from 2008 to 2018.

4 PREPARE RESULTS AND ANALYSIS

4.1 Baseline model and model regression with moderating effect

Panel data of 31 provinces from 2008 to 2018 were used in this paper. Table I shows the regression results of equations (1) and (2) under the mixed estimation model, random effect model and fixed effect model. Through F test and Hausman test in Eviews9.0, the fixed effect model is more suitable for this study than the random effect model.

In order to compare the applicability of different estimation methods more intuitively, the robustness of the regression results was enhanced. In this part, the regression results of equations (1) and (2) under the three estimation methods are summarized as shown in table 5: the sequence (1), (2), (3) and (4), (5) and (6) are the regression results of the three models without moderating effect and with

moderating effect respectively. According to the goodness of fit R^2 of the model, the fixed-effect model is better than the other two models in processing panel data.

In terms of explanatory variables, the front coefficient of highway density is 0.354, which passes the test of 1% confidence level, indicating that the construction of highway in China significantly promotes the economic growth. The front coefficient of railway density is negative and fails to pass the test of confidence level, which indicates that China's railway construction has no significant effect on economic growth or even leads to negative economic growth, which verifies H_1 . For one thing, as Albert Hirschman has argued infrastructure's neglect of public services makes it a drag on economic growth and large investment in transportation infrastructure and long construction cycle tend to lag behind economic development, which is not conducive to economic growth^[6]. On the other hand, this phenomenon may be related to the spatial misallocation of China's railway investment, resulting in the spatial misallocation of production capacity and transport capacity^[10].

In moderating effect, road density, the density of railway and urbanization rate coefficients are 0.057 and 14.24 respectively before cross terms, not by the confidence level inspection and 1% confidence level, suggesting that the role of railway in terms of the road to economic more the restriction of the level of urbanization, the urbanization level is higher, the effect is more significant, verify the H_2 .

In the aspect of control variables, labor input and investment level have a promoting effect on economic growth.

TABLE I. REGRESSION RESULTS UNDER DIFFERENT ESTIMATION METHODS

Methods Variables	The mixed estimation model (1)	The random effect model (2)	The fixed effect model (3)	The mixed estimation model (4)	The random effect model (5)	The fixed effect model (6)
$road_{it}$	-0.007 (-0.243)	0.379*** (9.762)	0.354*** (6.524)	0.232* (1.87)	0.884*** (9.8)	0.323** (2.484)
$rail_{it}$	2.71*** (3.859)	-1.345* (-1.8)	-0.324 (-0.346)	-2.593 (-0.589)	-12.97*** (-4.043)	-11.985*** (-2.994)
$open_{it}$	0.331*** (6.241)	0.212*** (7.915)	0.044 (1.4)	0.283*** (4.66)	0.174*** (6.28)	0.009 (0.281)
thi_{it}	-1.037*** (-7.732)	-1.01*** (-14.008)	-0.99*** (-12.839)	-1.157*** (-8.19)	-1.07*** (-14.197)	-1.168*** (-13.582)
lab_{it}	0.741*** (31.19)	0.533*** (25.946)	0.182*** (6.453)	0.132** (3.229)	0.592*** (32.755)	0.167*** (6.017)
ln_{it}	0.166*** (4.124)	0.04 (1.438)	-0.05 (-1.649)	0.228*** (11.408)	0.065** (2.473)	-0.045 (-1.152)
fix_{it}	0.258*** (14.319)	0.152*** (18.423)	0.209*** (21.898)	0.258*** (14.319)	0.114*** (10.849)	0.177*** (13.636)
$urban_{it}$				0.7*** (3.851)	1.019*** (6.795)	0.795*** (4.055)
$urban_{it} * road_{it}$				-0.344* (-1.747)	-0.875*** (-6.581)	-0.057 (-0.346)
$urban_{it} * rail_{it}$				4.815 (0.839)	14.853*** (3.834)	14.24*** (2.972)
R^2	0.874	0.874	0.928	0.876	0.893	0.958
N	341	341	341	341	341	341

Note: "***", "**" and "*" mean significant at the confidence level of 1%, 5% and 10% respectively; In parentheses is the corresponding t statistic of the statistic value.

Data source: author based on data processing result.

4.2 Robust test

In this paper, the panel model with hysteresis effect mentioned above is used for robustness test. Under the fixed effect model, the regression results are shown in table II. Sequences (1) and (2) respectively represent the regression results of the benchmark model with one hysteresis and the benchmark model with one hysteresis with moderating effect. It is easy to know that in the

deformation model (1) and model (2), the positive and negative values and significance of the front coefficients of each variable are basically consistent with the results of the initial model, which indicates that the results obtained by the benchmark model truly reflect the impact of transportation infrastructure on economic growth, and further proves that the research results in this paper are robust.

TABLE II. ROBUSTNESS TEST RESULTS

Methods Variables	Lag effect (1)	Lag effect (2)	Methods Variables	Lag effect (1)	Lag effect (2)
$road_{it(t-1)}$	0.268*** (4.996)	0.056 (0.333)	ln_{it}	-0.016 (-0.546)	-0.013 (-0.428)
$rail_{it(t-1)}$	-6.096 (-4.059)	-8.724 (-1.35)	fix_{it}	0.211*** (21.361)	0.179*** (13.503)
$open_{it}$	0.05 (1.647)	0.02 (0.604)	$urban_{it}$		0.683*** (3.888)
thi_{it}	-1.156*** (-15.102)	-1.368*** (-16.202)	$urban_{it}*road_{it(t-1)}$		-0.177 (-0.817)
lab_{it}	0.183*** (6.985)	0.165*** (6.487)	$urban_{it}*rail_{it(t-1)}$		19.66** (2.004)

Note: "****", "***" and "*" mean significant at the confidence level of 1%, 5% and 10% respectively; In parentheses is the corresponding t statistic of the statistic value.

Data source: author based on data processing results.

5 CONCLUSIONS AND COUNTERMEASURES

In this paper, panel data of 31 provinces and autonomous regions were selected from 2008 to 2018, and the fixed-effect model was used for the research and the following conclusions were drawn:

- From a national perspective, different types of transportation infrastructure have different effects on economic growth. Compared with railways, roads play a stronger role in driving economic growth, and railways gradually increase their positive impact on the economy over time.

- In terms of moderating effect, the effect of railway on economy is more restricted by the level of urbanization than that of highway. The higher the level of urbanization, the more significant the effect.

- In terms of control variables, the level of labor input and investment plays a significant role in promoting economic growth, while the level of industrial structure plays a sluggish role in economic growth. This may be because China's industrial structure transformation and upgrading is still in the exploratory period, and its ability to drive economic growth is limited. The level of opening to the outside world and the degree of manufacturing industry concentration are significantly different in different models, which indicates that their impact on economic growth is not stable.

According to the above conclusions, this paper puts forward the following countermeasures and Suggestions:

- On the one hand, China should continue the investment and construction of highways; on the other hand, it should rationally plan and invest in railways from a scientific and practical perspective to improve the utilization efficiency of railway resources and capital.

- Among the control variables, labor input and investment level significantly promote economic growth.

China's economic development in the future needs to continue to consolidate and play to the advantages of labor resources and fixed assets investment, especially new infrastructure investment to stimulate economic growth.

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REFERENCES

- Q.T. Xin, "Theoretical analysis of traffic power strategy in the new era,"Journal of Beijing jiaotong university (social science edition), vol.18, pp.58-62,p.92, April 2019.
- C. X. Min , L. J. Quan, F. Yi, "Research on the impact of China's transportation infrastructure construction on economic growth," Economic vertical & horizontal, pp.70-76, April 2017.
- X. Fei, "Comprehensive foundation and strategic significance of China's construction of a transportation power,"People's forum academic frontier, pp.70-79, November 2018.
- H. G. Jacoby, B. Minten, "On Measuring the Benefits of Lower Transport Costs," Journal of Development Economics, vol.89, pp.28-38,p.724, January 2009.
- G. Duranton, P. M. Morrow, MA Turner, "Roads and Trade: Evidence from the US,"Journal of Review of Economic Studies, vol.81, p.681, February 2014.
- F. F. Ling, Z. Lei, G. Y. Hua and Y.Ren, "The relationship between China's railway construction

- and economic growth,”*Journal of railway science and engineering*, vol.7, pp.79-83, January 2010.
7. Z. H. Tao, L. M. Jun, “Transportation infrastructure and urbanization of the new silk road economic belt - a study based on high-speed rail and expressway,” *Industrial technology economy*, vol.36, pp.33-39, April 2017.
 8. H. S. Ping, Z. Yong, “ Spatial spillover effect of railway and highway transportation infrastructure on economic growth -- a case study of the Yangtze river delta,” *East China economic management*, vol.31, pp.20-27, November 2017.
 9. T. H. Xiang, W. Y. Bin, W. G. Dan, et al, “Research on the influence of transportation infrastructure on manufacturing agglomeration in western China,” *China soft science*, pp.137-147, August 2018.
 10. Z. Jian, “Reasons and countermeasures of China's economic growth slowdown,” *Journal of Beijing jiaotong university (social science edition)*, vol.15, pp.15-27, February 2016.