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A comparative study on the effects of high-speed rail and ordinary rail on regional economic growth—empirical research based on DlD model

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Abstract: Today, high-speed rail has become an indispensable means of transportation in people's production and life. However, after the opening of the high-speed rail, the development of ordinary railways has also become an object of concern, and the impact of high-speed rail on ordinary railways is worth studying from an empirical perspective. This article takes more than 2,000 counties and cities in China as the research object, using the data from 2004 to 2018, using the double difference method to analyze the impact of high-speed railway construction and ordinary railway construction and further fitting the relationship between high-speed railway and ordinary railway. The research results show that: the opening of high-speed railways has a negative effect on the regional economy; the opening of ordinary railways has a positive effect on the regional economy. By analyzing the interaction effect of the opening of high-speed rail and ordinary railway, it can be concluded that the opening of high-speed rail has a restraining effect on the impact of ordinary railway on regional economic development.

1. Introduction

China's high-speed railway began to be put into operation in 2008, and by 2015, China's high-speed railway operation mileage exceeded the sum of other countries and regions in the world. Whether transportation infrastructure promotes regional economic development depends on the size of "diffusion effect" and "agglomeration effect". Through the "diffusion effect", the transportation infrastructure enables the regions with faster economic growth to drive the economic development of the regions with slower economic growth, thus showing a positive spillover effect; at the same time, through the "agglomeration effect", the transportation infrastructure makes it easier for production factors to flow to Economically developed areas, so the transportation infrastructure is not conducive to the economic development of less developed areas. Ordinary railway, as one of the important modes of freight transportation, plays an important role in China's material transportation and economic growth, and it plays a complementary role to a certain extent with the construction of

passenger-based high-speed railway. Then, what role do high-speed rail and ordinary railway play in regional economic growth, and whether there is a linkage effect between the two on regional economic growth? This needs to be verified from an empirical point of view.

The research on the influence of high-speed railways on regional economy is mainly manifested in two aspects, namely, the impact of high-speed railways on regional economic growth and the impact of high-speed railways on regional economic development imbalance. In terms of regional economic growth, there is no consensus among academic circles on whether the high-speed railway has a negative impact or a positive impact on it. Kim K S [1], after examining the high-speed railways in Japan and Europe, believes that high-speed railways can improve the accessibility between regions and stimulate regional economic growth. On the contrary, Vickerman R [2] believes that the impact of high-speed railway on regional economic growth is not clear. He believes that the development of high-speed railways will promote the interests of core regions, thus reducing the economic growth rate of peripheral regions. Hall P [3] also pointed out that the development of core areas connected by high-speed railways, especially central cities, will have adverse effects on peripheral areas, and may even have a polarization effect.

However, compared with the research on regional economic growth of high-speed rail, there are less research results on the effect of ordinary railways on regional economic growth. Tang Sheng et al. [4] used the panel GMM method to evaluate the impact of railway construction on regional output growth. The results show that ordinary railways have a greater impact on provincial economic growth due to their high levels of network accessibility and connectivity. Some scholars have also conducted research on the impact of ordinary railways on the economy of specific regions [5].

The development of ordinary railways in the era of high-speed railways faces three problems: the conflict between ordinary railways and urban space, the support of ordinary railways for the freight system, and the optimal utilization of ordinary railway special lines [6]. Based on the support of the above literature, this study takes more than 2,000 counties across the country as the research object, and through the quantitative analysis of the double difference model, studies the linkage effect and synergistic effect of high-speed rail and ordinary rail on regional economic growth.

2. Research design

2.1 Model design

The double difference model, English name is Difference-in-Differences, that is, DID model. It was originally a powerful model for evaluating the effect of policy implementation. It can effectively avoid data endogenous problems, alleviate the problem of missing variable bias, and can effectively separate research objects. The difference between "before the policy is implemented" and "after the policy is implemented", the real effective separation of the policy impact and other advantages. The double-difference model is also suitable for analyzing the impact of the opening of high-speed railways and ordinary railways on regional economic development. This paper intends to use the double difference model to conduct statistical research on the impact of the opening of ordinary railways on regional economic development and the impact of the opening of high-speed railways on regional economic development and draw corresponding conclusions effect to be further studied.

The regression model established in this paper is as follows:

When studying the impact of high-speed rail on regional economic growth, we take "cities with high-speed rail" as the treatment group and "cities without high-speed rail" as the control group, if the two groups of variables before "high-speed rail construction" have a parallel trend relationship, The changes in the latter two are the changes caused by the "high-speed rail construction effect". Its basic hypothetical model is:

$$Y_{it} = \alpha_0 + \alpha_1 highway_{it} + \alpha_2 post_{it} + \alpha_3 highway_{it} \times post_{it} + \varepsilon_{it} \quad (1)$$

Among them, it represents the t-th year of the i-th county-level city, Yit represents the economic level of a certain county-level administrative region, highwayit represents the dummy variable of whether the high-speed rail is opened, if the county-level city opens the high-speed rail, the value of the dummy variable is 1;

Conversely, if the city does not have high-speed rail, the dummy variable is 0, that is:

$$highway_{it} = \begin{cases} 0, No\ high-speed\ rail \\ 1, High-speed\ rail \end{cases} \quad (2)$$

Postit represents the dummy variable before and after the opening of the high-speed rail. Before the opening of the high-speed rail in a county-level city, the value of the dummy variable is 0; after the opening of the high-speed rail, the dummy variable is 1, namely:

$$post_{it} = \begin{cases} 0, Before\ the\ opening\ of\ the\ high-speed\ rail \\ 1, After\ the\ opening\ of\ the\ high-speed\ rail \end{cases} \quad (3)$$

The transit item highwayit ×postit represents the dummy variable of the city after the high-speed rail is opened, and represents the estimated item of the double difference. Its estimated coefficient α is the difference in the impact of the opening of the high-speed railway on the treatment group and the control group that we will mainly analyze in the later research, indicating the impact of the opening of the high-speed railway on regional economic development.

Similarly, when studying the impact of general railways on regional economic growth, we use "common railway cities" as the treatment group and "non-common railway cities" as the control group, assuming that the two groups of variables before "common railway construction" have Parallel trend relationship, the changes in the latter two after the "common railway construction" are the changes caused by the "common railway construction effect". Its basic hypothetical model is:

$$Y_{it} = \beta_0 + \beta_1 train_{it} + \beta_2 post_{it} + \beta_3 train_{it} \times post_{it} + \varepsilon_{it} \quad (4)$$

Among them, it represents the t-th year of the i-th county-level city, Yit represents the economic level of a certain county-level administrative region, and trainit represents the dummy variable of whether the high-speed rail is opened. If the county-level city opens the high-speed rail, the value of the dummy variable is 1; otherwise, if the city has not opened the high-speed rail, then the dummy variable is 0, that is:

$$train_{it} = \begin{cases} 0, No\ high-speed\ rail \\ 1, High-speed\ rail \end{cases} \quad (5)$$

Postit represents the dummy variable before and after the opening of the high-speed rail. Before the opening of the high-speed rail in a county-level city, the value of the dummy variable is 0; after the opening of the high-speed rail, the dummy variable is 1, namely:

$$post_{it} = \begin{cases} 0, Before\ the\ opening\ of\ the\ high-speed\ rail \\ 1, After\ the\ opening\ of\ the\ high-speed\ rail \end{cases} \quad (6)$$

The traffic item trainit ×postit represents the dummy variable of the city after the opening of the ordinary railway, and its estimated coefficient β3 is the difference in the impact of the opening of the high-speed railway on the treatment group and the control group that we will mainly analyze in the later research, indicating that the opening of the high-speed railway has a positive effect on the regional impact on economic development.

2.2 Variable setting

The explained variable in this paper is the level of economic development, and the per capita GDP of each county-level city is used as a measure of the level of economic development of each county-level city. The key explanatory variables are the opening of high-speed rail and ordinary rail. Control variables include household registration population, per capita public budget income, per capita resident savings balance, and per capita loan balance of financial institutions at the end of the year.

2.3 Sample selection and data description

This article selects 2004-2018, the time span is 15 years, and the 0/1 variable of whether to open high-speed rail and ordinary rail in about 2100 county-level cities across the country, various economic indicators including per capita GDP, etc. Data set up panel data.

2.4 Sample descriptive statistics

Table 1 is the descriptive statistics of core explanatory variables, explained variables and control variables. The descriptive statistics calculated the mean value, standard deviation, and data fluctuation interval of each variable. Overall, the variables and data selected in this paper are reasonable and have research significance.

Table 1: Descriptive Statistics for Variables

VARIABLES	Descriptive Statistics	mean	sd	min	max
code	30,766	400,648	158,255	110,115	659,006
year	30,766	2,011	4.319	2,004	2,018
nsr	30,766	0.319	0.466	0	1
hsr	30,766	0.0488	0.215	0	1
lnpopulation	30,756	5.029	1.550	-2.345	12.13
lncGDP	30,140	9.776	0.890	0.0437	15.02
lnbudget	30,747	8.124	0.989	3.180	12.66
lnsaving	30,455	9.250	0.969	-0.288	12.78
lnloan	30,549	9.014	1.122	-0.745	13.69

3. Analysis of empirical results

This paper first adopts the regression analysis of high-speed rail and ordinary railway on regional economic growth, and then conducts regression analysis on the effect of high-speed rail on ordinary railway and on the impact of ordinary railway on regional economy through the interaction effect. In order to obtain more accurate and robust results, this paper uses a fixed effect regression model (xtreg regression) for regression when performing regression analysis on the double difference method.

3.1 Analysis of the regression results of the fixed effect model

First, apply xtreg regression to regress the data. xtreg is the official command of the fixed effect model. xtreg has strict requirements on the data format, and the data must be panel data. When dealing with time fixed effects, it is necessary to introduce dummy variable i.year to represent different times.

Table 2: Regression analysis of the impact of high-speed rail and ordinary rail on regional economic growth

VARIABLES	(1) initial regression	(2) add hsr	(3) add insaving	(4) full control variable
nsr	0.006 (0.65)	0.011 (1.32)	0.017** (2.09)	0.017** (2.21)
hsr		-0.054*** (-3.43)	-0.038** (-2.55)	-0.043*** (-3. 19)
lnsaving			0.218*** (8.70)	0. 132*** (6.51)
lnpopulation				0.057* (1.79)
lnbudget				0. 196*** (11.47)
lnloan				0. 127*** (11.91)
Constant	9.774*** (3,576.44)	9.774*** (3,562.86)	7.751*** (33.38)	5.533*** (18. 10)
Observations	30,136	30,136	29,870	29,828
R-squared	0.950	0.950	0.953	0.958

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0. 1

The regression results in Table 2 show that from the perspective of the impact on regional economic growth, the time effect coefficient of the opening of the high-speed rail is -0.0427041, which is significant at the 1% level, indicating that the opening of the high-speed rail has a negative impact on the economic growth of county-level cities. Through the analysis of the reasons behind this, it can be concluded that after the opening of the high-speed rail, there will be the following mechanisms for the county-level cities along the high-speed rail, which will bring negative impacts: First, the circular cumulative causal mechanism of commerce and service industries[7], That is to say, after the opening of the high-speed rail, as the center of the high-speed rail network, the commercial, service and public infrastructure of large cities can attract a larger population, and then expand, increase more jobs and employment opportunities, and provide more wages. Thereby attracting more population, and more population will further increase the business scale of central large cities, and then more effectively promote the economic development and urbanization process of these areas, attracting more population, which also means that more of the population will choose to leave county-level cities whose competitiveness is getting weaker and weaker, inhibiting the economic development of county-level cities [8]. At the same time, due to its high-efficiency and rapid transportation advantages, the high-speed rail enables the population, labor, and resources to quickly gather in large central cities, which facilitates the outflow of population from economically backward county-level cities to first tier and second-tier cities or other cities with more developed economies in large central city [9]. Second, the personnel spillover effect mechanism. This is a spillover effect aimed at megacities [10]. Due to problems such as large population density, high living pressure, and serious urban environmental pollution in large cities, with the increase of per capita income and technological level, part of the population and manufacturing in large cities. Businesses will move towards the surrounding environment and sub-central cities with better air quality, convenient transportation, and higher quality of life [11]. At the same time, the opening of the high-speed rail will accelerate the differentiation of the urban pattern, which will have a weakening effect on the low-level and backward county-level cities. Most county-level cities will be marginalized due to the opening of the high-speed rail. Inhibition impact. In addition, because the maintenance of high-speed rail requires high costs and high technology, the maintenance of high-speed rail also inhibits the development of county-level cities with relatively backward economies to a certain extent [12].

At the same time, the regression results in Table 2 show that from the perspective of the impact on regional economic growth, the time effect coefficient of the opening of ordinary railways is 0.0172672, which is significant at the 1% level, indicating that the opening of ordinary railways has a significant impact on the economic growth of county-level cities. Growth has a positive effect. The reason behind this is that ordinary railways are not as strong as high-speed railways due to their speed, passenger capacity, and degree of development, so the degree of inhibition of economic development of county-level cities is far less serious than high-speed railways [13]. However, in comparison, ordinary railways, as an efficient means of transportation, can provide strong impetus and support for the economic development of county-level cities with their ability to transport human and material resources. Since most county-level cities opened ordinary railways earlier and the cities are in the embryonic stage of development, the construction of ordinary railways is equivalent to a seesaw for urban development, which can provide the original source of economic development for county-level cities that were originally closed and backward [14].

3.2 Analysis of the interaction between high-speed rail and ordinary rail on regional economy

Table 3: Interaction (nsr*hsr) analysis results of common railway and high-speed railway

VARIABLES	(1) nsr*hsr
sr	-0.067*** (-3.02)
nsr	0.021*** (2.64)
hsr	0.013 (0.63)
lnsaving	0. 132*** (6.50)
lnpopulation	0.057* (1.79)
lnbudget	0. 196*** (11.48)
lnloan	0. 126*** (11.90)
Constant	5.534*** (18. 11)
Observations	29,828
R-squared	0.958

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0. 1

Table 3 shows the analysis results of the interaction effect of ordinary railway and high-speed railway. When analyzing the interaction effect of high-speed rail and ordinary rail, it is necessary to add the influence of high-speed rail or ordinary rail to the control variables. By adding the interaction term in the xtreg command, we can get the effect of the opening of the high-speed rail on the ordinary railway. From the results in Table 3, it can be concluded that the opening of high-speed rail has a negative effect on the impact of ordinary rail on regional economic growth, and its estimated coefficient is -0.0673908, which is significant at the 5% level. Through analysis, it can be deduced that the reason behind this negative effect is mainly because for a specific city that has opened ordinary railways, after the opening of high-speed railways, the inhibitory effect of high-speed railways on the regional economy is greater than the promotion effect of ordinary railways, so the interaction effect present as inhibition.

3.3 Stability test

The random dummy variable is used for 1000 cycles, the result shows: c=35, only 35 times the random coefficient exceeds the true value, the probability is 35/1000, it is a small probability event, and the stability test passes. It can be seen from this that it is the policy impact brought about by the construction and opening of ordinary railways, not the policy impact caused by other reasons. [15]

4. Conclusion

This paper uses the data of more than 2,000 counties and cities across the country from 2004 to 2018, takes the cities without high-speed railways as the control group, and the cities with high-speed railways as the treatment group, and analyzes whether the construction of high-speed railways can drive the Yangtze River Delta through the double difference model. Regional economic development, narrowing regional development gaps, and promoting coordinated regional economic development. This paper selects the main factors affecting economic development such as fixed asset investment, fiscal expenditure, urbanization and industrial structure as control variables, and draws the following conclusions through the DID model:

First, in the fixed effect regression (xtreg regression), the opening of the high-speed railway has a negative effect on the regional economy. The main reason can be explained by the circular cumulative causal mechanism and personnel spillover mechanism of business and service industries.

Second, in the fixed effect regression (xtreg regression), the opening of ordinary railways has a positive effect on the regional economy. Ordinary railways are not as strong as high-speed railways due to their speed, passenger capacity, and degree of development, so the economic development of county-level cities is far less severe than high-speed railways.

Third, the research conclusions of this paper are drawn from the two perspectives of a relatively short period of time and counties and cities with differences or large differences in initial endowments. Since the high-speed railway has a long-term effect on the development of the regional economy, the analysis in this paper is obviously short-term, and the short-term impact may not represent the long-term effect of the behavior.

Fourth, when analyzing the factors affecting the economic growth of high-speed rail and ordinary rail cities, it is necessary to consider their own characteristics. The opening of high-speed railways and ordinary railways have different effects on the economic development of different cities. Some cities may integrate resources and gather elements in a wider range, while some cities have no attraction force, which makes it easier for resource elements to flow outward.

As China's economy as a whole enters a new era, all counties and cities should seize the opportunity to break down the barriers between regions with the support of high-speed railways and ordinary railways, promote the construction of a unified market, focus on eliminating market barriers, and expand the "regional Economic integration" construction efforts [16]. Strengthen regional exchanges and cooperation, promote the optimal allocation of resources, realize complementary advantages, promote the equalization of basic public services in regions, urban and rural areas, and realize shared development [17].

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