Do High-Speed Trains improve the urban economy? Evidence from the Yangtze River Delta

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Abstract:

High-Speed Trains vastly improve traffic connections among cities and have significant impact on the regional spatial structure. On the one hand, high-speed trains bring new opportunity for urban economic development; on the other, for cities less competitive, high-speed rail may exacerbate the resources flow and become a new challenge for municipal development.
China pays attention to high-speed railway construction since the 21st century and soon plays a leading role in the world. In this essay, the Yangtze river delta is chosen as the research object to examine whether high-speed trains improve the urban economy or not.
The quantitative model is modified from CD production function. The dependent variable is GDP in every city in each year. Three basic variables are: fixed asset investment, labor, and the proportion of tertiary industry. This study includes two observation variables: railway passenger flow and whether there is HST this year (dumb variable). Based on data from 24 cities from 2009 to 2016, I use a regression model to analyze the economic impact of HST in YRD. As a result, the overall construction of HST has a positive impact on urban economic development, but this effect is not significant for non-first-tier cities.

1. Introduction

High-Speed Trains (in short, HSTs) vastly improve traffic connections among cities and have significant impact on the regional spatial structure. It has become a hot topic in the field of economic geography for a long time that whether the high-speed trains improve urban economy or not. In China, the first HST line, Beijing-Tianjing HST line was open to traffic in 2008, which signals a revolution in the regional transit system.
Passed by HST line means that the city has been incorporated into a more efficient economic network, and thus it has become an important strategic resource in the competition among major cities. But on the other hand, many scholars mention that the construction of HST has adverse effects, that aggravates the outflow of resources for some cities. The effect of high-speed trains on the economic growth of cities along the lines becomes a heated topic. I will examine this effect by observing the Yangtze River Delta area and base on panel data from 2006 to 2016.

2. Literature review

2.1 high speed trains construction in China

"High speed" is a relative concept compared to the speed of ordinary railways. The definition of high speed railways varies in different countries. The State Railway Administration of China defines the High-Speed Train as: trains designed to 250km/h (including the upgraded ones) and more EMU trains, and the initial operation speed is not less than 200 km/h.
The construction of HST in the world started in Japan. In 1964, Tokyo-Osaka's Shinkansen was the first HST line with a speed of 210km/h, making a day trip possible between Tokyo and Osaka. In 1981, the first TGV high-speed train line opened in France, connecting Paris with Lyon and running at 270km/h. Subsequently, the HST lines in Germany, Spain and other countries have been opened, including not only the newly built HST lines, but also the

upgraded lines based on the original railways. The HST has become the core issue attracting global attention in the second half of the twentieth Century, bringing the second railway age. In twenty-first Century, China began to focus on high-speed and large volume railway construction and put it into practice quickly. The State Council of China depicted "four vertical and four horizontal" passenger HST lines in the Medium and Long Term Railway Network Plan, released in 2004. In 2009, Wuhan-Guangzhou HST marked the High-Speed Train Era in China with the speed of 394km/h. A global report by the world bank compared the construction of HST all over the world, as showed in the figure 1 and 2. HST construction of China quickly surpassing the developed countries in Europe and the United States. China becomes the country with the longest mileage of HST in the world.

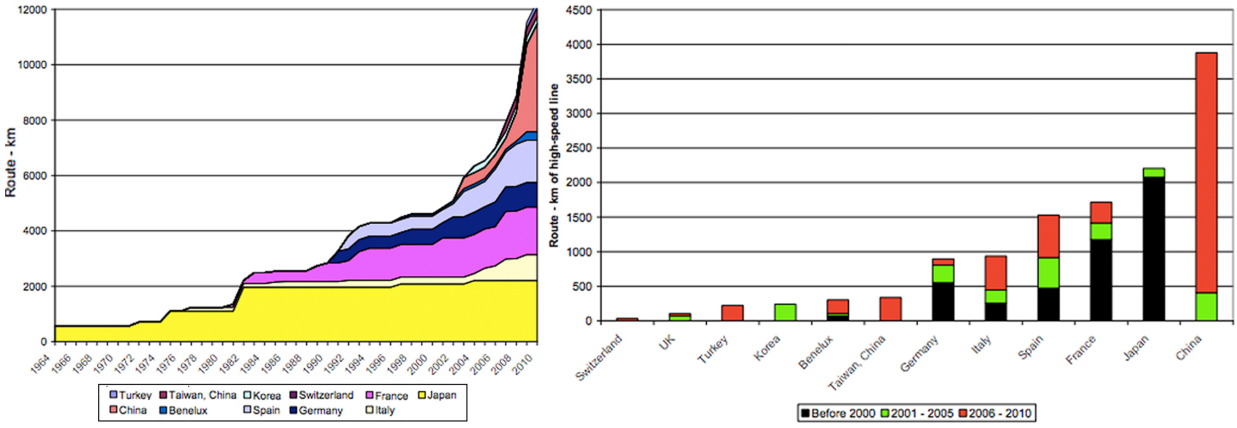

Figure 1-2: The world's HST mileage 1964-2010； HST mileage increasement 2001-2010（source: the World Bank report）

However, after ten years of rapid development, the regional disparity of HST construction of China is noteworthy. As Myrdal(1957) said, the more developed regions are, the more attractive they are to attract new investments. In 2012, scholars applied accessibility analysis on national HST lines and found that HST network can improve the accessibility of the whole country, but the promotion of accessibility is not balanced nationwide. They expected that with the expansion of HST construction to the west, it may be more balanced. Based on National High-Speed Rail data and GDP data in 2014 compared with data in 2006, Liu conducted a spatial analysis by GIS and found "corridor effect" along Beijing-Shanghai, Beijing-Guangzhou, Shanghai-Wuhan and Shanghai-Xuzhou-Xi'an. Places with high accessibility gathered near larger cities and HST corridors. Wen (2017) analyzed the influence of HST on the accessibility of Chinese cities on a scale of urban agglomeration. It is proved that the HST construction has the largest impact on the Yangtze River Delta area, and influence on Beijing-Tianjin and the Pearl River Delta followed. In this essay, I will examine the influence on the Yangtze River Delta.

2.2 debates on influence of HST on urban economy

Scholars who believe that the construction of HST promotes local economy explain that the HST lines can enhance the economic ties among cities, and then promote the integration and overall development of the regional economy. The main logic of this conjecture is that the HST strengthens city accessibility, thereby enhancing the regional production factors and ultimately bringing about economic growth. Scholars first proved that with the construction of high-speed rail network, the accessibility of cities has been significantly enhanced. There is an obvious correlation between accessibility and production factors in the region. From the perspective of time and space compression, faster speed redefines the boundary of the interconnected regions, facilitates cooperation in a larger regional market, and expands the scope of the flow

of production factors. Accordingly, some scholars with positive attitudes point out that "there will be an integrated development trend between cities or regions" and may form a "high-speed rail economic belt".

Along with the HST construction nationwide, more and more scholars remind the negative effects of HST construction on the development of cities along the line. For example, Wang Jie(2015) think that "siphon effect" is a major challenge for cities along the high speed rail line, that the lost resources exceed resources being attracted to invest in the target city. The development of regional transport network is a double-edged sword. The convenience brought by HST speeds up the resource flow, and also promote the accumulation of capital, talents and information to the regions with more competence. That is, the HST construction can greatly improve the accessibility of the city and promote the formation of a larger scale of the division of labor, but for some cities, the loss of the elements will also be accelerated.

Since the 70s of the last century, the impact of the construction of high speed rail on the urban economy and the regional economic pattern has attracted wide attention from scholars in Japan, Britain and France. For example, Bonnafous (1987), when studying the impact of French high speed rail (TGV) on the development of Lyon City, pointed out that high speed rail transit provides a new economic vitality for the economic development of Lyon. Pol (2003) also put forward a similar view by a case study in Lille, but at the same time, he believed that only cities with exceedingly economic potential can use the accessibility of large external traffic to improve their own economy. If not, the increase of external traffic accessibility will even bring the backwash effects. Puga (2008) also indicated that the high-speed railway benefited the core cities at the expense of minor cities, exacerbating the regional imbalance.

In China, scholars are still arguing about the effect of China's HST development on the urban economy. Some scholars believe that HST has brought opportunities for some cities, but they never indicate cities gaining profits while others losing fortunes on a scale of urban agglomeration. Some scholars point out that the siphon effect of HST construction has existed but fail to scale the influence, because the duration after HST construction is too short. This study tries to analyze the effect in YRD area, hoping to show the impact of the HST on the economic development of the cities.

3. Research design

3.1 research area

As cited above, the construction of China's HST started from east to west, and the urban agglomeration in the Yangtze River Delta is one of the first agglomerations equipped with HST and the speed of construction is astonishing and the passenger volume is remarkable. Considering the following three reasons, this study chose the Yangtze River Delta as the research object. Firstly, as a world-class urban agglomeration, the YRD is in the forefront of the country with an active market and strong capital flow, thence it is easier to observe the economic adjustment. Secondly, HST construction started relatively early in YRD, which can provide data for this study for a relatively long time. Besides, information and development data of the Yangtze River Delta urban agglomeration are relatively open. According to the development plan of the Yangtze River Delta urban agglomeration in 2016, this area includes Shanghai, 9 cities of Jiangsu province (Nanjing, Wuxi, Changzhou, Suzhou, Nantong, Yancheng, Yangzhou, Zhenjiang, Taizhou), and 8 cities of Zhejiang Province, 8 cities (Hefei, Wuhu, Ma'anshan, Tongling, Anqing, Chuzhou, Chizhou, Xuancheng), as a total of 26 cities. By 2016, 24 cities(except Yancheng, Zhoushan) had been included in the national HST network. In order to compare the relationship between economic development and high-speed rail transport, the panel data in this study ranged from 2006-2016. Finally, 166 objects were obtained, including Shanghai, Nanjing, Hangzhou, Hefei, Ningbo, Taizhou, Jiaxing, Shaoxing, Jinhua, Suzhou, Shanghai, Nanjing, Hangzhou, Hefei, Ningbo, Taizhou, Jinhua, Suzhou, Wuxi, Wuxi, Ningbo, Ningbo, Hangzhou, Hangzhou, Taizhou, Jiaxing, Jinhua, Suzhou.

In the context of China's high-speed rail, I consulted the difference between D line and G line.

High speed railways generally refer to "railway lines" while D line refers to a type of marshalling trains. According to some scholars' textual research, EMU trains run on high-speed railways in Russia, which means that the two concepts are not antagonistic. In China, the difference of high speed rail and motor train is in speed, that the D train runs at 200-300km/h speed while the G high speed rail reaches above 300km/h. According to China Railway Administration, trains running at more than 200km/h are HSTs, so cities with D trains passing through are also calculated in this study. The construction sequence of the Yangtze River Delta high-speed railway is shown in the following table.

Time	Line	Cities (in YRD)
2008	Hefei-Nanjing line	Hefei, Nanjing
2009	Yong-Wen line	Ningbo, Taizhou
2010	Shanghai-Nanjing line	Shanghai, Suzhou, Wuxi, Changzhou, Zhenjiang, Nanjing
2010	Shanghai-Hangzhou line	Shanghai, Jiaxing, Hangzhou
2011	Beijing-Shanghai line	Chuzhou, Nanjing, Zhenjiang, Changzhou, Wuxi, Suzhou,
2013	Hangzhou-Ningbo line	Hangzhou, Shaoxing, Ningbo
2013	Ningbo-Hangzhou line	Nanjing, Changzhou, Huzhou and Hangzhou
2014	Hangzhou-Changsha	Hangzhou, Shaoxing, Jinhua
2015	Hefei-Fuzhou line	Hefei, Tongling, Xuancheng
2015	Jinhua-Wenzhou line	Jinhua
2015	Nanjing-Anqing line	Nanjing, Ma'anshan, Wuhu, Tongling, Chizhou, Anqing
2016	Nanjing-Nantong line	Nanjing, Yangzhou, Taizhou, Nantong

Table1: construction sequence of HST in Yangtze River Delta area

3.2 model and variables

Taking the construction of HST as one of the independent variables, this study uses an econometric model to simulate the development of the urban economy. In the traditional econometric research, CD function is widely used to estimate the development of the urban economy. That is, economic progress is determined by technology, capital and labor force. In the study of economic development in the YRD area, some important conclusions have been obtained by simulation and correction of models. For example, Zhang Xiaodi and Li Xiaozhong (2005) compared the TFP and the growth rate of Jiangsu, Zhejiang and Shanghai in the YRD area, finding that the marketization and internationalization were the main ways to improve the regional efficiency. Zhou Xiaoyan (2009) analyzed the economic growth of the YRD by a stochastic production frontier model. It is believed that the improvement of the urbanization rate, the structure of the second industry, the level of infrastructure and the level of human resources in the second industry will increase the efficiency of production. Zhang Xueliang and Sun Haiming (2009) divided the economic growth of the Yangtze River Delta into four parts: capital accumulation, efficiency improvement, technological progress and human capital input through DEA analysis. It is considered that the dominant economic growth is still the accumulation of material capital, and the second is the accumulation of human capital. At the same time, they found evidence of TFP's leading role in economic growth in Shanghai.
Based on previous studies, this essay modifies CD function. First of all, the economic development of the YRD area mainly depends on the accumulation of capital and labor force. Other factors, such as technological progress, industrial structure and policy advantages, have different degrees of contribution. The first-tier cities, such as Shanghai, are more affected by

technological progress. Considering the availability of data, this essay selects three main variables including fixed assets investment, labor quantity and three production proportion. According to the purpose of this study, the statistics of railway passenger flow and whether HST lines passes by are also included. To eliminate heteroscedasticity, I take the logarithm of both sides and the model in this study as follows:

$$lnY_{it} = c + \alpha_1 lnL_{it} + \alpha_2 lnK_{it} + \alpha_3 S_{it} + \alpha_4 lnQ_{it} + \alpha_5 P_{it} + \alpha_t + \beta_i + \varepsilon_{it} \quad (1)$$

The dependent variable Y is the annual gross domestic production (GDP) of each city.
The five independent variables are:
1) Variable L stands for the labor force. The value is the total number of employed persons in various cities at the end of each year.
2) Variable K stands for capital and the value is the total investment in fixed assets of different cities at the end of each year.
3) Variable S stands for the industrial structure and value is the proportion of third industries to the annual gross domestic production.
4) Variable Q stands for the railway passenger flow and the value is the railway passenger volume each city in a year.
5) P is a dumb variable indicating whether HST line passes through this city or not. The value is 1 since the year when HST line passed, which is 0 before this year.

The key variables of observation are: Q_{it} and P_{it}.
If significant positive effects of the dumb variable on economic growth are observed, it proves that HST promote urban economy. Besides, I will further study non-first-tier cities in the YRD area. If significant negative effects of economic growth were observed, it demonstrates significant siphon effect of HST on the non-front-line cities.

4. Results

Firstly, 166 objects are analyzed by a panel regression model. The results are obtained by using the fixed effect and the random effect, and the result of Hausman test is 0.1053. Therefore, the fixed effect estimation is selected (Table 2). According to the results, there is a significant positive effect (95% confidence interval) in labor force, capital input and industrial structure. In addition, within the 95% confidence interval, the railway passenger flow has a significant positive effect on the urban economic development in the YRD area. The dumb variable P has a significant positive effect on the urban economic development in the 90% confidence interval. Therefore, generally speaking, HST construction has positive effects on urban development.

Variable	estimated coefficients	standard deviation	P value
L	0.948	0.111	0.000
K	0.346	0.035	0.000
Q	0.110	0.035	0.002
S	1.894	0.351	0.000
P	0.053	0.032	0.100

Table2: Results of economic development and HST construction in Yangtze River Delta

Then the panel data of non-first-tier cities is analyzed. 12 cities, including Hefei, Ningbo, Taizhou, Jiaxing, Shaoxing, Jinhua, Wuxi, Changzhou, Zhenjiang, Wuhu, Ma'anshan and Nantong, are selected for further regression. The amount of objects is 111. Through Hausman test, p value is 0.0215, and thence this part chooses fixed effect regression model, and the estimated results are shown in Table 3.

Variable	estimated coefficients	standard deviation	P value
L	1.354	0.149	0.000
K	0.261	0.043	0.000
Q	0.070	0.043	0.104
S	2.953	0.494	0.000
P	0.018	0.042	0.668

Table3: Results of economic development and HST construction effect of non-first-tier cities in YRD

According to panel regression analysis, labor force, fixed capital and industrial structure have significant positive effects on the economic development of non-first-tier cities. In the 90% confidence interval, railway passenger flow has positive effects on the urban economic development. However, the dumb variable doesn't show a significant economic contribution. That is, for non-first-tier cities, the effect of HST on urban economic development is not significant.

5. Conclusion and discussion

This essay first analyzes the impact of HST construction on the economic development of cities theoretically. Due to the significant spatial compression effect, HST construction is conducive to the economic cooperation and development of cities along the line, but the risk of resources outflow of non-first-tier cities is also increasing. Further, I conduct an empirical test based on panel data of Yangtze River Delta area for 11 years. The results show that the overall construction of HST has a positive effect on urban economic development, but this effect is not significant for non-first-tier cities.

The results of this empirical analysis reflect the complex effects of HST construction on urban economic development. For cities with superior economic development and strong resource competitiveness, they can easily benefit from high-speed railway stations. For non-first-tier cities, the construction of HST does not have a significant positive effect on urban economy, perhaps because of the "siphon effect", but the negative effect on economic development has not been found in the empirical analysis either. Perhaps for the YRD urban agglomeration, HST construction can promote the restructuring of the urban agglomeration economic structure, but the specific effects need to be further observed.

However, there are still many deficiencies in data analysis, which include three aspects: sample selection, variables and time effect.

Firstly, the total amount of data selected in this paper is small. Although the Yangtze River Delta's HST construction is at the forefront of the country, many cities only have high-speed rail after 2010. In order to expand the number of samples and form a contrast, this paper extends the time of panel data to 2006-2016 years, but the time of high speed rail in some cities is too short, which is unfavorable to the analysis of panel data. In addition, the difficulty of obtaining urban statistical data leads to the lack of many samples, resulting in a smaller data range.

Secondly, the selection of variables is limited by data availability. For the economic development of the urban agglomeration in the YRD, labor, capital and land are important factors, but the influence of policy, innovation and technological revolution is also significant. In the previous study, some scholars pointed out that only Shanghai has found the significant influence of policy and technological innovation on the economic development. Therefore, in this research, the model is simplified, and these kind of variables are not included.

Thirdly, in the result of the quantitative analysis, the construction of HST has no significant effect on non-first-tier cities. This conclusion also needs further observation. For some cities, after the high-speed rail operation in 2014, there is not sufficient data in this study, which needs further observation and analysis.

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