Impact of Beijing-Guangzhou High-speed Rail on Capital Accumulation in Cities Along the Line

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Abstract. The development of transportation has triggered regional element flows by changing the location conditions of cities along the route. In recent years, with the full implementation of the National Medium and Long-term Railway Network Plan, China's high-speed railway network layout has continued to expand, and high-speed rail has become an important means of transportation for people. The development of high-speed railways will definitely have a wide-ranging and far-reaching impact on the concentration of elements along the route. This article takes the Beijing-Guangzhou high-speed rail as an example, adopts the matching idea as the high-speed rail experimental group to match the control group, and estimates the impact of high-speed rail on the accumulation of capital factors by constructing a double difference model. The results show that the completion of the Beijing-Guangzhou high-speed rail has made a significant contribution to capital agglomeration.

1. Introduction
The emergence and development of transportation infrastructure is an important foundation for regional factor flows, and it is the backbone support that any country must pay attention to in the process of economic development. At the same time, the relationship between transportation and factor flows is also a hot issue widely studied and discussed by domestic and foreign scholars. Whether in classical location theory, modern location theory, or new economic geography, it can be found that changes in transportation costs will cause changes in the direction and scale of economic factor flows. With the advancement of technology and the improvement of transportation methods, in order to meet the transportation needs of people with the times, high-speed railways have emerged. As an emerging mode of transportation, it can significantly reduce interregional transportation costs, which will inevitably affect the pattern of spatial accumulation of economic factors.

2. Literature review
In terms of economics, factors refer to the factors invested in the formation of the final product, including capital and labor. In a region, the elements are always in a flowing state, and eventually they will always form a cluster of elements in a certain area. The Chinese Academy of Social Sciences' "High Speed Rail Impact on Urban Agglomerations" research report conducted a comprehensive and comprehensive study of the areas along which high-speed rail has been opened, and concluded that high-speed rails have the following four effects on the development of urban agglomerations: (1) Space-time effects: The high-speed transportation network shortens the distance between cities in time and promotes the flow of factors; (2) Boundary breakthrough effect: The high-speed transportation network spatially expands the space for factor aggregation and diffusion; (3) Location enhancement
effect: transportation location changes in conditions have improved the investment environment in the area where the station is set up, which has led to agglomeration of factors; (4) Factor integration effect: resources can be reintegrated along the line. Jin Fengjun et al. (2007) believed that the speed increase of railway passenger transportation can shorten the space-time distance between areas along the line, reduce transportation costs, accelerate the flow of people, logistics, capital flows, and information flows, and have a significant impact on the regional industrial structure. Wu Hui (2014) pointed out that the construction of high-speed rail has effectively promoted the flow of factors, and promoted the accumulation of labor, capital, and technology in cities along the high-speed rail, forming a new industrial concentration belt. Givoni (2006) research found that high-speed rail effectively improves the level of interregional accessibility, improves the convenience and possibility of enterprises to seek production factors in time and space, reduces the cost of production and sales of enterprises, and makes the return rate on investment of enterprises increase. At the same time, the high-speed rail is conducive to further strengthening the exchanges and cooperation between cities, which increases the frequent exchanges between cities, smooth communication, and reduces transaction costs, thereby accelerating the flow of capital factors. Long Yu et al. (2017) studied the impact of high-speed rail on the scale of venture capital in cities along the route from the perspective of venture capital. Through empirical research, it is concluded that the increased accessibility brought about by high-speed rail and the effect of space-time compression make cities along the high-speed rail attract more venture capital. Yu Qin (2017) believes that the infrastructure investment brought by the construction of high-speed railways will guide economic activities from the less affected areas to the more affected areas. The railway speed upgrade in 2004 and 2007 is the object of investigation. It is found that the total GDP and per capita GDP of counties located on high-speed rail lines without high-speed rail stops have dropped significantly. Therefore, it is believed that high-speed rail has improved the accessibility of cities along the stations, and at the same time, the factors such as capital and labor of surrounding cities have moved to the stations city.

3. Empirical analysis

3.1. Beijing-Guangzhou High Speed Rail

The Beijing-Guangzhou high-speed rail line opened for operation on December 26, 2012, and is an important one of the "eight vertical and eight horizontal" national high-speed rail lines, with a total length of 2118 kilometers and a design speed of 350 kilometers per hour. Since its operation, it has been safe, stable, and orderly, and passenger shipments have continued to increase. The Beijing-Guangzhou high-speed railway connects the Bohai Rim Economic Circle, the Central Plains Economic Zone, the Wuhan City Circle, the Changzhutan Urban Agglomeration, and the Pearl River Delta Economic Zone. As the world's longest mileage high-speed rail line, there are 39 stations in total, connecting 26 cities, including first-tier cities such as Beijing, Guangzhou, and Shenzhen, and provincial capitals such as Shijiazhuang, Zhengzhou, Wuhan, and Changsha.

3.2. Empirical model construction

The generalized multi-period DID model constructed in this paper is as follows:

$$\ln FDI_t = \beta_0 + \beta_1 H_t + \beta_2 T_t + \beta_3 GDP_t + \beta_4 Pr_t + \beta_5 Invest_t + \beta_6 Gov_t + \beta_7 Hit_t + \beta_8 Control_t + \beta_9 Time_t + \varepsilon_t$$

| Variable category | index | Express | Variable meaning |
|-------------------|-------|---------|------------------|
| Agglomeration variables | capital | InFDI | Foreign direct investment |
| virtual variable | Experimental group / control group | Hit | The sample in the experimental group is 1 and the sample in the control group is 0 |
| | Time dummy | Tit | The year before the opening of the high-speed rail is 0, and |
Control variable                                 | the year after opening is 1
-----------------------------------------------|---------------------------------------------------
Urban economic development level               | pgdp                                          | GDP per capita
Human capital level                           | stu                                           | Number of students in regular colleges and universities
Urban population size                          | peo                                           | Population at the end of the year
labor cost                                     | salary                                        | Average wage of employees in urban units
Investment level of fixed assets               | linvest                                       | Proportion of urban fixed assets investment in regional GDP
environment system                            | gov                                           | Proportion of government public fiscal expenditure to regional GDP

The above formula will be the benchmark model studied in this paper. Among them, the control variable is a covariate that affects both the degree of aggregation of urban capital elements and whether the high-speed rail passes the city.

3.3. Data source and processing
The time range of the data used in this paper is from 2006 to 2016. The sample cities studied are cities above the prefecture level. The control variable data in the model are mainly derived from the China City Statistical Yearbook (2006-2017) and the EPS database. For some missing statistical data, this paper uses interpolation to fill.

3.4. Outcome of Practice
Column (1) shows the impact of foreign direct investment in high-speed rail opening using double-difference (DID) analysis. After the high-speed rail opens, it can be found that the growth rate of foreign direct investment in cities that have opened high-speed rail is 18% higher than in cities that do not have high-speed rail. And it is significant at the 10% confidence interval. It should be noted that there is no propensity value matching analysis in column (1).

Column (2) shows the results of the double-difference analysis using PSM-DID. It can be found that after the precise matching, the difference between the experimental group and the control group is reduced, and the impact of the opening of the high-speed rail to foreign direct investment is more obvious. With a significant 5% confidence interval, the growth rate of foreign direct investment in cities with high-speed rail is 27.8% higher than in cities without high-speed rail. Comparing column (2) and column (1), it can be found that the matching of propensity scores is necessary in this study. The difference between cities is further eliminated by matching to obtain the net effect of high-speed rail opening on urban foreign direct investment.

Column (3) shows the impact of high-speed rail changes in different years after the opening of the high-speed rail. It can be found that the impact of the high-speed rail in the first, second and fourth years of the opening of the high-speed rail is significantly positive, of which the third year is not significant and the fifth year is not significant. As time increases, it gradually decreases.

In order to further study the impact of the opening of the high-speed rail on cities of different population sizes, cities are divided into two categories according to the quantile of urban population density, one is large cities, and the other is small and medium cities. Columns (4) and (5) respectively reflect the impact of foreign direct investment in the opening of high-speed rail in large cities and small and medium-sized cities. It can be found that the impact of high-speed rail on large cities is significant, while the impact on small and medium cities is not significant.

| Table 2. Regression Analysis of the Impact of High-speed Rail's Foreign Direct Investment |
|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|
|                                        | (1)                                    | (2)                                    | (3)                                    | (4)                                    | (5)                                    |
| lnFDI                                  | 0.188*                                 | 0.278**                                | 0.310*                                 | 0.080                                  |
| lnpgdp                                 | -0.165                                 | -0.306                                 | -0.345*                                | 0.014                                  | -1.026**                               |
| lnstu                                  | 0.008                                  | 0.050                                  | 0.077                                  | 0.337*                                 | -0.103                                 |
|   | (0.06) | (0.35) | (0.52) | (1.72) | (-0.57) |
|---|--------|--------|--------|--------|---------|
| lnpeo | 0.141  | 0.213  | 0.252  | 0.050  | -1.332  |
| lnsalary | -0.100 | -0.042 | -0.126 | 0.444  | -0.520  |
| linvest | 1.578*** | 1.811*** | 1.688*** | 1.545** | 2.161*** |
| gov | -2.953* | -3.847** | -3.460** | -4.319  | -2.799  |
| HT1 | 0.284*** | | | | |
| HT2 | 0.259** | | | | |
| HT3 | 0.238  | | | | |
| HT4 | 0.443*** | | | | |
| HT5 | 0.269  | | | | |
| HT6 | -0.284 | | | | |
| HT7 | -0.504 | | | | |
| cons | 1.499  | 1.445  | 2.121  | -8.051 | 23.144  |
| N | 793    | 643    | 643    | 363    | 279     |
| r2 a | 0.551  | 0.505  | 0.516  | 0.543  | 0.502   |
| F   | 28.434 | 18.407 | 25.460 | 27.644 | 41.230  |

### 4. Conclusion
This article selects the cities along the Beijing-Guangzhou high-speed rail line as the research object, and uses the propensity score matching multiple method to try to estimate the impact of high-speed rail on the accumulation of capital factors. Based on the above research, this article draws the following main conclusions:

1. The Beijing-Guangzhou-Shenzhen Railway has significant time effects on the capital elements of the cities along the route. In the early stage of opening, the high-speed rail promoted the accumulation of urban elements along the line, but as the opening time prolonged, the effect of high-speed rail on the elements became diffuse.

2. The impact of the Beijing-Guangzhou high-speed rail on the accumulation of capital elements in cities along the route has significant differences among cities of different sizes.

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