Quantitative Analysis of High-speed Rail Spillover Effect——Evidence from Sichuan Tourism

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Abstract. Since China opened its first high-speed railway in August 2008, high-speed railways have developed rapidly in China. The rapid development of high-speed rail has brought a huge spillover to China’s social and economic development. An important aspect is that high-speed rail has promoted the transformation and upgrading of the regional economic structure. Taking Sichuan province as an example, this paper uses the difference in difference (DID) method to analyze the effect of the opening of high-speed rail on the development of tourism. The conclusions of this paper show that the opening of high-speed rail has promoted tourism development of Sichuan province. This paper also has some important implications for the planning and construction of high-speed rails in other regions.

1. Introduction

High-speed railway refers to a railway with high design speed standards that allows trains to travel safely at a high speed on the track. China opened its first high-speed railway in August 2008, the Beijing-Tianjin Intercity Railway. Since then, high-speed railways have entered a period of rapid development. According to data from China Railway Corporation, by the end of 2018, China's high-speed railways have reached 29,000 kilometers, accounting for more than 65% of the world's total high-speed rail mileage. China has become the country with the longest high-speed rail mileage, the highest density and the most complex operating scenarios in the world. High-speed railways have become the main channel of railway passenger transportation in China and play a very important role in China's social and economic development. Among the spillover effects of high-speed rail on regional social and economic development, one of the important aspects is that high-speed rail has promoted the development of local tourism. The largest high-speed railway network has an impact far beyond the railway industry itself, and has also brought about changes in the urban development, the growth of tourism, and the promotion of regional economic growth.

At present, the decline in exports caused by the trade disputes between China and the United States has some negative effects on the economy. It is necessary to accelerate the transformation of the economic structure, expand domestic demand, and increase the driving effect of consumption on the economy. On September 20, 2019, China issued the "Opinions on Improving the Consumption Promotion System and Mechanism to Further Stimulate Residents' Consumption Potential". The "Opinions" pointed out: In recent years, China has been expanding the scale of consumption. Notable achievements have been made in raising consumption levels and improving the consumption structure. However, it must be noted that the current institutional obstacles to the expansion and upgrading of consumption are still prominent. It is necessary to further improve the consumption system and mechanism to further stimulate the consumption potential of residents. Tourism, as a typical green
economy, is an important industry that needs to be developed in future. It can be seen from the "Opinions" that tourism will become one of the important industries that China will develop in the future. The improvement of transportation infrastructure will undoubtedly greatly promote the development of tourism. Taking high-speed rail as an example, the impact of high-speed rail on the tourism industry is mainly reflected in the following aspects: 1. The high-speed rail has a large volume and it is easy to buy tickets, which makes it more convenient for people to travel; 2. The high-speed rail is faster than ordinary trains, compared to airplanes. The waiting time period and the relatively low ticket price not only shorten the time people spend on the road when traveling, but also reduce the cost of travel. It makes weekend trips that could not be carried out before become possible. 3. The clean and comfortable ride of the high-speed rail also greatly pleases people's travel mood, making the high-speed rail the first choice for travel within 500 kilometers. For regions with rich tourism resources but underdeveloped external transportation, the opening of high-speed rail will undoubtedly greatly promote the development of local tourism. The next part of this paper will quantitatively analyze the spillover effect of the opening of high-speed rail to the local tourism industry.

2. Literature Review

The impact of high-speed rail on urban and regional development is mainly reflected in the following aspects: changing the urban spatial structure; making the same-city effect more significant, weakening the boundaries between cities and regions; and promoting economic development.

The development of high-speed railways will strengthen the existing urban hierarchy and help promote the formation of urban networks. The development of high-speed rail to the urban economy is reflected in two aspects—catalysis and promotion. From the perspective of catalysis, linking with the high-speed rail network will attract new economic activities to the city, thereby bringing about economic growth. High-speed rail affects not only urban development, but also strengthens regional economic ties. Sun Ting (2008) analyzed the Kyoto Shinkansen line in Japan and found that high-speed railways promoted the formation of urban circles and promoted regional economic integration; Liu Yi et al. (2018) found that the opening of high-speed railways promoted the integration of the Beijing-Tianjin-Hebei region China. Ou Guoli and Xie Hui (2017) analyzed the impact of high-speed rail on regional economy. They found that high-speed rail enhances the strength of regional economic ties by improving the accessibility of cities along the route and enhances the overall regional economic integration strength. High-speed rail promotes population mobility, and the convenient transportation conditions can attract migrants to work locally and improve the quality of local labor (Dong Yanmei and Zhu Yingming, 2016). High-speed rail can not only promote local economic development, but its spatial spillover effect can also promote the economic growth of neighboring cities (Liu Yongzheng and Li Yan, 2017). The construction of high-speed rail has also significantly changed the regional economic structure. Li Hongchang et al. (2016) found that the impact of high-speed rail on the economic agglomeration level of eastern, central and western cities has significant differences, and high-speed rail can promote economic agglomeration in the western region.

In addition to promoting the growth of regional economic aggregates, high-speed rail also plays an important role in promoting regional industrial upgrading and consumption structure upgrading. One of the important aspects is the promotion of high-speed rail to the development of tourism. Regarding the impact of high-speed rail on tourism, some scholars at home and abroad have done a lot of research. Paul Peeters et al. (2007) analyzed the entire European high-speed rail transportation system and found that the rapid development of high-speed rail has promoted the integration of European countries in social and economic aspects. High-speed rail plays a pivotal role in the travel of European countries. Paul Peeters et al. (2007) pointed out that the construction of high-speed rail stimulates tourism development. The emergence of a large number of tourists has also caused the adjustment of the industrial structure of tourism enterprises. For example, in the research of Bolden, T., & Harman, R. (2013), it is also pointed out that the fast and convenient high-speed rail reduces travel time. This has led to a rapid increase in the number of "day trips" tourists, which has also had an impact on the accommodation industry in tourist destination cities.
Based on the above literature, the impact of China's high-speed rail on tourism is mainly concentrated in qualitative aspects, and there are relatively few quantitative studies. Some existing quantitative studies are also based on the micro data research of questionnaire surveys. Based on macro data, this paper attempts to use econometric methods to study the spillover effect of high-speed rail openings to the local tourism industry.

3. Empirical Analysis

In recent years, China’s tourism has developed rapidly, and the most important reason is the rapid growth of residents’ income. In recent years, the per capita disposable income of Chinese residents has grown rapidly, which has provided a solid foundation for tourism and other consumption. According to data from the National Bureau of Statistics of China, the per capita expenditure on education, culture and entertainment of Chinese residents has accounted for more than 10% of the total expenditure. Tourism has become more and more a necessity for residents. From a macro perspective, tourism has increasingly become a new driving force for economic development. Table 1 shows the relevant situation of China’s tourist arrivals and tourism income from 2010 to 2018. It can be seen that in recent years, China’s tourist arrivals and tourism income has shown a trend of substantial growth, and its role in economic development has become increasingly important. The overall contribution of the national tourism industry to GDP in 2017 was 9.13 trillion yuan, accounting for 11.04% of the total GDP. Tourism directly employed 28.25 million people and has gradually become a new growth point for China's economy.


| Year | Domestic tourist arrivals ( million ) | Domestic tourist income ( million ) | Number of tourists (thousand) |
|------|--------------------------------------|------------------------------------|-------------------------------|
| 2010 | 21.03                                | 12580                              | 5739                          |
| 2011 | 26.41                                | 19035                              | 7025                          |
| 2012 | 29.57                                | 22706                              | 8318                          |
| 2013 | 32.62                                | 26276                              | 9819                          |
| 2014 | 36.11                                | 30312                              | 10728                         |
| 2015 | 39.9                                 | 34195                              | 11689                         |
| 2016 | 44.35                                | 39390                              | 12203                         |
| 2017 | 50.01                                | 45661                              | 13051                         |
| 2018 | 55.39                                | 51278                              | 14972                         |

Note: The data comes from the Ministry of Culture and Tourism

This paper takes Sichuan Province as an example to analyze the impact of the opening of high-speed rail on the tourism industry in Sichuan Province. There are two main reasons for choosing Sichuan Province to analyze the impact of high-speed rail construction on the tourism industry: First, many cities in Sichuan province have very rich tourism resources, such as the Chengdu Giant Panda Base and Leshan Giant Buddha. Second, the transportation connection between Sichuan Province and other provinces has not been very convenient. Therefore, even though Sichuan Province has abundant tourism resources, if the external transportation is inconvenient, the tourism industry will also unable to achieve better development. This helps to examine whether the opening of high-speed rail has an impact on the tourism industry in Sichuan Province.

First of all, from public reports on the Internet and the official website of the National Railway Administration, we collected the time for the opening of high-speed rail in various cities in Sichuan Province-see. Since 2008, Sichuan Province has established 52 high-speed rail stations. The first high-speed railway station is the Chengdu Station, which was established in Chengdu in May 2010. Overall, despite the constraints of the geographical environment, the construction of high-speed railways in Chengdu is relatively fast. Since the opening of the first high-speed rail in Sichuan Province in 2010, Sichuan’s tourism operating income and tourist numbers have entered a stage of rapid growth. Despite fluctuations, the overall growth is very rapid. As of 2017, the operating income of scenic spots in Sichuan Province has been close to 450 billion yuan. According to the data published by Sichuan Province's tourism work TV and telephone recalls, if the tourism-driven income of hotels and catering is included, the total tourism revenue of Sichuan Province in 2017 exceeded 890 billion yuan. Yuan, only one step away from the trillion industry. The number of tourists in scenic spots in Sichuan Province exceeded
540 million. If including self-driving tours and other tourists who are not counted in the scenic spots, it is close to 669 million. According to the official website of the National Bureau of Statistics, Sichuan’s GDP in 2017 was 3.7 trillion yuan, and tourism revenue accounted for approximately 24% of GDP. Obviously, the tourism industry has become a new growth point driving Sichuan’s economic growth. In addition, the tourism industry has very little pollution and has a great stimulating effect on surrounding industries, which is conducive to promoting the economic restructuring and high-quality economic development of Sichuan Province.

This article uses econometric methods to quantitatively study the impact of the opening of high-speed rail on the development of tourism in Sichuan Province. For missing data, this article performs interpolation processing, and for a large number of missing samples, it is deleted.

This paper uses the DID model to study the impact of the opening of high-speed rail on Sichuan’s tourism revenue, the regression is as below:

$$\ln income_{it} = \alpha_0 + \alpha_1 \text{highspeedrail}_{it} + \alpha_2 \ln gdp_{it} + \alpha_3 \ln population_{it} + \alpha_4 \ln attractions_{it} + \alpha_5 \ln hotels_{it} + \alpha_6 \ln restaurants_{it} + year_t + region_t + \epsilon_{it} \quad (1)$$

The subscript $i$ represents a certain city, $t$ represents the year, and the dependent variable is the income log value of income. The logarithm is used to reduce the influence of heteroscedasticity. The same is true for the logarithm of the related control variables. The independent variable is whether to open the high-speed rail. The control variables are the log value $\ln gdp$ of each city's GDP, the log value of population $\ln population$, the number of city scenic spots attraction, the number of local hotels $\ln hotels$, and the number of restaurants $\ln restaurants$. $year_t$ is the year fixed effect, $\epsilon_{it}$ is the unobservable error term.

Table 2: The impact of the opening of the high-speed rail on the revenue of Sichuan's tourism industry

| Variables      | Dependent Variable | Dependent Variable |
|----------------|--------------------|--------------------|
|                | Income             | The number of visitors |
| highspeedrail  | 0.186***           | 0.305***           |
|                | (6.03)             | (2.72)             |
| $\ln gdp$      | 0.66***            | 0.05***            |
|                | (3.95)             | (4.81)             |
| $\ln population$| 0.05               | 0.097              |
|                | (0.97)             | (1.45)             |
| $\ln restaurants$| 0.41***           | 0.56***            |
|                | (2.77)             | (3.32)             |
| $\ln hotel$    | 0.28***            | 0.33**             |
|                | (2.92)             | (2.00)             |
| Time fixed effect | No               | Yes               |
| Region fixed effect | No               | Yes               |
| R-square       | 0.264              | 0.211              |

Remark: *、**、*** respectively represents the significance level of 10%、5% and 1%． The $t$ statistic is in brackets.

Table 2 shows the quantitative impact of the opening of high-speed rail on tourism revenue and the number of tourists in Sichuan Province. The second and third columns are the impact of the opening of high-speed rail on the tourism revenue of Sichuan Province, and the fourth and fifth columns are the impact of the opening of the high-speed rail on the number of tourists in Sichuan Province. Table 2 shows that whether or not the control variables are added, the opening of the high-speed rail has a
significant positive impact on the tourism revenue and the number of tourists in Sichuan Province. From the third column of this paper, we can see that after controlling for important control variables and time and regional fixed effects, the opening of high-speed rail will increase local tourism revenue by 18.5% on average every year. It can be seen from the fifth column of this article that after controlling important control variables and time and regional fixed effects, the opening of high-speed rail will bring 27.7% of new tourists to the local area on average every year. It can be seen that the promotion effect of high-speed rail on the local tourism industry is very obvious.

4. Conclusion and Policy Implications
This paper shows that for those provinces with rich tourism resources, the high-speed railway construction can play an important role in local economic development. First of all, high-speed rail will bring significant spillover effects to the development of local tourism. Secondly, as a new economic growth point, tourism is of great significance to the transformation of the local economic development mode and the promotion of the transformation of the regional industrial structure. We should vigorously build high-speed rail to promote China's economic development.

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