



High-Speed Rail Construction and Residents' Consumption of Urban Agglomeration, China

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Abstract. Urban agglomeration economy brings the advantage of scale economy in big cities and benefits from the low cost of small and medium-sized towns. It is helpful for coordinated development in different scales of cities. Transportation development is an essential means to promote the cluster economy, and it is of great significance to strengthen the organic combination of transportation and urban agglomeration construction. This study selects the research objects of China's three major urban agglomerations of the Yangtze River Delta, Beijing-Tianjin-Hebei, and Pearl River Delta. Using its urban panel data from 2006 to 2019, construct a spatial DID model to explore the impact of high-speed rail construction on residents' consumption level in the urban agglomeration. The results are heterogeneous in different urban agglomerations. High-speed rail construction has significantly promoted the consumption level in the Beijing-Tian-Hebei area and the Pearl River Delta regions. However, the effect in the Yangtze River Delta is not significant.

Keywords: Foreign Direct Investment · Host Country's Legal System · Investment Performance · Influencing Factors

1 Introduction

Consumption is one of the critical factors driving economic growth, but insufficient household consumption has severely restricted the sustainable development of China's economy for a long time. Expanding domestic demand has become an important strategy to promote economic development today. China's transportation infrastructure has thrived over the past 40 years of reform and opening up. Since the opening of the Beijing-Tianjin intercity in 2008, China's high-speed rail construction has developed rapidly. As of the end of 2020, China's high-speed railway operating mileage reached 37,900 km, ranking first globally. The construction of large-scale transportation infrastructure can promote the reduction of inter-regional trade costs, increase the variety of goods in various regions, and help form a unified consumer market [4, 7]. The well-developed transportation network also significantly reduces residents' travel time across regions, and residents' willingness to travel increases accordingly [2, 9]. To further expand domestic demand and promote the formation of a solid domestic market, the General Office of the Ministry of Transport issued a notice on Doing a Good Job in Transportation

to Promote Consumption Expansion and Quality Improvement. The report pointed out the need to improve transportation infrastructure conditions to stimulate consumption potential and improve the quality of transportation services to upgrade service consumption (Assignment Planning [2020] No. 26). In particular, it pointed out the need to speed up the construction of inter-city infrastructure, focusing on urban agglomerations and metropolitan areas. What's more, it is significant to promote the formation of a multi-level rapid transportation network with rail transit and expressways as the framework.

The report of the 19th National Congress of the Communist Party of China clearly stated that the urban agglomerations should be the mainstay to build a town pattern in which large, medium, and small cities and small towns develop in harmony. The development of the urban agglomeration economy has the advantage of scale economy effect of big cities. Besides, it takes advantage of the low cost of small and medium-sized cities. Therefore, the construction of urban agglomerations with large cities as the core has become the focus of China's current economic development. Transportation development is an essential means to promote the growth effect of clusters. Strengthening the organic combination of transportation and urban agglomeration construction is particularly important for backward areas. The Beijing-Tianjin-Hebei, Yangtze River Delta, and Pearl River Delta are the most critical locations for China to implement the strategic layout of urbanization. Thus, the government intends to promote the deep integration of these three urban agglomerations, realizing their respective main functions and potentials focus on regional optimization and coordinated development across the country.

During the 13th Five-Year Plan period, the three major urban agglomerations have achieved excellent performance in rail transit development. The operating mileage of high-speed rail in the Beijing-Tianjin-Hebei region increased from 1,616.3 km to 2,288.6 km, an increase of 41.6%. The high-speed rail mileage in the Yangtze River Delta region increased from 3,250 km to 6,008 km, increasing by 2,758 km, 84.9%. In 2019, the high-speed rail mileage in the Guangdong-Hong Kong-Macao Greater Bay Area high-speed was 1,232 km. Meanwhile, its high-speed rail network density was the highest among the three major urban agglomerations. In total, the current high-speed rail mileage of Beijing-Tianjin-Hebei, Yangtze River Delta, and Guangdong-Hong Kong-Macao Greater Bay Area has exceeded 9,500 km, accounting for a quarter of the country. In addition, the "14th Five-Year Plan" outline mentioned that "Being built on the track of Beijing-Tianjin-Hebei; speeding up the construction of the Guangdong-Hong Kong-Macao Greater Bay Area intercity railway; realizing the full coverage of high-speed rail in cities above the prefecture-level in the Yangtze River Delta." High-speed rail construction has dramatically shortened the distance between the central and fringe cities in the three major urban agglomerations. It also hastens the spatial association of the urban agglomerations. So in recent years, has the rapid development of high-speed rail construction in China's three major urban agglomerations promoted the expansion and quality of urban residents' consumption? If the impact is not significant, what are the influencing factors?

The relationship between transportation infrastructure construction and economic growth has always been the focus of academic circles. On the one hand, large-scale transportation infrastructure investment as a production input directly promotes economic growth [1]. On the other hand, transportation infrastructure construction can reduce transportation costs, promote the free flow of factors, and realize the optimal allocation of resources to indirectly promote economic growth [3, 10]. Its internal mechanisms are as follows. First, improved transportation accessibility is conducive to human capital transfer and regional innovation capabilities [5]. Second, reduced transportation costs are beneficial to the industry agglomeration, forming a scale effect, thereby promoting the increase in total output value [8]. Third, the construction of transportation infrastructure can strengthen regional relevance and promote the spatial spillover of regional economic growth to drive the economic development of surrounding areas [6, 11].

Based on the development of HSR and the necessity of enlarging the consumption potential in China, this paper builds a spatial DID model to explore the direct effects and spatial spillover effects of high-speed rail construction on the consumption of urban agglomerations.

2 Model Setting and Data Source

2.1 Model Setting

At present, there are pieces of literature on the establishment of DID or spatial measurement models to explore the impact of high-speed rail construction on urban residents' consumption levels. A few research studies have considered DID and spatial factors simultaneously, so the estimated results may have certain deviations. In addition, most of the existing literature explores from the perspective of cities across China and has not yet explored the impact of various urban agglomerations. To this end, this study intends to construct a spatial DID model to fully explore the impact of high-speed rail construction on the consumption level of urban agglomeration residents. The specific settings of the model are as follows:

$$\begin{aligned}
 Y &= \alpha + \beta_1 \times Post + \beta_2 \times Treat \\
 &+ \beta_3 \times (Treat \times Post) \\
 &+ X' \gamma + \varphi + \tau + \varepsilon
 \end{aligned} \tag{1}$$

where Y is the consumption level of urban residents. We select the total sales of social retail goods to represent the variable. $Post$ is a dummy variable for whether the high-speed rail is opened. And $Treat$ is a dummy variable of whether the city is in the treatment group. X is a vector of variables to reflect the city characteristics. φ is the spatial fixed effect, τ is a time-fixed effect, ε is a random interference term.

At the same time, considering the spatial dependence effect of urban agglomeration residents' consumption, we construct a SAC regression model as follows:

$$Y = \rho WY + Z' \eta + u, \quad u = \lambda Wu + \varepsilon \tag{2}$$

W is the spatial weight matrix, this study selects the geographic distance matrix and the economic distance matrix, Z are all explanatory variables.

2.2 Variable Setting

- Explained variable: This article intends to explore the impact of high-speed rail construction on the entire region and residents' consumption level, so retail sales of consumer goods and per capita retail sales of consumer goods are selected as indicators to measure regional consumption levels. The per capita consumption estimate is based on the registered population. However, Mao (2020) believes that the permanent population can better reflect the size of the people. This paper simultaneously uses two indicators, the registered and permanent resident populations, to calculate whether there exists a difference between the two measurement results.
- Core explanatory variables: The core explanatory variable is the construction of high-speed rail. In this paper, we use the dummy variable to represent the opening of the high-speed rail. The number of 1 indicates there has opened the HSR, 0 represents no HSR construction in this area. In addition, China's high-speed rail includes three types, namely high-speed trains (denoted as D), high-speed trains (G), and intercity trains (C). We manually collected the HSR data for 2006–2019 from the National Railway Passenger Train Schedule issued by the China Railway Corporation and www.12306.com.
- Control variables: (1) Economic level: According to consumption theory, income is a prerequisite to affect residents' consumption. Because the research object is the level of social consumption, per capita GDP can better reflect the consumption ability than residents' per capita income. (2) Industrialization rate: Generally speaking, industrialization and urbanization are highly related and mutually promote each other. Industrialization and urbanization are essential factors affecting consumption. We choose the proportion of industrial added value to GDP to calculate the development of industrialization. (3) Proportion of service industry: The industrial structure is an essential aspect of the supply side, reflecting social and economic development characteristics. Meanwhile, it is also critical to reflect the advanced industrial structure. We calculated the proportion of gross output value of the service industry in GDP to represent the indicator. (4) Per capita financial expenditure: We selected the general budgetary expenditure of local finance/resident population to calculate. Fiscal expenditure tends to provide public services, which has an important impact on the quality of life of residents and the consumption environment. (5) Human capital level: the number of people in ordinary colleges and universities/resident population is used for calculation. The proportion of college students is a dimension of the population structure, which reflects the characteristics of the primary consumer and is an essential factor influencing consumption. (6) Transportation development conditions: we select road mileage/resident population to measure. Transportation infrastructure can reduce consumption costs by reducing costs or time costs, which impacts consumption. More details can be seen in Table 1.

Table 1. Definition and Description of the variable.

Type	Variables	Description	Mean	S.E.	Min	Max
Explained variable	LNCONS	Retail sales of consumer goods	16.07	1.08	13.03	18.88
Core explanatory variable	HSR	High-speed rail opening	0.49	0.50	0.00	1.00
Control variables	LNP GDP	Per capita GDP	10.87	0.65	9.08	12.71
	LNP FIN	Per capita financial expenditure	8.80	0.73	6.87	11.00
	LNP SEC	Per capita secondary output added value	10.15	0.66	8.16	11.76
	THIRD	industrial structure	0.44	0.18	0.23	4.17
	LN WAGE	Wage level	10.76	0.48	9.50	12.06
	PROAD	Per capita road area	5.76	4.80	0.74	37.32

3 Empirical Results and Analysis

3.1 Heterogeneity Analysis: High-Speed Rail Construction and Residents' Consumption in Three Major Urban Agglomerations

This paper analyses the impact of HSR construction in three major urban agglomerations, and the results are heterogeneous. In Table 2, we can see that high-speed rail construction has significantly promoted retail sales consumption of urban social consumer goods on the whole. Then, the regression results of social consumer goods retail sales show that the high-speed rail construction has significantly promoted residents' consumption level in Beijing-Tianjin-Hebei and Pearl River Delta urban agglomerations. But it has no significant impact on residents' consumption level in Yangtze River Delta urban agglomerations.

3.2 Decomposition of the Effect of High-Speed Rail Construction on the Consumption Level of Urban Agglomeration Residents

It can be seen from Table 3 that in the regression of total consumption level, the direct effect, indirect effect, and total effect of the whole, Beijing-Tianjin-Hebei and Pearl River Delta regions are significantly positive. The result shows that high-speed rail construction promotes residents' consumption level in this city and produces positive externalities for residents in surrounding areas. From the decomposition result of the consumption level effect, the three effects in the Beijing-Tianjin-Hebei area and Pearl

Table 2. Regression Results.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All regions		YRD Region		BTH Region		PRD Region	
	DID	SDID	DID	SDID	DID	SDID	DID	SDID
HSR	0.09***	0.02**	0.03	-0.01	0.08**	0.03**	0.15**	0.05***
	(0.02)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)	(0.05)	(0.02)
LNPGDP	0.54***	0.16***	0.42**	0.17**	0.41**	0.20***	-0.01	0.05
	(0.15)	(0.04)	(0.20)	(0.07)	(0.15)	(0.08)	(0.43)	(0.14)
LNPFIN	-0.03	-0.09***	0.01	-0.11***	0.20**	0.00	0.13	-0.08
	(0.09)	(0.02)	(0.11)	(0.03)	(0.08)	(0.05)	(0.22)	(0.05)
LNPSEC	0.01	0.04	-0.22	-0.07	0.22**	0.05	0.31	0.12
	(0.08)	(0.03)	(0.16)	(0.05)	(0.08)	(0.04)	(0.29)	(0.12)
THIRD	0.02	0.01	0.06	-0.15	0.01	0.01	0.64*	-0.05
	(0.01)	(0.02)	(0.42)	(0.13)	(0.01)	(0.02)	(0.31)	(0.32)
LNWAGE	0.78***	0.16***	1.14***	0.23***	0.40***	0.05	0.62**	0.21***
	(0.17)	(0.03)	(0.27)	(0.05)	(0.10)	(0.05)	(0.27)	(0.05)
LNPROAD	-0.18***	-0.05***	-0.18**	-0.05***	-0.15	-0.05	-0.09	0.04
	(0.06)	(0.01)	(0.07)	(0.02)	(0.11)	(0.04)	(0.10)	(0.03)
Constant	2.23***		1.59		3.75***		5.28***	
	(0.87)		(1.11)		(0.68)		(1.57)	
rho		0.84***		0.88***		0.78***		0.78***
		(0.02)		(0.03)		(0.04)		(0.04)
Lambda		-0.52***		-0.61***		-0.62***		-0.43***
		(0.06)		(0.09)		(0.13)		(0.12)
Sig2_e		0.01***		0.01***		0.004***		0.004***
		(0.00)		(0.00)		(0.00)		(0.00)
N	686	686	364	364	196	196	126	126
R2	0.95	0.40	0.96	0.37	0.97	0.40	0.95	0.46

Note: *** means significant at a significance level of 1%, ** means significant at a significance level of 5%, * means significant at a significance level of 10%, the value in parentheses is the t value.

River Delta region are significantly positive. And the effect is larger in Pearl River Delta. But the effects are insignificant in Yangtze River Delta. To a certain extent, this reflects that the inter-regional correlation in the Pearl River Delta region is more potent than that in the Yangtze River Delta region and Beijing-Tianjin-Hebei region, thus resulting in significant spatial spill-over.

Table 3. Regression Results.

Region	All regions	YRD Region	BTH Region	PRD Region
Direct effect	0.03 ^{***}	-0.02	0.04 ^{**}	0.08 ^{***}
	(0.01)	(0.02)	(0.02)	(0.03)
Indirect effect	0.09 ^{**}	-0.12	0.10 ^{**}	0.16 ^{***}
	(0.04)	(0.12)	(0.06)	(0.06)
Total effect	0.12 ^{**}	-0.13	0.15 ^{**}	0.24 ^{***}
	(0.06)	(0.14)	(0.06)	(0.08)

Note: *** means significant at a significance level of 1%, ** means significant at a significance level of 5%, * means significant at a significance level of 10%, the value in parentheses is the t value.

4 Conclusions and Recommendations

4.1 Conclusion

In this paper, we used three major urban agglomerations as the research sample: the Yangtze River Delta, Beijing-Tianjin-Hebei, and Pearl River Delta. Then, we use the data of these cities from 2006 to 2019 to construct the spatial DID model to explore the impact of high-speed rail construction on the consumption level of urban agglomeration residents. We have found the following conclusions. (1) The results are heterogeneous among the three major urban agglomerations. From the perspective of total social consumption and retail sales, the construction of high-speed rail has promoted the consumption level of Beijing-Tianjin-Hebei and the Pearl River Delta region. At the same time, the impact on the Yangtze River Delta region is not significant. (2) The high-speed rail construction has a spatial spill-over effect on residents' consumption in urban agglomerations, but this effect is different among the three major urban agglomerations. The construction of high-speed rail has significantly expanded the positive consumption externalities in the Pearl River Delta region. But this effect has not been exerted in the Yangtze River Delta and Beijing-Tianjin-Hebei region.

4.2 Suggestions

From the above research conclusions, we can draw the following policy implications:

First, the government needs to continue improving high-speed rail construction in urban agglomerations to promote residents' consumption levels. The construction of high-speed rail can reduce the travel time of residents and effectively promote the flow of goods and realize the expansion of the consumer market. Urban agglomerations with backward development should learn the experiences from the three major regions. For the three major urban agglomerations they should further improve the service quality of high-speed rail, shorten the connection time, and realize residents' yearning for a better trip.

Second, the Yangtze River Delta region and Beijing-Tianjin-Hebei region should constantly break down institutional barriers, improve the degree of marketization, and

promote the spatial correlation between areas to expand the local consumer market. Local governments should build regional linkage mechanisms, broaden cooperation areas, establish regional open markets and build a new pattern of the wide opening.

Third, the Beijing-Tianjin-Hebei region should formulate relevant policies to prevent brain drain and expand local consumption potential. The population is the most dynamic factor of production in the economy and society, and it is the guarantee to realize regional economic growth. Specific policies such as providing preferential policies for high-quality talents to settle down and buy housing, and providing employees with generous welfare benefits, providing more opportunities to young people.

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