

Economic Impact of High-Speed Rail: A Case Study of The Beijing-Shanghai Line

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Abstract. In this study, the impact of Beijing-Shanghai high-speed railway on urban economic growth has been explained in combination with case studies, literature reviews, and This paper uses mixed methods, a systematic literature review combined with a deep case study. Factor aggregation and mobility perspective; Industrial structure optimization perspective; Spatial spillovers effects perspective Combined with the case study, the paper also examines the literature on the Beijing-Shanghai High-Speed Railroad and economic development from these findings, we can tell that the opening of the high-speed railway has created complex and diverse employment effects in cities of different levels along the route, which also promotes the flow of capital and changes the industrial structure. The growth rate of GDP in the Secondary industry of Intermediate cities is much higher than the Growth rate of GDP in the First tier cities, the growth rate of GDP in the Tertiary industry of Intermediate cities is much lower than the Growth rate of GDP in the First tier cities. In terms of the regional economic structure, the Beijing-Shanghai High-Speed Railway mainly affects the regional economy through spatial spillover effect with capitals. The growth of capital in cities along the way has promoted the economic development of other regions. Therefore, the paper puts forward differentiated policy recommendations according to the above findings and gives advice for future long-term follow-up studies and international comparative studies. As for future research on the economic impact of the Beijing-Shanghai High-speed Railway, it could also continue. Long term investigations. Comparing the effects of high-speed railways on different countries and regions can also be used to expand on the impact of high-speed railways on high-quality economic development.

Keywords: High-Speed Railway; Regional Economic Growth; Beijing-Shanghai High-Speed Railway; Agglomeration Effect; Spatial Spillover Effect.

1. Introduction

1.1. Research Background

China has witnessed tremendous growth in its high-speed rail network over the last 10 years. By the end of 2023, its operating mileage had topped 45,000 kilometers, it held the first place in the world. The outline of the advanced planning for railways in the new era: "A Strong Transportation Nation" sets a great goal to have almost 70,000 kilometers of high-speed rail operating mileage and total high-speed rail coverage for cities with over 500,000 people by 2035, showing the national strategy of high-speed rail development continues. High-speed rail is a fast means of transportation as it is an important factor influencing structural change for regional area. With greatly improved regional accessibilities, it has a great influence on the flow and spatial allocation of production factors, which brings multiple impacts to the industrial upgrading, spatial structure and coordinated regional development of cities along the routes. Under this background, an in-depth analysis of the economic benefits and mechanism of the Beijing-Shanghai High-speed railway, which is an artery connecting the Beijing-Tianjin-Hebei region and Yangtze River Delta economic zone, has both great theoretical and practical value.

1.2. Research Methods and Approach:

This paper uses a combination of literature review and case study research methods as a basis for a scientific investigation into the influence mechanism and practical effects of high-speed rail opening on city economic growth.

Literature review method: Review the related literature both domestic and abroad on the economic impact of high-speed railways systematically, and form the theoretical analysis framework of high-speed rail's economic impact on three aspects: factors' agglomeration and flow, industrial structure optimization, and space spillovers. This is the theoretical premise for the following empirical study

Case study method: Choosing the Beijing-Shanghai high-speed railway as a typical line, and using its representative cities such as Beijing, Shanghai, Bengbu, Cangzhou, etc., based on the combination of economic data and policy implementation, we do a detailed analysis of how high-speed trains affect the economy of cities with different levels of power, verify the mechanism of theory, and draw policy implications.

The research approach follows the logical sequence of "theoretical construction - case verification - conclusion refinement", striving to reveal the mechanism of high-speed rail's economic impact while providing empirical evidence for regional coordinated development.

1.3. Research Gaps, Research Objectives and Significance:

Though current literatures completely approve of the macro-effect of high-speed railways networks on economic growth in regions, most of them studied the overall region or core cities. So there are two huge gaps, the first is the comparison of growth of different kinds of cities along the line like core hubs and small and middle cities were not compared. The second point is detailed analysis of specific interactions and equilibriums of 'siphon' and 'spill-over' effects in different types of cities. In order to address the above shortages, this paper hopes to build a theoretical mechanism framework, and use the Beijing-Shanghai high-speed railway as a typical case, to deeply analyze and study the differences in the economic impacts of high-speed railway opening on major cities and underdeveloped cities along the way. The significance of the study is as follow: Firstly, theoretically this study can help us explain the diverse mechanisms through which transportation infrastructure will affect regional economies, and thus add to practical applications of the "siphon-spillover" theory. Secondly, practically these results may also inform differentiated development guidelines for cities of different levels as they attempt to navigate the era of high-speed rail and offer policy recommendations to the country as it seeks to promote regional coordinated development strategy, as well as minimize economic gaps between different cities

2. Analysis of the Economic Impact Mechanism of High-Speed Rail Based on Literature Research

2.1. Factor Agglomeration and Flow

The opening of high-speed railways has led to an improvement in the accessibility of transportation in the areas along the railway lines, which has accelerated the flow of production factors and expanded their scope. Labor factors such as population and employment, as well as capital factors, have concentrated in hub cities. From the perspective of the heterogeneity of the impact and the asymmetry of capital flows, the siphon effect is significant. After the opening of high-speed railways, the capital factor allocation optimization effect of cities with relatively complete infrastructure and their surrounding enterprises is stronger, which leads to a net inflow of capital from small and medium-sized cities to large cities [1]. After the opening of the Beijing-Shanghai Railway, the economic agglomeration pattern of different cities along the railway line tended to be unbalanced. Beijing exerted a radiation effect on the surrounding areas, and some production factors began to flow to the Tianjin area, which has obvious location advantages [2]. The Beijing-Tianjin-Hebei region and the Yangtze River Delta region have produced a certain "siphon effect" on the cities along the railway

line in Shandong Province; at the same time, the trend of economic activities of three cities in Anhui Province spreading to the Yangtze River Delta region is also very significant [3].

2.2. Optimization of Industrial Structure

High-speed rail opening greatly promotes the development of the tertiary industry in cities by the route, especially the rapid development of the business service industry and the tourism industry [4]. Elevating the business service sector: The development of high-speed rail has significantly boosted the business appeal of first- and second-tier cities, facilitating their shift towards a "headquarters economy" and the expansion of "professional services" [5]. Take Beijing and Shanghai as examples. The time-space compression effect brought by high - speed rail has attracted a great number of corporate headquarters, financial institutions, and consulting firms to locate there. This has further promoted the agglomeration and development of professional service industries like law, accounting, and advertising. The Beijing-Shanghai high-speed railway links the two economically advanced regions of Beijing-Tianjin-Hebei and the Yangtze River Delta, passing through trillion-yuan level cities including Beijing, Shanghai, Nanjing, Hangzhou, and others. These cities have attracted many business professionals and cross-regional enterprises, creating a steady demand for business travel. For instance, by leveraging the advantage of being a high-speed rail hub, Jinan West Station has drawn in a great number of high - end business individuals and corporate headquarters, which has in turn driven regional economic growth. The network effect of high-speed rail draws talents, technology, and capital to converge along its routes. The Huaiyin District of Jinan has leveraged the high-speed rail hub to drive the optimization of its industrial structure and attract investments, expediting the region's modernization process.

The booming tourism industry: High speed rail has greatly improved the accessibility of tourism destinations and promoted the rise of the tourism revenue of cities on the high-speed rail lines. For example, the number of tourists in Tai'an, Shandong has increased significantly due to the opening of the Beijing Shanghai high-speed railway. Mount Taishan Scenic Spot's annual tourist reception has increased by over 40% in just five years following the start of operations of the high-speed rail; Anhui Bengbu has merged into the Yangtze River Delta tourism circle via the high-speed rail network and made the transition from a transitory city to a tourist destination [6]. The high-speed railway has cut down to under 5 hours the travel time in between Beijing and Shanghai considerably boosting up the connectivity efficiency amongst those two cities and the ones situated alongside the path. This convenience immediately sparks up the demand for the consumption of tourism, leads to an increase in the number of tourists, and especially facilitates the rise of new tourism models like weekend tours and short-distance tours. High-speed rail can speed up the flow and sharing of tourism resources among cities and industries and form a tourism value chain with a network. For instance, the passenger flow linkage effect between core cities like Beijing and Shanghai and secondary tourist destinations such as Suzhou and Nanjing are substantial.

Furthermore, it also promotes the development of modern service industries such as exhibition economy, cultural creativity industry, and accelerates the transformation of urban industry towards a high-end and service-oriented direction.

2.3. Spatial Spillover Effect: "Urban Integration" Brought by High-Speed rail and the Reshaping of Regional Economic Patterns

The opening of high-speed rail greatly reduces the distances between cities, causes a reshaping of the regional economy, and results in the "spatial spillover effect." The effect mainly shows the "integration" between cities, which leads to the transfer of economic activities over geographic space [6]. The opening of the Beijing-Shanghai high-speed rail has significantly improved the economic growth of the cities along its way, driving the development of the secondary and tertiary industry and financial development as well as innovative activities of the cities [7]. Spatial spillover effect is important for reshaping regional economy. It may become a catalyst for coordinated regional development, but it can also cause imbalance in regional development.

3. Background of the Beijing-Shanghai High-Speed Railway Case and Economic Overview of Cities Along the Line

3.1. Overview of the Beijing-Shanghai High-Speed Railway and its Strategic Position

Beijing-Shanghai HSR is the most important part of China’s “Eight vertical eight horizontal” high-speed railway plan and one of main investment and advanced technology project of China’s MTRP. The canal covers up for 1318 km of journey, spanning across the three areas that includes Beijing, Tianjin and Shanghai, Hebei, Shandong, Anhui, Jiangsu. Linking the more economically developed and more concentrated Beijing-Tianjin-Hebei economic zone and Bohai rim economic zone and Yangtze River delta economic zone. It was opened on June 30, 2011. Opening the Beijing-Shanghai HSR has promoted factor mobility between cities along the line, changing the economic development structure and spatial arrangement of cities along the line. The cities along Beijing– Shanghai HSR take up 6.5% of China’s total urban area, 25.8% of the country’s total population and more than 40% of its GDP, which means it is a region in China with the most potential for developing into a new type of economy.

3.2. Selection of Core Node Cities Along the Route

In order to carry out a comparative analysis of different impacts, this paper selects several core node cities on BSR that cover the complete spectral range of BSR’s economic gradient. The selected cities including Beijing, Shanghai, Tianjin, Nanjing, Jinan, Suzhou, Bengbu and Cangzhou were picked according to differences in economic level, administrative level and industrial structure. Selects national megacities, regional central cities, and industrial centers, laying a foundation for a comparison of how the BSR has impacted economies differently.

3.3. Comparison of the Economic Foundation of Cities Along the High-Speed Rail before its Opening.

On the eve of the opening of the Beijing-Shanghai High-Speed Railway, the cities on the high-speed railway are clearly graded on the economic development gradient. To make it clear, some node city nodes have been selected from the perspective of key indicators such as GDP amount, industrial structure, and population level for comparison, as shown in table 1:

Table 1: Key Economic Indicators of Major Node Cities along the Beijing-Shanghai High-Speed Railway before its Operation (2010)

city	GDP (in billions of yuan)	Per capita GDP (10,000 yuan)	Proportion of the tertiary industry (%)	Permanent resident population (in 10,000s)
Beijing	14,113.6	7.20	75.5	1,961
Shanghai	15,046.5	7.60	57.3	2,303
Tianjin	9,224.5	7.10	45.9	1,299
Nanjing	5,130.7	6.30	51.0	800
Jinan	3,910.5	5.80	50.7	681
Suzhou	9,228.9	8.70	41.4	1,046
Bengbu	636.0	2.10	36.2	316
Cangzhou	2,200.0	3.10	34.5	713

Data source: Statistical yearbooks of the respective cities (2010) and the national bureau of statistics of China. As can be seen from the table above, the relevant data show that there is already a large economic development gap among the frontier cities ahead of the high-speed railway. Large economic aggregate differences: Both Beijing and Shanghai have exceeded the GDP of one trillion yuan, while our city of Bengbu’s GDP is still below 70 billion yuan, there is a huge difference.

The industrial structure is quite different in terms of levels: Beijing as its political and cultural center, service industry shares reach up to 75.5%, thus indicating that it is in a post-industrialized era, Shanghai, Nanjing, and Jinan also have tertiary industry shares larger than 50%, showing signs of service economy dominance; cities like Bengbu and Cangzhou however, have tertiary industry shares under 40%, signaling an accelerated industrializing pace. The development gradient is complete: from core metropolises to regional central cities, and then to developing cities, a complete economic gradient has been formed along the Beijing-Shanghai line, providing a clear basis for comparing the heterogeneous impacts after the opening of high-speed rail.

4. Analysis of the Economic Effects of Beijing-Shanghai High-Speed Railway Based on Case Study Method Analysis

4.1. Overall Promotion of Economic Growth

From the above, we can see that the economic agglomeration degree of cities near the Beijing-Shanghai High-Speed Railway is also increased. In this city, every 1% increase in the accessibility of a city along the railway leads to an increase of 0.572 in the urban economic agglomeration index [8]. The opening of the Beijing-Shanghai high-speed railway has promoted the economic development of cities along the line, and there exists a spillover effect on surrounding cities along the line, however, the city along the line with higher development level benefits more from the opening of the Beijing-Shanghai High-speed railway, which suggests agglomeration effect and spillover effect coexisted [9]. Researcher selected 6 representative cities from Beijing-Shanghai High-Speed Rail line and carried out case analysis according to Regional Activity Model. Regional activities of megacities, large cities and small and medium-sized cities in 2012 greatly increase. The absolute value of the activities of 3 representative cities is approximately twice as much as in 2010. The average growth rate of the urban area is as high as 117.9%, and the regional activity level is in a leap type activity [10]. The growth rate of GDP is running a regression on it, and a linear regression found that the Beijing-Shanghai high-speed railway has accelerated the development of the core cities at both ends of Beijing and Shanghai, and the high-speed railway has opened the high-speed railway. The gap between central large cities and peripheral small and medium-sized cities is greater than the opening of the high-speed railway.

4.2. Specific Manifestations of Industrial Structure Upgrading:

The opening of the Beijing Shanghai high-speed railway has had a significant impact on the upgrading of the industrial structure of cities along the line, manifested in the following aspects:

Strengthening the industrial hub status of core cities: The Beijing Shanghai high-speed railway has enhanced the radiating power of Beijing and Shanghai as regional economic centers [11]. Beijing attracts high-end production factors through high-speed rail, with an average annual growth rate of 12% in the number of high-tech enterprises in Zhongguancun Science and Technology Park. The R&D headquarters are located in Beijing, and production bases are laid out in small and medium-sized cities along the route; Shanghai has consolidated the position of Pudong New Area as a financial and trade center. In 2024, Pudong New Area will attract 210% more foreign investment compared to 2010, and a large number of multinational companies will set up their Asia Pacific headquarters or research and development centers in Shanghai.

Small and medium-sized cities along the route undertake industrial transfer: Node cities such as Cangzhou take advantage of land and labor costs to undertake industrial transfer such as Beijing's automotive parts manufacturing, forming an automotive parts industry cluster with an annual output value exceeding 30 billion yuan. Similar cases have appeared in multiple cities along the route, promoting the gradient diffusion of manufacturing industry to small and medium-sized cities [11].

Industrial structure optimization and economic belt development: High-speed Railway speeds up fast circulation of high-tech elements, capital, etc. Promoting the emerging of high value-added industrial cluster such as Digital Economy, High End Equipment Manufacture in areas alongside the route [12].

For instance, the digital economy in Beijing and Shanghai's high-end equipment manufacturing industry have progressively formed industrial clusters with international competitiveness, thanks to the resource integration capabilities facilitated by high-speed rail.

Accelerating regional economic integration: Beijing Shanghai High Speed Railway connects the big two economic circle in Beijing Tianjin Hebei and Yangtze River Delta, it forms a 'High speed rail Economic Corridor' From the data in 2021, the GDP value in the areas beside the route has a huge increase, which provides opportunities for tourism and logistics development, and regional economic synergy effects have been formed.

Business service industry improvement: In addition to this, Beijing and Shanghai, the most important hub for the high-speed railway, have built up headquarters economy and professional services. In addition, Beijing also leverages its own high-speed rail advantages to attract multi-national group companies in Beijing, Shanghai, Zhejiang, Jiangxi, etc., to build their national and even global headquarters and research and development centers; Shanghai is committed to becoming the national-level international finance and trade service center, relying on the rapid growth of lawyer, accounting, consulting and other professional service personnel.

The booming tourism industry: high-speed rail, tourism resources have been greatly promoted, and the number of passengers has been greatly increased. relying on the high-speed rail network, tai an of shangdong developed rapidly in terms of tourist reception every year; bengbu of anhui transformed into a regional tourist destination from a traditional transportation hub, resulting in an increase in tour stay and consumption.

Industrial upgrading path differentiation: The proportion of service industry in core cities is increasing, and small and medium-sized cities promote the industrialization process through the transfer of manufacturing industry. For instance, Cangzhou attracts enterprises transferred from Beijing by building Bohai New Area thus making its traditional industries changed into advanced ones.

4.3. Analysis of Heterogeneity of Impacts (case comparison)

High-speed rail's effect on cities along its route shows considerable differences, and whether it is effective hinges on the level and industrial foundation of the city. Strengthening concentration towards main hubs: Like Beijing and Shanghai, core cities take advantage of the travel convenience given by high-speed rail, and further enhance the concentration of talent, capital, and technology, strengthening the strengths in headquarters economy and high-end service industries. For example, the percentage of Shanghai's financial industries among GDP increased greatly due to the opening of the high-speed rail. Differentiation and development of intermediate cities: Bengbu did not just carry out industrial transfer from the Yangtze River Delta, it also used the HSR to improve its own logistics strength and join the innovation links in the region; take advantage of the opportunity brought by HSR to plan and build industrial cooperation parks. It has successfully introduced projects such as silicon-based new materials. From 2011 to 2015, the annual growth rate of investment projects from the Yangtze River Delta exceeded 20%. Relying on its port-adjacent advantage, Cangzhou has established the Bohai New Area Biomedical Industrial Park, attracting pharmaceutical companies from Beijing to settle in, thus achieving a transformation from factor outflow to industrial undertaking. In summary, the high-speed rail effect presents a polarization: core cities continue to strengthen agglomeration, while intermediate cities must adopt precise positioning and proactive engagement to transform the "corridor effect" into a "development effect".

5. Conclusion and Enlightenment

5.1. Research Conclusions

Analyze and review the literature in this article about the impact of the Opening of the Beijing-Shanghai High Speed Railway on the economic development of cities along the line and summarize it from three aspects: production factor concentration and movement, optimization of industrial

structure, and transformation and reconstruction of regional economic structure. Therefore, it can be concluded on the entire basis of the current research.

Firstly, from the perspective of factor gathering and flow, the opening of the high-speed railway increases people movement, indirectly affecting the employment situation in all the cities along the high-speed rail; and at the same time, the opening of the high-speed railway can bring capital, improve the efficiency of flow in the capital market.

Second, from an industrial structure perspective, the opening of the Beijing-Shanghai High-speed trains changed the industrial structure of the city. the rise speed of secondary industry in the GDP of second and third tier city is much higher than the big city like Beijing Shanghai. the growth rate of the secondary industry proportion in GDP in Beijing and Shanghai, the two extremes, is greater than that in 2nd and 3rd tier cities.

Thirdly, on the basis of regional economic structure, the Beijing-Shanghai High-speed railway mainly produces spatial spillover effect on economic growth by means of capital factors. The increase in capital stock of cities along the line promotes economic development in other areas. The secondary industry within Beijing-Shanghai line cities shows a typical spillover effect, showing an inverted U-shaped pattern while the tertiary industry shows a typical siphon effect and is characterized by a U-shaped pattern. the high-speed railway opened the way to a large wave of people, money and knowledge came pouring into big cities along its route and helped develop the tertiary industries in Beijing and Shanghai which offered relatively rich supplies of production elements for optimizing and upgrading industrial structures.

5.2. Policy Implications

According to the heterogeneous development of cities along the Beijing Shanghai high-speed railway as a result of the high-speed rail construction, the following differentiated policy suggestions are made:

Hub cities should strengthen functional decentralization and radiation driving. Core cities such as Beijing and Shanghai should guide industrial spillover through "enclave economy" and co construction of parks, avoiding the negative effects of excessive agglomeration, while enhancing high-end service functions and strengthening regional radiation capabilities.

For intermediate cities like Bengbu and Cangzhou, policy should focus on developing specialized industrial parks (e.g., for silicon-based materials or biomedical products) based on their resource endowments, while simultaneously improving urban livability and public services to attract and retain skilled talent. And simultaneously improve transportation connectivity and public, so as to make them more attractive to talents and capital.

Establish an industrial cooperation mechanism with the central city for secondary cities affected by the siphon effect, encourage them to develop supporting industries or characteristic industrial clusters, and avoid homogeneous competition.

Attract enterprises to settle down through tax incentives and preferential land policies, while establishing cross regional industrial parks to share research and development resources. Break down administrative barriers, promote joint industrial planning among cities along the route, and avoid vicious competition.

Improve regional collaboration mechanisms. It is suggested to establish a cross city high-speed rail economic coordination platform to promote collaboration in industrial planning, land policies, ecological compensation, and other aspects, facilitate two-way flow of factors, and achieve regional win-win development. The inhibitory impact of the Beijing Shanghai high-speed railway can be alleviated through differentiated policies, with the core being "tailored to the city": strengthening industrial collaboration in cities affected by siphon effects, optimizing station functions in marginalized cities, and balancing development through subsidies, cultural tourism integration, and

other means. At the same time, attention should be paid to regional cooperation to avoid targeted policy mistakes.

5.3. Research Prospects

This study looks at the effect of the Beijing-Shanghai high-speed train on economies by doing a heterogeneity analysis and case comparison, but there are still some flaws. The author carried out research and analysis on the data from the macroeconomic data and secondary sources, without primary information. For future study, it should try to do longitudinal studies to track the long-term economic implications of the opening of this railway. And finally, future work could use economic data that is more granular. Finally, compare with other high speed rail systems in the world like Beijing - Shanghai high speed railway for summarizing positive experiences from its development.

6. Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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