

The Impact of China's High-speed Rail Overseas Investment on Economic Growth of the Belt and Road Countries

Xiaotang Chen *

School of Public Affairs, Xiamen University, Xiamen, 361005, China

* Corresponding author: 13720202201272@stu.xmu.edu.cn

Abstract. Formally proposed in 2009, China's high-speed rail 'go global' was effectively promoted in 2013 with the proposal of the Belt and Road Initiative (BRI), which expanded China's high-speed rail overseas investment to a global scale. Studying the impact of China's high-speed rail (HSR) investment overseas is of great significance for the continuous promotion of BRI. Based on the panel data of 46 countries along the Belt and Road from 2006 to 2021, the difference-in-difference method (DID) is used to evaluate the impact of China's HSR overseas investment on the economic growth of corresponding countries. Besides, heterogeneity analysis in terms of region is carried out in this paper. The empirical results show that, first, China's overseas investment in HSR promotes the economic growth of the countries along the Belt and Road, and this conclusion is confirmed by the parallel trend test. Second, compared with other regions, China's HSR investment has a more obvious positive effect on the economic growth of Asian countries.

Keywords: the Belt and Road Initiative, high-speed rail, DID.

1. Introduction

In 2013, China proposed the Belt and Road Initiative (BRI) which covers 66 countries and regions, covers more than 60 percent of the world's population. The year 2023 marks the tenth anniversary of both the Belt and Road Initiative and the establishment of a community with a shared future. A new journey of high-quality development of the BRI has set sail. After ten years of BRI implementation, China remains determined and confident in its ability to advance the BRI which has grown to be a significant and useful strategy for China. As of August 24, 2023, China had signed the Belt and Road cooperation documents with 152 countries and 32 international organizations. At this point in time, it is necessary to re-understand the cooperation model between China and countries along the Belt and Road (B&R).

Since BRI was put forward, China has carried out extensive cooperation with countries along B&R, especially in the field of transportation infrastructure. China's high-speed rail (HSR) has developed into a new 'diplomatic greeting card' of China. China's HSR network has successfully expanded overseas, as evidenced by the Azerbaijan-Kazakhstan Railway built in 2013, the An-Iraq high-speed railway built in 2014, the Benguela Railway, the China-Thailand Railway in 2015, the Azerbaijan-Djibouti Railway built in 2015, the Jakarta-Bandung High-Speed Railway built in 2016, and the China-Laos Railway built in 2021. At present, China has carried out high-speed rail cooperation in Asia, Europe, Africa, America and Oceania, and it can be said that the overall situation of high-speed rail going global is good.

Under the major changes unseen in a century, China faces many new challenges, such as escalating trade frictions, the stagnation of multilateral economic and trade cooperation, and the risk of rupture of traditional global value chains. But the BRI is still moving forward and the construction of China's HSR is still contributing to global economic growth. The achievements of high-speed rail construction under BRI are shared. For China, it is conducive to building a new development pattern. For other countries, it helps to achieve economic growth and greater prospects for economic development. Meanwhile, countries along B&R can forge closer links which is conducive to address regional or global challenges through high-speed rail construction. In this context, it is important to empirically research the impact of China's high-speed rail overseas investment. Therefore, this article

uses the difference-in-difference (DID) method to assess the effect of China's overseas HSR investment on the economic growth of the countries along B&R, based on panel data of 46 countries.

2. Literature Review

The policy effect of BRI has become a research hotspot in academic circles since 2013. In view of the economic effects brought by the initiative, most of the literature has explained the effect of the initiative on China, including economic growth, RMB internationalization, investment and financing, foreign trade and so on. With the enrichment and refinement of research results, there are more and more literatures on the economic impact of the BRI on countries along B&R, mainly focusing on trade, industrial structure, financial investment, economic growth and other fields.

In terms of trade, most of the research results show that the BRI is favorable to the development of trade in countries along B&R. Xiang Songlin discovered that the program had a favorable impact on the Belt and Road countries' exports. [1]. Qiu Fahua also drew a similar research conclusion [2]. However, some scholars have proposed that there may be debt risks in trade cooperation. For example, after researching the loan of projects related to the BRI, John et al. found that eight borrower countries are facing the risk of debt crisis [3].

In terms of industrial structure, BRI affects the industrial upgrading and concentration of the countries along the B&R. This results in changes to the structural percentage of primary, secondary, and tertiary industries as well as changes within individual industries. For example, after the initiative was put forward, the insurance industry, tourism industry and logistics industry of the countries along the B&R developed [4-6].

In terms of economic growth, there is a lack of quantitative evidence on the true impact of BRI on the economic growth of countries along B&R. In recent years, Cao Xiang et al used DID model for quantitative evaluation and proved that the BRI can bring a certain degree of economic growth to the corresponding countries, and the economic promotion effect will gradually increase over time [7].

Although the literature on the economic impact of BRI on the corresponding countries is generally recent, and the quantitative results are relatively few. Most of the existing studies show that the initiative has positive policy effects in many aspects, such as trade, industrial structure and economic growth. At the same time, countries along B&R should pay attention to guard against lending risks.

In addition, transport infrastructure plays an increasingly prominent role in economic growth, and more and more scholars have conducted research on the economic effects of transport infrastructure construction. Existing studies can be broadly categorized according to their research topic, which includes the influence of transportation infrastructure on productivity, export value, export decision-making and other aspects. For example, in terms of the effect of transport infrastructure on export value, Zarzoso believes that the worse the transport infrastructure is, the higher the transport cost of goods will be, leading to the less international trade flow [8]. Yang Youxiao and Ning Jin and Fang Xingming et al. also further proved the positive impact of transport infrastructure on economy based on data such as trade volume among China and ASEAN countries [9, 10].

The literature analysis demonstrates that numerous studies conducted since the inception of BRI in 2013 have demonstrated the initiative's positive policy effects on the economy of the countries along B&R. In addition, scholars have fully and comprehensively studied the economic impact of transport infrastructure. The above studies provide the basis and support for this study. On the one hand, meanwhile, there are not many studies that address how China's HSR foreign investments affect the economic development of the host nations from the standpoint of research content. On the other hand, the DID approach is a popular empirical analysis technique for looking at study techniques. However, some of the literatures that used the DID technique to examine how China's high-speed rail investment affected the economies of other nations did not perform the parallel trend test. Given the significant global impact of BRI, this study will fully utilize previous research findings and develop a DID method to examine the influence of China's overseas HSR investment on the economic development of BRI countries.

3. Theoretical Hypothesis

China's investments in HSR have the potential to strengthen the economy of the countries bordering B&R, especially in the employment and transportation sectors. In terms of transportation, B&R links the developed Europe at one end and the dynamic East Asian at the other, which has boosted rail freight turnover and international trade between the two areas. The countries along B&R are in this trade chain that it is easier to obtain international investment and it is also very convenient to sell their own advantageous products around the world, so as to achieve economic growth. Meanwhile, infrastructure and other large-scale projects invested by China have also brought many local jobs and promoted the development of the local economy.

Given the differences between countries along B&R, BRI may have a greater impact on China's neighboring countries. On the one hand, China invests more in its neighboring countries generally than in its non-neighboring ones except for a few transportation centers. On the other hand, neighboring countries are more active in participating in BRI.

Based on the above analysis, this paper proposes the following theoretical hypotheses:

H1: China's overseas investment in high-speed railway promotes the economic growth of the countries along B&R.

H2: Compared with other countries, China's high-speed rail investment has a more obvious optimistic effect on the economic growth of neighboring countries.

4. Measurement Model, Index Data and Sample Selection

4.1. Measurement Model

When assessing the impact of policies, the difference-in-difference (DID) method is frequently employed. Its advantage is that it can eliminate the inherent differences of individuals and estimate the net effect of policies. The traditional DID assumes that the individuals in the experimental group are affected by the policies at exactly the same time, while the time of China's HSR investment in countries along B&R is different. Considering that this policy occurrence points of individuals are not completely consistent, this paper adopts the staggered DID method for empirical analysis based on the panel data from 2006 to 2021. The staggered DID model is constructed as follows:

$$Y_{it} = \alpha + \beta CR_{it} + \gamma X_{it} + \mu_i + \nu_t + \varepsilon_{it}$$

Y_{it} is the logarithm of each country's gross domestic product, reflecting economic growth. α is a constant term. CR_{it} , as the core explanatory variable, is the interaction term of China's HSR overseas investment, indicating whether a country has China's HSR construction projects. 'i' represents the country along B&R, and 't' represents the time. X_{it} represents control variables, including urbanization level, residents' consumption level, government size and population growth rate. μ_i is the individual fixed effect in each country, ν_t represents the time fixed effect, and ε_{it} is the random perturbation term.

4.2. Index Data

The indicators selected for each variable are as follows: The explained variable is economic growth, measured by the logarithm of GDP. The explanatory variable is the interaction term of China's high-speed rail construction. If and only if country 'i' is the samples from the experimental group and 't' is the year when the high-speed rail project started and the years after, CR_{it} is 1, otherwise 0. One of the control variables is urbanization, which is determined by dividing the overall population by the urban population. The logarithm of consumer expenditure per capita is used to measure the level of household consumption. The size of government is measured by the ratio of fiscal expenditure to GDP. Population growth rate is determined by the population's yearly growth rate. The data of economic variables corresponding to the samples are mainly from the World Bank database, EPSDATA and CSMAR, and the descriptive statistics are shown in Table 1.

Table 1. Descriptive Statistics

VARIABLES	Observations	Average	Standard Deviation	Minimum	Maximum
LnGDP	736	25.16	1.60	20.59	28.78
CR	736	0.23	0.42	0	1
Urban	736	58.44	19.83	15.46	100.00
Consume	736	8.22	0.94	6.25	10.64
Government	736	26.40	11.46	1.37	62.37
Population	736	0.74	1.66	-4.26	18.13

4.3. Sample Selection

According to the International Union of Railways in Europe, HSR includes both the renovation of old railway lines with speeds of 200km/h, and the construction of new railway systems with speeds of 250-300km/h. Therefore, in this paper, China's overseas railway projects with a speed of more than 200km/h will be included in the scope of high-speed rail. In addition, this paper takes the year when the high-speed rail overseas projects start as the policy year, there are 10 years, including 2008, 2009, 2010, 2011, 2013, 2014, 2015, 2016, 2017, 2018.

Except for China, there are 65 countries along B&R, as shown in Table 2. Due to the existence of various factors such as the instability of war and the impact of epidemic, some countries were of limited significance to the study because of the lack of economic statistics. Therefore, this paper excluded 19 countries including Afghanistan, Palestine and so on, and selected 46 other countries as samples, and divided them into experimental group and control group according to the DID method. By consulting official websites, such as the National Railway network, CRRC, the Belt and Road Network, etc., and using databases, such as CSMAR, a total of 20 high-speed rail countries along B&R were selected as experimental group, and the remaining 26 countries automatically became control samples. As shown in Table 2.

Table 2. Countries along the Belt and Road

Eastern Asia	Mongolia, Singapore*, Malaysia*, Indonesia*, Myanmar*, Cambodia, Viet Nam, Thailand*, Laos*, Brunei, Philippines
Western Asia	Iran*, Iraq, Syria, Turkey*, Jordan, Lebanon, Israel*, Palestine, Yemen, Oman, UAE, Qatar, Kuwait, Bahrain, Greece, Cyprus, Saudi Arabia*
Southern Asia	Pakistan, Afghanistan, India*, Sri Lanka, Maldives, Nepal, Bhutan, Bangladesh*
Central Asia	Kazakhstan*, Uzbekistan*, Turkmenistan, Tajikistan*, Kyrgyzstan
Cis	Russian Federation*, Ukraine, Belarus, Azerbaijan, Armenia, Moldova, Georgia*
Europe	Poland, Montenegro, Estonia*, Latvia, Slovakia, Czech Republic*, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Hungary*, Albania, Romania, Bulgaria, Serbia*, North Macedonia*
Africa	Egypt

Note: The countries with * are the countries that received China's high-speed rail investment, a total of 21.

5. Empirical Analysis

5.1. Benchmark Regression

Table 3 shows the result of step-to-step regression in this paper. Compared with the previous model, a control variable is added to the latter model. This paper focuses on whether the coefficient of China's HSR investment in the results is significantly positive. By observing the coefficient of the explanatory variable CR, it can be seen that model (1) to model (5) are all positive, and all are significantly positive at the level of 1%, which means that the policy of high-speed rail investment is positively correlated with the economic growth of the countries to which high-speed rail enters, and there is no significant change due to the consideration of different control variables.

Table 3. Regression Results

VARIABLES	(1) ln GDP	(2) ln GDP	(3) ln GDP	(4) ln GDP	(5) ln GDP
CR	0.952*** (0.14)	0.841*** (0.13)	0.877*** (0.13)	0.775*** (0.13)	0.775*** (0.13)
urban		0.022*** (0.00)	0.014*** (0.00)	0.011** (0.00)	0.011** (0.00)
consume			0.233** (0.09)	0.479*** (0.01)	0.475*** (0.10)
gov				-0.031*** (0.01)	-0.031*** (0.00)
pop					0.008 (0.04)
Constant	24.937*** (0.07)	23.662*** (0.17)	22.238*** (0.58)	21.227*** (0.60)	21.236*** (0.60)
Observations	736	736	736	736	736
R-squared	0.063	0.138	0.146	0.180	0.180

***, **, * means passing the significance test at the significance level of 1%, 5%, and 10% respectively. The values in brackets are standard errors.

In addition, in terms of control variables, according to the coefficients shown in Table 3, the household consumption level has a significant promoting effect on economic growth. When household consumption level increases 1%, the logarithm of GDP will increase by 0.48%, which fully proves that household consumption plays an important role in economic growth. In terms of urbanization level, although it can promote economic growth, the coefficient is small, which may be because the average urbanization rate of the sample is higher than 58%. On the one hand, the rural development is relatively slow. On the other hand, the urban resource utilization efficiency has declined. Meanwhile, the scale of government has a certain inhibitory effect on economic growth, which may be due to excessive fiscal expenditure, which has a negative impact on the improvement of economic growth.

5.2. Parallel Trend Test

This research undertakes parallel trend analysis to confirm that it is fair for it to use the DID approach to investigate the effect of China's foreign investment in high-speed railways on the economic growth of nations along B&R. Specifically, the Stata18 software was used to research the trend of the logarithm of GDP in the experimental group and the control group for a total of nine years before and after the high-speed rail investment. As illustrated in Figure 1, there is no significant difference in GDP between two groups throughout the first four years of the high-speed rail investment policy. After high-speed rail investment, the parallel trend test is confirmed by the substantial GDP difference between the experimental and control groups. Therefore, it is reasonable to use the DID model to test the influence of overseas investment in HSR on the economic growth of countries along B&R.

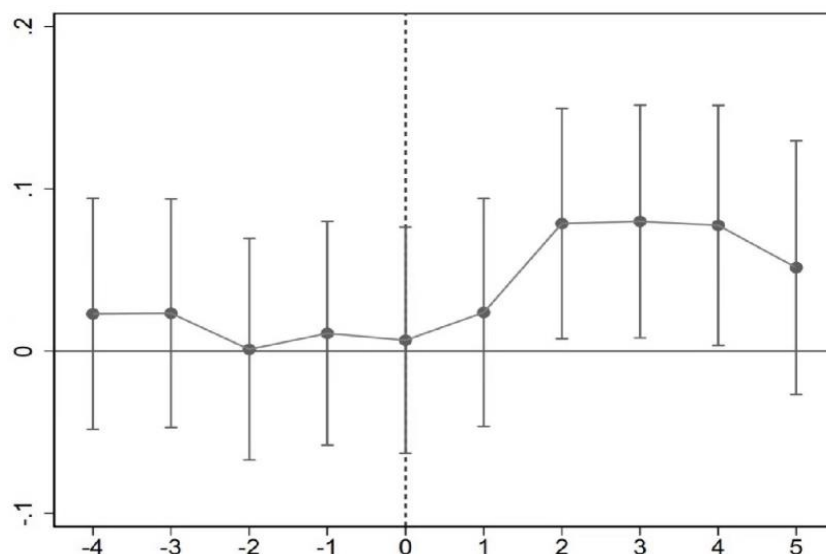


Figure 1. Parallel Trend Test

In addition, the difference between the experimental group and the control group became significant in the second year of China's HSR investment, which may be due to the lag of the positive economic effect of HSR investment on the host countries. At the same time, the difference between two group became significant in the second to fourth year, which may be because the project contracting stage can quickly bring positive economic effects to the host countries, making the influence of China's HSR policy on the experimental group particularly intuitive in the construction stage.

5.3. Heterogeneity Test

The countries along B&R involve a wide geographical range. The countries or regions on different continents have differences in the degree of economic development, resource ownership, infrastructure construction and many other aspects. Therefore, the intercontinental differences are tested in this paper. Considering that the countries along the B&R are mainly distributed in Asia and Europe, and Africa has only one country, the Arab Republic of Egypt, so it is difficult to estimate alone.

Therefore, this paper analyzes the heterogeneity of Asia and the other two regions, and Table 4 shows the regression results of regional heterogeneity test. Based on the findings, it is evident that investments in HSR significantly boost GDP growth rates in Asian nations along the Belt and Road. At the 1% significance level, the coefficient of CR is 0.819, indicating significance. In contrast, host nations in other regions have not seen a notable increase in GDP as a result of China's HSR investment. This may be because the original transport facilities in Europe are relatively perfect, so the economic promotion effect of China's high-speed rail investment overseas is difficult to show. It may also be because the economic contribution rate of high-speed rail investment is different in other regions due to different levels of economic development. After all, among the 26 Asian countries, only two are developed countries, while among the 20 other samples, there are eight developed countries in Europe.

Table 4. Regional Heterogeneity Test

Variables	Asia ln GDP	Other Regions ln GDP
CR	0.819*** (0.17)	0.299 (0.19)
urban	0.011* (0.01)	0.039*** (0.01)
consume	0.147*** (0.15)	0.449** (0.14)
gov	-0.034*** (0.01)	0.031* (0.01)
pop	-0.130** (0.05)	0.028*** (0.07)
Constant	21.204*** (0.84)	17.406*** (1.11)
Observations	416	320
R-squared	0.238	0.185

***, **, * means passing the significance test at the significance level of 1%, 5%, and 10% respectively. The values in brackets are standard errors.

6. Conclusion

The year 2023 marks the tenth anniversary of the Belt and Road Initiative, and the Initiative will embark on a new journey. As an important part of the BRI, whether infrastructure construction can bring positive economic effects is becoming one of the hotspots in academic research. This paper takes the 20 countries along B&R that China has invested in the investment of HSR from 2006 to 2021 and the remaining 26 countries that have not been invested in HSR as samples. And the DID is used to analyze the influence of China's HSR investment on the economic development of the corresponding countries along B&R. The following conclusions are drawn. First, China's foreign HSR investments facilitate better traffic conditions along the Belt and Road, which in turn fosters the economic development of countries along B&R. Second, the effects of China's abroad investment in HSR on the economic development of other nations or areas are diverse. While the influence on the economic growth of other regional countries, mostly in Europe, is negligible, the promotion effect on the economic growth of Asian countries is enormous.

The revelatory suggestions of this study on high-speed rail investment along B&R are as follows: First, China's HSR overseas investment plays a significant, stable and sustained positive role in boosting the economic growth of countries along B&R. Therefore, the current BRI should persist in deepening infrastructure connectivity among countries. Second, China's overseas high-speed rail investment has heterogeneity in boosting the economic growth of corresponding countries. In the new decade of the new journey of B&R, China should further establish and improve the coordination and communication mechanism with the corresponding countries in the construction of HSR. BRI should focus on deepening the cooperation with neighboring countries. Third, the high-speed rail industry characterized by high efficiency and low carbon belongs to the green category, while high-speed rail cooperation between countries or regions can promote innovation, and high-speed rail connectivity can provide a fast channel for coordination, opening and sharing. Therefore, advocating and thoroughly implementing new development concepts in the Belt and Road will help guide countries along B&R to pay more attention to high-speed rail cooperation and construction.

This study provides some support for the continuous promotion of BRI. First, it is conducive to encouraging enterprises engaged in the investment of China's HSR and other businesses to take international responsibility and actively practice localization. Secondly, it provides a certain reference for individuals and enterprises to make overseas development decisions. In addition, this paper needs

to carry out extended research. The overseas investment of high-speed railway involves many Belt and Road countries. Because of the complicated national conditions, and the impact of war and epidemic, there is a certain difficulty in data collection. There may be some errors in the selection and statistics of a few data in this paper. Therefore, in the follow-up research, it can be promoted by adding the number of samples and optimizing the selection of control variables.

References

- [1] Xiang Songlin. The Influence of the "Belt and Road" on the export growth of China and countries along the Belt and Road: An analysis based on the differentially differential model. *Research on Finance and Economics*, 2020, (04): 110 - 120.
- [2] Qiu Fahua. Policy effect assessment of the Belt and Road Initiative on China's import and export trade development: Based on comparative analysis of regional differences. *Business Economics Research*, 2020, (23): 140 - 143.
- [3] John Scott Gailyn. Examining the debt implications of the Belt and Road Initiative from a policy perspective. *Journal of Infrastructure Policy and Development*, 2019, 3 (1): 139.
- [4] Qiu Juandong, Ge Cube, Chen Junmei. Has the "Belt and Road" Initiative driven the development of insurance industry in economies along the route? -- Empirical Analysis based on PSM-DID method. *Modern Finance and Economics (Journal of Tianjin University of Finance and Economics)*, 2020, 40 (02): 84 - 99.
- [5] Xueying Huang, Yuanjun Han, Xuhong Gong, et al. Does the belt and road initiative stimulate China's inbound tourist market? An empirical study using the gravity model with a DID method. *Tourism Economics*, 2020, 26 (2): 299 - 323.
- [6] Li Guohao, Zhang Qi, Bai Zhengyu, et al. Research on Logistics Service Supply Chain Information Sharing Mechanism in the Belt and Road Initiative. *IEEE Access*, 2020, 189 (8): 684 - 701.
- [7] Cao Xiang, Li Shenting. The impact of the Belt and Road Initiative on the economic growth of countries along the routes and China's role. *World Economic Research*, 2021, (10): 13 - 24+134.
- [8] Martínez—Zarzoso Suárez—Burguet C. Transport costs and trade: empirical evidence for Latin American imports from the European Union. *Journal of International Trade & Economic Development*, 2005, (3): 353.
- [9] Yang Youxiao, Jing Jing. A study on the impact of ASEAN Infrastructure status on China-Asean bilateral trade. *International Economic and Trade Exploration*, 2018, 34 (06): 34 - 49.
- [10] Fang Xingming, Lu Yuxiu, Wei Jing. The impact of the opening of China-Europe Express Trains on the trade openness of Chinese cities: from the perspective of the "Belt and Road" construction. *International Economic and Trade Exploration*, 2019, 36 (02): 39 - 55.