

Research Article

Impact of the Belt and Road Initiative on Poverty Reduction in Countries along the Route

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Poverty reduction is an important driving force for the global realization of the United Nations 2030 Sustainable Development Goals and the building of a global community with a shared future for mankind. This paper takes the Belt and Road Initiative (BRI) as a quasi-natural experiment. Based on the panel data of 134 countries in the world from 2000 to 2018, this paper uses the difference-in-difference (DID) model to examine the impact of the BRI on poverty reduction in countries along the route and to study its internal mechanism from the dual perspectives of trade openness and investment openness. The results show that (1) the BRI can significantly reduce the incidence of poverty with the impact coefficient stable at -0.26 , and the empirical conclusion has passed the parallel test, placebo test, and instrumental variable test; (2) the mediating effect test model shows that the BRI can achieve poverty reduction through the dual openness of trade and investment, and the intermediary effect of trade openness is greater than investment openness; and (3) from the perspective of heterogeneity analysis, geographically, the BRI has a slightly higher role in promoting poverty reduction in landlocked countries than in coastal countries. In terms of economic location, the effect of poverty reduction has a certain “pro-poverty” characteristic, that is, the BRI promotes poverty reduction in low- and middle-income countries far more than other types of income countries. Therefore, we believe that the continuous deepening of the BRI high-quality construction and the strengthening of cooperation among countries along the route will play a key role in promoting the international cycle of trade, investment, and other factors, as well as the cause of poverty reduction in the region and the world.

1. Introduction

Poverty reduction is an important driving force for the global realization of the United Nations 2030 sustainable development goals and the construction of community of a shared future for mankind. In recent years, the global poverty issue has been significantly alleviated. According to the data released by the World Bank, the proportion of the global extreme poverty population (measured by the daily cost of living less than USD 1.90 per person (purchasing power in 2011)) has decreased from 35.9% in 1990 to 9.2% in 2017; in other words, more than 1.2 billion people have got rid of extreme poverty in the almost past 30 years (Data source: Poverty and shared prosperity 2020: Reversals of Fortune released by the World Bank). As the largest

developing country in the world, China has always attached great importance to poverty alleviation, which has helped 770 million rural poor population (over 70% of the targeted global poverty population) completely shake off absolute poverty (Data source: Poverty Alleviation: China’s Experience and Contribution issued by China’s State Council Information Office), adding its own mark in the world’s history of poverty reduction efforts. Nevertheless, due to the impact and constraints of natural geography, social culture, economic development, and other factors, poverty reduction progress varies greatly across the globe: Poverty issue in South Asia and sub-Saharan Africa is still very prominent. In 2015, the total number of extreme poverty population in these two regions accounted for more than 85% of the world poverty population. In addition (Data source: Poverty and

Shared Prosperity 2018: Piecing Together Poverty Puzzle released by the World Bank), a sudden pandemic in 2019 has not only seriously hindered the global economic development but also slowed the process of global poverty reduction. Data show that there would be another new 97 million population living in extreme poverty globally in the year of 2020 (Data source: Updated estimates of the impact of COVID-19 on global poverty: Turning the corner on the pandemic in 2021? released by the World Bank). Therefore, from the global perspective, the poverty reduction task is faced with challenges and difficulties and there is still a long way to go before achieving the 2030 poverty reduction goals as scheduled.

When Chinese President Xi Jinping visited Central Asia and Southeast Asian in 2013, he raised the initiatives of jointly building the Silk Road Economic Belt and the 21st-Century Maritime Silk Road (hereinafter referred to as the Belt and Road Initiative (BRI)), which have attracted close attention and extensive discussion from all over the world. In 2015, the National Development and Reform Commission of China, the Ministry of Foreign Affairs, and the Ministry of Commerce jointly issued Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road (hereinafter referred to as the Vision and Action). The Vision and Action defined the principles, framework, cooperation priorities, and cooperation mechanisms, hence officially marking the start of implementation of the BRI. In fact, the establishment of the BRI is not to rebuild a Eurasian international trade network of the ancient silk routes but to create an open, shared, and inclusive international cooperation platform based on its cultural connotation [1]. From the perspective of the geographical region, the BRI covers a vast territory, involving China, Mongolia, Russia, Southeast Asia, South Asia, Central Asia, West Asia, North Africa, Central and Eastern Europe, and other regions, which consists of 39% of global land area, 31% of global GDP, and 62% of global population [2]. However, as observed from the indicators such as infrastructure conditions, agricultural modernization, industrialization, and per capita GDP, most countries along the BRI are still developing countries. Therefore, how to effectively alleviate poverty is an important problem facing those regions.

With the continuous improvement and popularity of the BRI, China will actively integrate into the economic and social development of countries along the BRI and show the responsibility as a great power in regional poverty reduction. For one thing, since the adoption of reform and opening-up in 1978, China has accumulated rich experience in poverty alleviation and thus been able to provide Chinese wisdom through policies and mechanisms for countries along the BRI to decrease poverty population. For another, the enhancing infrastructure connectivity of the participating countries leads to more frequent exchanges and cooperation between China and countries along the BRI in terms of trade and investment [3], hence bringing the economic openness of the participating countries into a new level and reducing the uncertainties of development [4] and building confidence in global economic recovery [5]. As can be seen, the BRI will promote the orderly flow of economic factors in the

vast Eurasian region and restructure trade and investment networks.

In fact, since the BRI was put forward in 2013, the Chinese government has been actively strengthening institutional cooperation with countries along the route, adhering to the spirit of openness, and carrying out wider, higher-level, and deeper-level regional cooperation [6]. By the end of July 2022, China had signed more than 200 cooperation documents with 149 countries and 32 international organizations (Data source: https://www.mfa.gov.cn/web/fyrbt_673021/jzhsl_673025/202208/t20220818_10745415.shtml). Of course, among the many cooperation documents, the most eye-catching is that China and the EU have fully reached the China-EU Comprehensive Investment Agreement (CAI). CAI benchmarks against international high-level economic and trade rules and is a balanced, high-level, mutually beneficial agreement [7–9], which will not only but will also strongly stimulate the recovery of the world economy in the post-pandemic era, promote the liberalization and facilitation of global trade and investment, and make important contributions to building an open world economy [10–12]. Relevant data indicates that in terms of trade, the total import and export volume between China and other countries along the BRI increased from USD 1.04 trillion to USD 1.34 trillion during 2003 to 2019, accounting for 29.3% of China's total goods from 25% (Data Source: China Belt and Road Initiative Investment Report 2020 issued by Chinese Academy of International Trade and Economic Cooperation). In terms of investment, China's direct investment in countries along the BRI rose from USD 200 million to USD 18.69 billion during 2003 to 2019, and its share in total foreign direct investment increased from 7.1% to 13.7%, with cumulative direct investment reaching to USD 117.31 billion (Data source: 2019 Statistical Bulletin of China's Outward Foreign Direct Investment jointly issued by the Ministry of Commerce, the State Bureau of Statistics, and the State Administration of Foreign Exchange). However, some foreign scholars have questioned the BRI, believing that it is the "Chinese version of the Marshall Plan" [13], "Chinese-style neocolonialism" [14], or "China's debt trap" [15], whose purpose is to expand the scope of forces and seize natural resources. Then, will the promotion of the BRI have a significant impact on poverty reduction in countries along the route? If will, what is the mechanism behind it? As the BRI has enhanced trade openness and investment openness, is it possible to facilitate regional poverty reduction through the openness of these factor? Answers to these questions will help to ensure a higher-quality development of the BRI and promote the sustainable development of countries along the route.

Based on the analysis above, this paper conducts a quasi-natural experiment. Based on the panel data of 134 countries worldwide from 2000 to 2018, this paper uses the difference-in-difference method to examine the impact of the BRI on poverty reduction in countries along the route. Meanwhile, the mechanism of the poverty reduction effect of the BRI is further tested from the perspectives of trade openness and investment openness.

This paper includes the following parts: The first part is the introduction, the second is the literature review and

research hypothesis, the third includes research methodology and data, the fourth is the empirical results analysis, and the last part is the conclusion and policy implications.

2. Literature Review and Hypothesis

The literature closely related to this paper involves two aspects. The first aspect is the impact of economic openness on poverty reduction. Poverty is a comprehensive problem formed by the interaction of multiple factors in a specific space-time context, to which worldwide governments and scholars have been committed to finding solutions. One of the solutions that advocates the further enhancement of trade openness and investment openness has become a key factor in achieving national poverty reduction [16–18].

In terms of the impact of trade openness on poverty reduction, Bhagwati and Srinivasan [19] first explored the relationship between the two, arguing that trade openness can stimulate national economic growth and thus effectively reduce regional poverty. Later, Dollar and Kraay [20], Tsai and Huang, [21] and other scholars generally followed this track for empirical analysis. Jenkins [22] believed that the income distribution effect brought by trade openness can help achieve effective poverty alleviation. In addition, some scholars have, by taking multiple perspectives into account, more systematically explored the mechanism of the impact of trade openness on poverty reduction. For example, Winters et al. [23] believed that trade openness could have a positive impact on poverty reduction through economic growth, family and market, wages and employment, and government income and expenditure. Heo and Doanh [24] took Vietnam as an example and found that trade openness could significantly reduce poverty in Vietnam through economic growth, enterprises, markets, and government. At present, as the issue of poverty has been studied even more extensively and intensively, some papers reveal the trade openness impact of poverty reduction and its mechanism from the perspective of multi-dimensional poverty. However, there are also scholars who believe that trade openness may exacerbate market competition, resulting in a sharp rise in unemployment among low-skilled workers and a gradual widening of the “Matthew Effect” between the rich and poor [25], and as a result, regional poverty will not be alleviated in a long-term period.

In terms of the impact of investment openness on poverty reduction, most scholars hold that foreign direct investment (FDI) has a significantly positive impact on poverty reduction in host countries. For example, based on panel data of 12 Vietnam provinces from 1992 to 2002, Hung [26] found that every 10% increase in foreign direct investment will lead to a 0.5% decrease in the poor population. Jalilian and Weiss [27], based on the study on the data of ASEAN country from 1997 to 2007, found that FDI could significantly increase income for the bottom 20% of the population. Later, Zhang [28], Nunnenkamp et al. [29], and Khan et al. [30] drew the similar conclusions when studying countries such as China, Bolivia, and Pakistan.

The second aspect is that the implementation of the BRI has promoted the trade openness and investment openness.

Guided by the principle of “extensive consultation, joint contribution and shared benefits,” China has conducted a series of trade and investment cooperation with countries participating in the BRI, which will better meet the development needs of countries along the BRI and further promote economic growth [31]. In terms of trade openness, most empirical literature shows that the BRI has continuously enhanced transport connectivity to countries along the route. For example, the China-Europe Railway Express will reduce transportation costs and trade time to a large extent [32], thereby further promoting trade openness and growth in countries along the BRI [33]. From the perspective of the whole areas covered in the BRI, Soyres et al. [34] found that the transportation infrastructure under the BRI will have a positive impact on the transportation costs and time of countries along the route by reducing 1.7%–3.2% and 1.5%–2.8%, respectively. On this basis, Baniya et al. [35] further analyzed how shorter trade time would affect bilateral trade and found that the BRI increased trade flows among participating countries by 4.1% and benefited time-sensitive products most. From the perspective of different regions along the BRI, Herrero and Xu [36] believed that the BRI strengthened freight links with European countries through the China-Europe Railway Express. This trans-continental railway transportation has the dual advantages of lower transportation cost and shorter trade time, thus playing an important role in promoting the development of trade between China and Europe. In addition, studies involving Southeast Asia [37] and South Asia [38] also show that the proposal of the BRI can significantly promote trade growth. Therefore, under the BRI’s cooperation framework, the continuous strengthening of trade links among the route will help countries achieve their goals of exploring endowment and comparative advantages, increasing employment of the poor, facilitating business transactions, and increasing income.

In terms of investment openness, many scholars have also conducted empirical studies on the impact of the BRI on FDI in countries along the route. He and Cao [39] constructed a bilateral FDI network of countries along the BRI and found that the advent of the initiative led to an expanding FDI network as well as closer investment links. Chen and Lin [40] discovered that the BRI will strengthen the cross-border transport network connection of countries along the route and reshape the spatial organization of cross-border investment by diverting 3% of the total FDI flows to participating countries.

To sum up, the BRI has been believed as an open and win-win cooperation platform and promotes the orderly flow and openness of international factors such as trade and investment by strengthening the connectivity of transportation infrastructure with countries along the route to achieve effective poverty reduction and high-quality development in the region. Figure 1 reflects the mechanism of the BRI on poverty reduction in countries along the route. The following to-be-tested research hypotheses are put forward.

Hypothesis 1. The implementation of the BRI has a significant positive impact on poverty reduction in countries along the route.

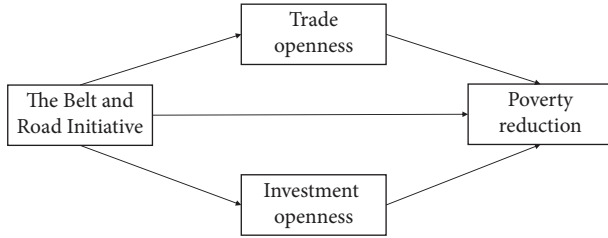


FIGURE 1: Mechanism of the BRI on poverty reduction in countries along the route.

Hypothesis 2. The BRI can reduce poverty in countries along the route through trade openness and investment openness.

3. Methodology and Data

3.1. Methodology

3.1.1. Model Building. This paper proposes the BRI as a quasi-experiment, and difference-in-difference (DID) is used to evaluate its impact on poverty reduction in countries along the route. Learning from the practice of Kong et al. [41], we construct a two-way fixed effect DID model. The model can be expressed as

$$\begin{aligned} \ln\text{Poverty}_{it} &= \alpha_0 + \alpha_1 \text{did}_{it} + a_2 \ln X_{it} + \gamma_i + \sigma_t + \varepsilon_{it}, \\ \text{did}_{it} &= \text{treat}_i \times \text{post}_t, \end{aligned} \quad (1)$$

where Poverty_{it} represents the incidence of poverty of country i in year t and post_t represents the dummy variable of the policy time effect. Since the BRI was put forward in 2013, 2013 is taken as the first year of policy advancement. Hence, post_t is equal to 1 in 2013 and after the BRI, otherwise it is equal to 0. Treat_i represents the dummy variable of the processing group. If the country belongs to the BRI, then Treat_i is equal to 1, otherwise $\text{Treat}_i = 0$. α_1 is the coefficient of the core independent variable. If the value is significantly positive, it means that the proposal of the BRI is conducive to reducing the incidence of poverty in countries along the route. X_{it} denotes all control variables. γ_i is the country fixed effect. σ_t is the year fixed effect. ε_{it} is the error term.

3.1.2. Variables Selection. Explained variable: incidence of poverty (*Poverty*). In consideration of data availability and comparability between countries, the incidence of poverty in this paper is based on the latest international standard of extreme poverty, published by the World Bank in 2015, that is, the proportion of the population living on less than USD 1.90 per person per day (purchasing power in 2011). The greater the indicator, the higher the incidence of poverty in the country.

Core variable: In defining whether a country is involved in the BRI (post_t), this paper is based on the development priorities cited in the Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road and the scope defined by the People's Daily Online and the BRI Research Center of the Chinese Academy of Social Sciences, setting the scope of the BRI involves 66 countries

including China. However, there is a lack of data in 12 countries including Afghanistan, the United Arab Emirates, Bahrain, Brunei, Bhutan, Cyprus, Kuwait, Laos, Maldives, Oman, Qatar, and Yemen, and 54 of them are selected as countries along the BRI. Meanwhile, 80 countries not along the BRI are selected as the control group. The list and classification of those countries are shown in Table 1.

Control variables: On the basis of existing empirical literature, the level of economic development (*Economy*), industrial structure (*Structure*), urbanization (*Urban*), transport development (*Transport*), education development (*Education*), and medical development (*Medical*) is screened out.

Economy: Most literature shows that the level of economic development has a significant negative impact on regional poverty. For one thing, the improvement of economic development has prospered the market and increased employment opportunities, making more jobs (especially non-agricultural jobs) available to the regional poverty population, thereby alleviating income poverty. For another, with the rapid development of regional economy, the government has increased financial expenditure on infrastructure, education, health care, and social security, thereby improving the living and production capacity of the poor population and alleviating the overall poverty in the region. The significant negative impact of economic development level on regional poverty is expressed by per capita GDP in this paper.

Structure: Ravallion and Datt [42] found that tertiary industry had the greatest impact on poverty reduction, followed by the secondary industry and the primary industry with the weakest impact. We conclude that the influence mechanism of industrial structure upgrading on poverty alleviation involved two aspects. First, the optimization and upgrading of industrial structure will transfer factors such as labor, capital, and science and technology innovation to higher industrial sectors, thus further promoting economic growth and reducing the incidence of poverty. Second, the upgrading of industrial structure will optimize the employment structure to a higher level in that the regional poor population will seek employment in the secondary and tertiary industries and get paid higher, thus reducing the incidence of poverty. In summary, this paper argues that the level of industrial structure has a significant negative impact on regional poverty, which is expressed by the ratio of the added value of the tertiary industry to that of the secondary industry.

Urban: There is still no unified conclusion about the impact of urbanization level on regional poverty. On the one hand, rapid urbanization can directly promote the transfer of rural population to urban areas, thereby increasing non-agricultural employment opportunities for rural labor population and alleviating regional poverty. At the same time, urbanization can promote economic development, industrial structure upgrading, and agricultural production efficiency, thereby indirectly alleviating poverty. On the other hand, due to the influx of a large number of rural labor force into the city, some production factors in rural areas will gather in urban areas, resulting in sluggish rural economic development. In

TABLE 1: List of countries and classification.

Country	Belong to the BRI	Belong to landlocked country	National income level
Albania	Yes	No	B
Algeria	No	No	C
America	No	No	A
Angola	No	No	C
Argentina	No	No	B
Armenia	Yes	Yes	B
Australia	No	No	A
Austria	No	Yes	A
Azerbaijan	Yes	Yes	B
Bangladesh	Yes	No	C
Belarus	Yes	Yes	B
Belgium	No	No	A
Benin	No	No	C
Bolivia	No	Yes	C
Bosnia and Herzegovina	Yes	No	B
Botswana	No	Yes	B
Brazil	No	No	B
Bulgaria	Yes	No	B
Burkina Faso	No	Yes	D
Cambodia	Yes	No	C
Cameroon	No	No	C
Canada	No	No	A
Chile	No	No	A
China	Yes	No	B
Colombia	No	No	B
Congo	No	No	D
Costa Rica	No	No	B
Cote d'Ivoire	No	No	C
Croatia	Yes	No	A
Cuba	No	No	B
Czech Republic	Yes	Yes	A
Denmark	No	No	A
Djibouti	No	No	C
Dominica	No	No	B
Ecuador	No	No	B
Egypt	Yes	No	C
England	No	No	A
Eritrea	No	No	D
Estonia	Yes	No	A
Ethiopia	No	Yes	D
Fiji	No	No	B
Finland	No	No	A
France	No	No	A
Gabon	No	No	B
Georgia	Yes	No	B
Germany	No	No	A
Ghana	No	No	C
Greece	Yes	No	A
Guatemala	No	No	B
Guinea	No	No	D
Guyana	No	No	B
Honduras	No	No	C
Hungary	Yes	Yes	A
India	Yes	No	C
Indonesia	Yes	No	B
Iran	Yes	No	B
Iraq	Yes	No	B

TABLE 1: Continued.

Country	Belong to the BRI	Belong to landlocked country	National income level
Ireland	No	No	A
Israel	Yes	No	A
Italy	No	No	A
Jamaica	No	No	B
Japan	No	No	A
Jordan	Yes	No	B
Kazakhstan	Yes	Yes	B
Kenya	No	No	C
Kyrgyzstan	Yes	Yes	C
Latvia	Yes	No	A
Lebanon	Yes	No	B
Liberia	No	No	D
Lithuania	Yes	No	A
Luxembourg	No	Yes	A
Madagascar	No	No	D
Malawi	No	Yes	D
Malaysia	Yes	No	B
Mali	No	Yes	D
Mauritania	No	No	C
Mexico	No	No	B
Moldova	Yes	Yes	C
Mongolia	Yes	Yes	C
Montenegro	Yes	No	B
Morocco	No	No	C
Mozambique	No	No	D
Myanmar	Yes	No	C
Namibia	No	No	B
Nepal	Yes	Yes	C
Netherlands	No	No	A
New Zealand	No	No	A
Nigeria	No	No	C
North Korea	No	No	D
North Macedonia	Yes	Yes	B
Norway	No	No	A
Pakistan	Yes	No	C
Palestine	Yes	No	C
Panama	No	No	A
Paraguay	No	Yes	B
Peru	No	No	B
Philippine	Yes	No	C
Poland	Yes	No	A
Portugal	No	No	A
Republic of Congo	No	No	C
Romania	Yes	No	A
Russia	Yes	No	B
Salvador	No	No	C
Saudi Arabia	Yes	No	A
Senegal	No	No	C
Serbia	Yes	Yes	B
Singapore	Yes	No	A
Slovakia	Yes	Yes	A
Slovenia	Yes	Yes	A
South Africa	No	No	B
South Korea	No	No	A
Spain	No	No	A
Sri Lanka	Yes	No	C

TABLE 1: Continued.

Country	Belong to the BRI	Belong to landlocked country	National income level
Sudan	No	No	D
Suriname	No	No	B
Swaziland	No	Yes	C
Sweden	No	No	A
Switzerland	No	Yes	A
Syria	Yes	No	D
Tajikistan	Yes	Yes	D
Tanzania	No	No	C
Thailand	Yes	No	B
Togo	No	No	D
Tunisia	No	No	C
Turkey	Yes	No	B
Turkmenistan	Yes	Yes	B
Uganda	No	Yes	D
Ukraine	Yes	No	C
Uruguay	No	No	A
Uzbekistan	Yes	Yes	C
Venezuela	No	No	B
Vietnam	Yes	No	C
Zambia	No	Yes	C
Zimbabwe	No	Yes	C

Note. A, B, C, and D present high-income countries, middle-high-income countries, middle-low-income countries, and low-income countries, respectively.

addition, the migration of rural people to cities leads to accelerated urbanization, which will not only put strains on current resources but also produce serious ecological environment problems, even more highlighting urban poverty problems. Therefore, with both positive and negative effects existing, the urbanization level often has a nonlinear impact on regional poverty, which is expressed by the proportion of urban population in the total population in this paper.

Transport: Due to a lack of port and aviation data at the national level, this paper focuses on the impact of roads and railways on global poverty reduction. As the two important types of transportation infrastructure vary greatly in mileage, volume, and flexibility, they are discussed in a separate way. To eliminate the impact brought by land areas in different countries, this paper selects the density of highway network (*Road*) and the density of railway network (*Rail*) as specific measurement indicators.

Education and Medical: Education and medical care are closely related to people's lives. Education is an effective way to improve the quality of human capital and a fundamental way to block intergenerational poverty, which is expressed by the public education expenditure per capita in this paper. Medical care is to improve the health level of human capital and is conducive to strengthening the medical and health protection of the poor, which is expressed by the public health expenditure per capita in this paper. The descriptive results of variables are shown in Table 2.

3.2. *Data.* Socio economic statistics are from multiple sources. GDP, per capita GDP, total population, employed

population, added value of primary, secondary, and tertiary industries, total import and export trade volume, urban population, land area, total railway mileage, public education expenditure and medical expenditure, incidence of poverty, and other data are from the World Bank's public database; the total road mileage is from the *World Road Statistics* published by the International Road Federation (IRF), the *International Statistical Yearbook* compiled by the National Bureau of Statistics, and the *World Affairs Almanac* published by the World Affairs Press, and the stock data of foreign direct investment is from the database of the United Nations Conference on Trade and Development (UNCTAD). Since the March of the 21st century, countries around the world have gradually increased their attention to poverty issue and implemented various poverty reduction strategies. Therefore, this paper sets the time of the chosen sample from 2000 to 2018 and includes 134 countries, 54 of which belong to countries along the BRI. As observed from the whole sample, the total GDP of the sample in 2018 accounts for 97.58% of the global GDP, and the total population accounts for 99.16% of the global population.

4. Results

4.1. *Overall Regression Analysis.* Based on the macroeconomic data of 134 countries worldwide from 2000 to 2018, the DID model of the two-way fixed effect is used to empirically test the impact of the BRI on poverty reduction. To make comparisons, this paper adds control variables in turn, as shown in Model 1–Model 8 of Table 3. The coefficient of *did* in Model 1 is -0.439 and passes the 1% significance test, while the coefficient of *did* in Model 2–Model 8 decreases significantly and stabilizes at around -0.26 after adding control variables. This fully demonstrated that the BRI could significantly reduce the incidence of poverty of countries along the BRI, but this poverty reduction effect could be overestimated without adding control variables. Thus, hypothesis 1 is proved.

The regression results of control variables show that the level of economic development, industrial structure, urbanization, road development, education development, and medical care development contributes to poverty reduction, while the level of railway development has no significant impact on the incidence of poverty.

4.2. Test Analysis

4.2.1. *Parallel Trend Test.* The premise of the DID model is that before a policy event occurs, the change trends in the treatment group and control group should be consistent. According to the research methods of Beck et al. [43], this paper selects the three years before and after the implementation of the BRI in 2013 to further observe the change trends of the treatment group and the control group. If DID is not obvious before the implementation of the BRI, there will be no significant difference between the treatment group and the control group, and thus the parallel trend hypothesis will be proved.

TABLE 2: Descriptive statistics.

Variables	Obs	Mean	S.D.	Min	Max
Poverty	2546	15.084	20.783	0.000	96.500
did	2546	0.125	0.331	0.000	1.000
Economy	2546	11541.907	17762.358	111.927	118824.156
Structure	2546	253.403	127.420	24.426	1320.228
Urban	2546	58.644	20.735	13.397	100.000
Road	2546	5498.630	8200.503	47.490	50843.115
Rail	2546	230.886	346.213	3.784	2815.091
Education	2546	579.025	981.563	0.563	7703.423
Medical	2546	960.923	1692.109	3.351	10550.938

TABLE 3: Overall regression results.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
did	-0.439***	-0.255***	-0.249***	-0.262***	-0.257***	-0.257***	-0.269***	-0.255***
lnEconomy		-0.850***	-0.874***	-0.863***	-0.845***	-0.846***	-0.699***	-0.494***
lnStructure			-0.180***	-0.187***	-0.181***	-0.181***	-0.156***	-0.097*
lnUrban				-0.683***	-0.408*	-0.407*	-0.385*	-0.467**
lnRoad					-0.214***	-0.211***	-0.211***	-0.207***
lnRail						-0.041	-0.047	-0.025
lnEducation							-0.142***	-0.036
lnMedical								-0.370***
Country-Fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.807***	8.266***	9.421***	12.053***	12.448***	12.608***	11.914***	11.514***
R ²	0.06	0.638	0.638	0.631	0.652	0.653	0.651	0.650

Note. *, **, and *** indicate that statistics are significant at the 10%, 5%, and 1% level of significance, respectively.

TABLE 4: Parallel trend test results.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
did ₂₀₁₀	-0.037	-0.029	-0.033	-0.031	-0.031	-0.041	-0.040
did ₂₀₁₁	-0.120	-0.109	-0.115	-0.112	-0.112	-0.126	-0.126
did ₂₀₁₂	-0.116	-0.108	-0.115	-0.111	-0.111	-0.124	-0.119
did ₂₀₁₃	-0.220***	-0.211***	-0.220***	-0.***	-0.221***	-0.233***	-0.222***
did ₂₀₁₄	-0.190**	-0.185**	-0.195**	-0.189**	-0.190**	-0.203**	-0.190**
did ₂₀₁₅	-0.251***	-0.245***	-0.256***	-0.250***	-0.249***	-0.261***	-0.250***
did ₂₀₁₆	0.265***	-0.257***	-0.269***	-0.262***	-0.262***	-0.271***	-0.261***
lnEconomy	-0.869***	-0.895***	-0.885***	-0.866***	-0.867***	-0.730***	-0.519***
lnStructure		-0.184***	-0.190***	-0.184***	-0.184***	-0.161***	-0.100*
lnUrban			-0.624***	-0.343	-0.341	-0.320	-0.407*
lnRoad				-0.220***	-0.216***	-0.216***	-0.212***
lnRail					-0.048	-0.054	-0.031
lnEducation						-0.132**	-0.024
lnMedical							-0.378***
Country-Fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.414***	9.593***	12.004***	12.410***	12.597***	11.945***	11.531***
R ²	0.635	0.634	0.629	0.649	0.651	0.649	0.648

Note. *, **, and *** indicate that statistics are significant at the 10%, 5%, and 1% level of significance, respectively.

As shown in Table 4, after adding control variables in turn, all regression results of *DID* before 2013 in Model 1–Model 7 do not pass the significance test. In addition, in 2013 and beyond, all regression coefficients of *DID* pass the significance test, and the influence coefficient is significantly smaller than that before the implementation of the BRI (Figure 2), which fully showed that the development trends of the treatment group and the control group are consistent before 2013, while the development trends of

the two groups are quite different after the implementation of the BRI. Therefore, the sample passes the parallel trend test.

4.2.2. *Placebo Test.* Referring to the research method of Cai et al. [44], the placebo test is conducted by randomly selecting the same number of countries along the BRI from the full sample. Therefore, this paper randomly selects 54

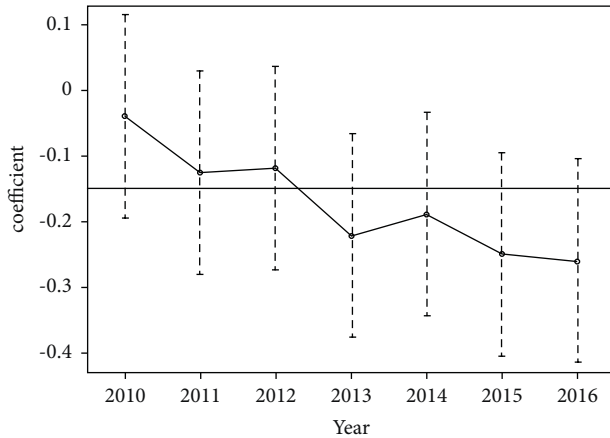


FIGURE 2: Parallel trend analysis chart.

countries from the full sample of 134 countries as the treatment group and considers other countries as the control group. The year of policy implementation is set at 2013. Since the processing group is randomly generated, the regression coefficient of the core explanatory variable *did* would not be likely to pass the significance test. To avoid errors in the estimation results caused by small probability events, 500 repeated tests are conducted for the above process. Figure 3 reflects the estimated coefficient of 500 randomly selected treatment groups and the distribution map of the corresponding *p* value. It can be clearly found therefrom that the mean value of the regression coefficient is close to zero, at -0.003 , and most *p* values do not pass the test level of 1%. At the same time, the vertical line in Figure 3 represents the actual estimated coefficient of the sample, which is obviously abnormal. Overall, the missing variables do not cause any errors to the empirical results in this paper.

Among the countries along the BRI, China and India face the toughest poverty issue as a result of a large population scale. Since the turn of the new century, the two countries have been attaching higher importance to poverty reduction and contributed a great deal to the wider efforts of global poverty reduction. To prevent the interference of these two abnormal samples on the results of this paper, the samples of these two countries are deleted, and the remaining countries along the BRI are estimated. If the coefficient of *did* is still significantly negative, the robustness of the empirical results of this paper would be further proved. According to Model 1–Model 4 in Table 5, the coefficient of *did* is significantly negative whether China or India is deleted or not. At the same time, the regression coefficients of *did* in Model 2 and Model 4 are -0.228 and -0.252 , respectively, while the coefficient of *did* in the total sample above is -0.255 , indicating that compared with the absence of India, the absence of China will significantly reduce the impact of the BRI on poverty reduction in countries along the route.

4.2.3. Endogeneity Test. Due to the non-randomness of the Chinese government’s choice of countries to implement the BRI, this may lead to the estimation of the impact of the

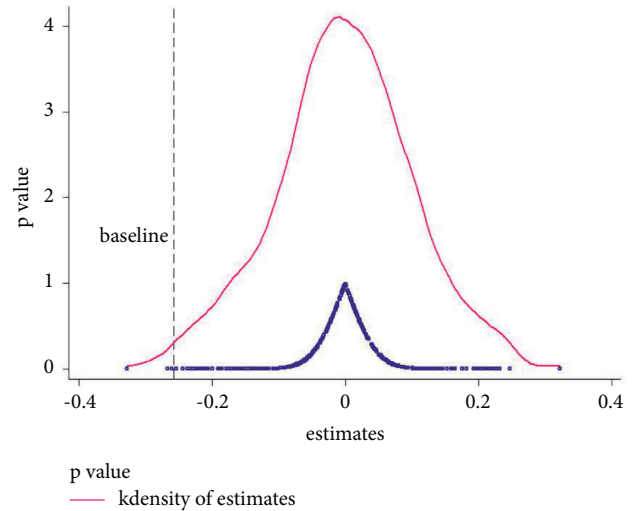


FIGURE 3: Placebo test chart.

implementation of the BRI on the incidence of poverty to be affected by endogenous issues. In order to deal with the endogenous problem, this paper further uses the instrumental variable method to estimate. Drawing lessons from the “Six-Dimensional Theory of Culture” (Six-Dimensional Theory of Culture includes Long-Term Orientation/Short-Term Orientation), Indulgence/Constraint, Right Distance Index, Individualism/Collectivism, Masculinism/Feminism and Uncertainty Avoidance) proposed by Hofstede [45], the cultural distance (we use the model constructed by Kogut and Singh [46] to measure the cultural distance) between countries is selected as an instrumental variable. The rationality of this instrumental variable is as follows: The smaller the cultural distance between a country and China, the stronger the cultural identity of the two countries, and the more likely it is to join the BRI, that is, to meet the relevance conditions; in addition, cultural differences are caused by differences in the cultural and historical backgrounds, social systems, and inheritance of the respective nations, which are relatively stable and do not change much over time, so they do not have a direct impact on the incidence of poverty in each country in the sample period. We use the two-stage least squares (2SLS) model to identify this endogenous problem. Model 1 in Table 6 is the regression result of the first stage: The estimated coefficient of *iv* is significantly positive at the 1% level, indicating that the greater the cultural distance from China, the lower the possibility of joining the BRI, that is, the correlation condition is met. At the same time, the F statistic is greater than the critical value of 10, indicating that there is no weak instrumental variable problem; Model 2 in Table 6 is the regression result of the second stage: The estimated coefficient of *did* is significantly negative, which shows that after considering the endogeneity problem, the BRI still significantly reduces the incidence of poverty in countries along the route.

4.3. Mechanism Analysis. Based on the above analysis, this paper argues that the BRI can have a positive impact on poverty reduction by elevating trade openness and investment openness of countries along the route to a higher level.

TABLE 5: Test results of deleting China and India samples.

Variables	Delete China		Delete India		Delete China and India	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>did</i>	-0.397***	-0.228***	-0.433***	-0.252***	-0.390***	-0.224***
Control variables	No	Yes	No	Yes	No	Yes
Country-Fe	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fe	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.793***	9.588***	1.793***	11.461***	1.779***	9.505***
R^2	0.061	0.644	0.065	0.648	0.067	0.642

Note. *** indicates that statistics is significant at the 1% level of significance.

TABLE 6: Instrumental variable test results.

Variables	Model 1	Model 2
<i>iv</i>	-0.076***	
<i>did</i>		-2.048***
Control variables	Yes	Yes
Country-Fe	Yes	Yes
Year-Fe	Yes	Yes
Constant	-0.514***	10.723***
R^2	0.109	0.619
<i>F</i> statistics	35.39	

Note. *** indicates that statistics is significant at the 1% level of significance.

Therefore, referring to the research results of Tang et al. [47], a mediation effect model is constructed to examine the mechanism of the BRI on poverty reduction. The test model for hypothesis 2 is as follows:

$$\begin{aligned}
 \ln\text{Poverty}_{it} &= \alpha_0 + \alpha_{11}\text{did}_{it} + \alpha_{12}\ln X_{it} + \gamma_{11} + \sigma_{11} + \varepsilon_{11}, \\
 \ln\text{Med}_{it} &= \beta_0 + \beta_{11}\text{did}_{it} + \beta_{12}\ln X_{it} + \gamma_{12} + \sigma_{12} + \varepsilon_{12}, \\
 \ln\text{Poverty}_{it} &= \gamma_0 + \gamma_{11}\text{did}_{it} + \gamma_{12}\ln\text{Med}_{it} + \gamma_{13}\ln X_{it} \\
 &\quad + \gamma_{13} + \sigma_{13} + \varepsilon_{13},
 \end{aligned}
 \tag{2}$$

where Med_{it} represents the intermediary variables, involving the trade openness level (*Trade*) and investment openness level (*FDI*), which are expressed as the proportion of the total import and export trade in the GDP and the total foreign investment in GDP of each country. The mediation effect of did_{it} is equal to $\beta_{11} \times \gamma_{12}$. The mediation effect accounted for the total effect proportion is equal to $(\beta_{11} \times \gamma_{12}) / (\beta_{11} \times \gamma_{12} + \gamma_{11})$.

Table 3 reports that the BRI has a significant negative impact on the incidence of poverty in countries along the route, that is, the estimated coefficient α_{11} is significantly negative, indicating that the mediation effect test can be carried out. Model 1 and Model 2 of Table 7 report whether the BRI will affect poverty reduction in countries along the route through trade openness. In Model 1, β_{11} is significantly positive, indicating that the BRI does promote the level of trade openness of countries along the route; furthermore, when trade openness is introduced into the poverty reduction equation, both γ_{11} and γ_{12} in Model 2 pass the significance test, so the Sobel test is unnecessary. Overall, the mediation effect of trade openness is -0.013, accounting for 5.098% of the total effect, which shows that the BRI can affect poverty reduction in countries along the route through trade openness. Hypothesis 2 is partly proved.

Model 3 and Model 4 of Table 7 report whether the BRI will affect poverty reduction in countries along the BRI through investment openness. In Model 1, β_{11} is not significant, indicating that the BRI has no significant impact on the investment openness of countries along the route; furthermore, by introducing investment openness into the poverty reduction equation, both γ_{11} and γ_{12} in Model 3 pass the significance test and Sobel test. From this, it can be found that the mediating effect of investment openness is -0.003, accounting for 1.176% of the total effect, which indicates that the BRI can affect poverty reduction in countries along the route through investment openness. Hypothesis 2 is finally proved.

4.4. Heterogeneity Analysis. Heterogeneity analysis is conducted mainly from two dimensions: First, according to the geographical location, countries are separated into coastal countries and landlocked countries. Second, according to the classification of national income level by the World Bank, countries are separated into high-income countries (per capita national income over USD 12,376 or higher), middle-high-income countries (per capita national income between USD 3,996 and USD 12,375), middle-low-income countries (per capita national income between USD 1,026 and USD 3,995), and low-income countries (per capita national income about USD 1,025 or lower). The results of heterogeneity analysis are shown in Table 8.

In Table 8, the regression coefficients of *did* in Model 1 and Model 2 are -0.383 and -0.229, respectively, which pass the 1% significance test, indicating that the implementation of the BRI has a positive impact on poverty reduction in landlocked countries and coastal countries along the route. Specifically, the BRI has a stronger impact on poverty reduction in landlocked countries than in coastal countries, which means that the opening of China-Europe Railway Express has widen the openness of landlocked countries and provided them with greater economic development potential.

In Table 8, the regression coefficients of *did* in Model 3-Model 6 are 0.150, -0.038, -0.524, and -0.259, respectively, with only Model 4 failing to pass the significance test, indicating that the implementation of the BRI has a positive impact on poverty reduction in low- and middle-income countries and low-income countries, and yet has a negative impact on high-income countries. In addition, its impact on middle- and high-income countries was not obvious.

TABLE 7: Mediation effect test results.

Variables	Trade openness		Investment openness	
	Model 1	Model 2	Model 3	Model 4
<i>did</i>	0.062***	-0.242***	0.044	-0.252***
<i>lnTrade</i>		-0.217***		
<i>lnFDI</i>				-0.077***
Control Variables	Yes	Yes	Yes	Yes
Country-Fe	Yes	Yes	Yes	Yes
Year-Fe	Yes	Yes	Yes	Yes
Constant	7.485***	13.142***	1.524*	11.632***
R^2	0.053	0.661	0.021	0.653

Note. * and *** indicate that statistics are significant at the 10% and 1% level of significance, respectively.

TABLE 8: Heterogeneity analysis results.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>did</i>	-0.383***	-0.229***	0.150 * *	-0.038	-0.524***	-0.259***
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Country-Fe	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fe	Yes	Yes	Yes	Yes	Yes	Yes
Constant	14.232***	11.842***	32.609***	15.167***	-0.602	6.953***
R^2	0.600	0.643	0.284	0.134	0.010	0.080

Note. Model 1, Model 2, Model 3, Model 4, Model 5, and Model 6 present landlocked countries, coastal countries, high-income countries, middle-high-income countries, middle-low-income countries, and low-income countries, respectively; * * and *** indicate that statistics are significant at the 10% and 1% level of significance, respectively.

Therefore, the impact of BRI on poverty reduction is pro-poor. For middle- and low-income countries and low-income countries along the BRI, to meet their own development needs, they are eager to join the BRI to obtain development opportunities. At the same time, the BRI strengthens the connectivity of transportation infrastructure in developing countries along the BRI, upgrades the level of openness, and transforms their resource advantages into economic advantages, thus achieving prominent poverty reduction results. For high-income countries, absolute poverty (the quantity of poverty) has been solved, but relative poverty (the quality of poverty) should be focused and alleviated. Therefore, under the BRI, they should make an effective use of international factor resources to achieve high-quality economic development and improve the welfare of people. For middle- and high-income countries, there is only one step to join in the rank of high-income countries, and yet they tend to fall into the middle-income trap. In addition, when some middle- and high-income countries optimize the development of industrial structure, their social employment and people's living standards may be affected to some extent, thus they should also take advantage of the BRI to achieve their further development.

5. Conclusions and Policy Implications

There are still more than 700 million extremely poor people in the world, and a considerable part of them live along the BRI. How to effectively lift themselves out of poverty has become a challenge for most developing countries along the BRI. As pointed out in the Joint Communique of the Roundtable Summit of the Belt and Road Forum for

International Cooperation signed at the first Belt and Road Forum for International Cooperation (BRF), "all countries, especially developing countries, still face common challenges such as eradicating poverty, promoting inclusive and sustained economic growth, and achieving sustainable development." The joint construction of the BRI is an open international cooperation platform, and its many concepts and practical measures have provided practical opportunities for promoting poverty reduction and governance in the countries along the BRI. In this context, it is of great theoretical and practical significance to assess the impact of the BRI on poverty reduction in countries along the route. Based on the panel data of 134 countries around the world from 2000 to 2018, we propose the 2013 BRI as a quasi-natural experiment, using the DID model and mediation effect model to examine the impact and mechanism of the BRI on poverty reduction. The main conclusions are as follows: First, the study finds that the BRI has an impact on poverty reduction in countries along the route, with the impact coefficient stable at -0.26, and the empirical conclusion has passed the parallel test, placebo test, and instrumental variable test. Second, mechanistic analysis results show that the BRI can reduce the incidence of poverty in countries along the route by promoting trade and investment openness. Finally, heterogeneity analysis shows that the BRI has a slightly greater role in promoting poverty reduction in inland countries along the route than in coastal countries. In addition, the BRI has a positive impact on the poverty reduction performance of low- and middle-income countries and low-income countries, a negative impact on high-income countries, and a non-significant impact on middle- and high-income countries.

Based on the above conclusions, we put forward policy implications. First, the BRI originated in China, but the opportunities and results are shared by all countries. At present, we should let go of the prejudice against China. The BRI is not a “Chinese version of the Marshall Plan,” “Chinese-style neocolonialism,” or “China’s debt trap.” It is an inclusive, open, and sharing platform, and it is also a goal-oriented development governance model, which differs from traditional standardized governance and is more inclusive. The degree of recognition of the BRI is a prerequisite for the effective and long-term service of the development of the areas along the route.

Second, facility connectivity is the foundation for cooperation and development of countries along the BRI. From the current point of view, the BRI is faced with a series of obstacles to transportation infrastructure, such as sparse transport network layout, imperfect port facilities, and complicated customs clearance procedures. Therefore, it is difficult to promote the orderly flow of factors such as trade, investment, and personnel in the countries along the route so that the intermediary effect of trade and investment in this paper is relatively small. Under this situation, on the one hand, it is necessary to establish a more complete and sound infrastructure cooperation mechanism, further optimize the customs clearance process, improve the efficiency of customs clearance, and reduce the obstacles that hinder the cross-border flow of factors; on the other hand, transport technology facilities in the countries along the route, especially in Central Asia, West Asia, and other regions, need more efforts in planning layout, engineering construction, speed-up and upgrading, etc.

Finally, there are significant differences in the stages of poverty reduction in different types of countries along the BRI, so there should be significant differences in development methods. For most developing countries along the route, which are still in the initial stage of poverty reduction, they are solving the problem of absolute poverty. Therefore, more emphasis should be placed on the development of economic scale and the improvement of people’s living standards. For developed countries, they are in the late stage of poverty reduction and alleviate the problem of relative poverty. Therefore, more emphasis should be placed on high-quality economic development and the improvement of people’s welfare.

Data Availability

All data used to support the findings of the study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

Acknowledgments

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