Empirical Research on the Development Effect of China's "Belt and Road Initiative" Outward Foreign Direct Investment on Countries along the Routes ——Analysis Based on Linear Regression Algorithm

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Abstract. Theoretically, outward foreign direct investment (OFDI) can promote the economic and social development of host countries through capital formation effect, technology spillover effect and industrial upgrading effect, as well as influencing employment and finance. Countries with different levels of economic development have different abilities to absorb and utilize foreign capital. This paper uses linear regression algorithm to test the impact of China's "Belt and Road Initiative" (BRI) OFDI on the Human Development Index (HDI) of countries along the BRI. The result shows that China's BRI OFDI can promote the economic and social development of the countries along the routes, which answers the relevant doubts. Meanwhile, the development effect of OFDI is more significant in countries with high-income levels than in countries with low-income levels. To maintain positive economic interaction between China and countries along the BRI, China should continue to implement the concept of inclusive development, improve cooperation mechanisms, give play to the role of enterprises, and break the stigma of BRI from international opinion.

Keywords: BRI; OFDI; HDI;

1 Introduction

With the implementation of the Belt and Road Initiative (BRI), China has achieved economic connectivity with more and more countries through outward foreign direct investment (OFDI) [1]. In 2021, China's OFDI traffic reached $178.82 billion, ranking among the top three in the world for ten consecutive years. From 2014 to 2021, China's OFDI flow and stock to countries along the BRI showed an overall upward trend (Fig 1). China's OFDI has brought rich financial support to the host country, created new job opportunities, provided advanced cutting-edge technologies, and promoted the development of the host country in economic, social, and environmental aspects [2]. However, recently the "debt trap theory" "ecological disaster theory" and "resource plunder theory" caused negative impact on the international reputation of China's OFDI.

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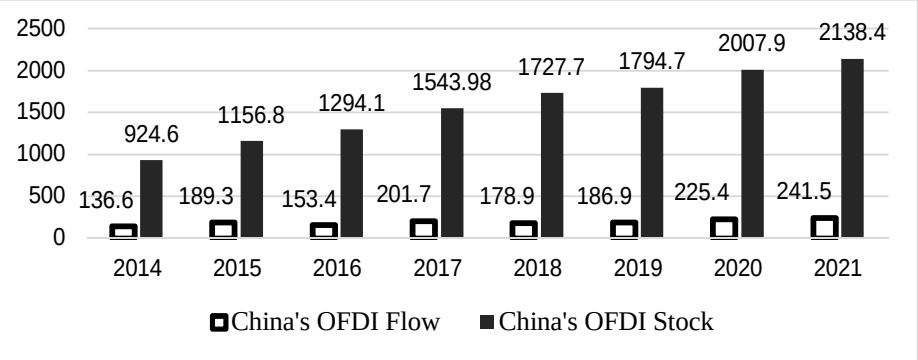

Fig. 1. China's OFDI flow and stock to countries along the BRI from 2014 to 2021 (unit: USD 100 million)

From the regional perspective and different dimensions of economic and social development, the existing literature has conducted rich research on the impact of China's OFDI on the development of the host country, but it also leaves space for this paper to analyze the external effects of China's OFDI from other perspectives. On the one hand, the existing studies mainly focus on economic benefits, environmental changes, and other indicators [3][4], while the analysis of instead of the impact of China's OFDI on the social life of the people in the host country. On the other hand, due to the differences in economic strength, social composition, and industrial development, the heterogeneity analysis on the impact of Chinese OFDI on host countries with different levels of development needs to be supplemented as well [5][6].

This paper uses the Human Development Index (HDI) as a measure of the level of economic and social development of the countries along the BRI, and uses a linear regression algorithm to empirically test the relationship between the HDI and China's OFDI in 59 countries along the routes from 2004 to 2020, to investigate whether China's OFDI really promotes the development of the countries and people along the BRI, and whether there is heterogeneity in this effect among countries at different levels of development.

2 Theoretical Analysis and Research Hypotheses

Theoretically, OFDI can contribute to the economic and social development of the host country through capital formation effect, technology spillover and industrial upgrading effect, as well as indirect ways such as affecting employment and finance [7]. Firstly, foreign capital inflows can promote the host country to break the capital constraint to better carry out economic construction [8]. Secondly, foreign capital can often make more efficient use of the resource endowment of the host country and promote the upgrading of the host country's industry in the demonstration-imitation interaction. Finally, the inflow of foreign capital will directly create many jobs and promote the economic and social development of the host country through labor income and government distribution.

Hypothesis 1: China's OFDI plays a positive development effect on countries along the BRI.

The effect of OFDI on the development of the host country is not only influenced by the scale and structure of foreign capital, but also closely related to the economic foundation and absorption capacity of the host country [9][10]. Countries with a higher level of economic development tend to have a more solid economic foundation and a better policy environment, and their domestic enterprises are also more competitive and risk-resistant, which can actively cope with the potential risks.

Hypothesis 2: The development effect of China's OFDI differs among countries with different levels of development along the BRI.

3 Empirical Design

3.1 Data Source and Description

To use linear regression algorithm analyze the development effect brought by China's BRI OFDI to countries along the routes, this paper takes HDI of host country as explained variable and China's BRI OFDI as explanatory variable, and selects annual data of 59 countries along the BRI from 2004 to 2020 as samples to establish an econometric model (Table 1).

Table 1. Variable definition table

Type of Variable	Variable Name	Variable Symbol	Variable Declaration
Explained Variable	Human Development Index	lnhdi	According to the Human Development Index Report
Explanatory Variable	Outward Foreign Direct Investment	lnOFDI	the Natural Logarithm of China's OFDI
Controlled Variable	Rural Population	rup	the Proportion of the Total Rural Population in each Country
	Capital Abundance	lnpcap	the Natural Logarithm of the Capital Formation per capita
	Trade Level	lntrade	the Natural Logarithm of the Import and Export Volume
	Economic Development Level	lnpgdp	Natural Logarithm of GDP per capita
	Industrialization Level	ids	Manufacturing Increased as a Share of GDP
	Jobless Rate	jlr	the Annual Unemployment Rate of Countries

3.2 Model Building

Based on the traditional regression theory and the research hypothesis, the following econometric model is developed to discuss the development effects of China's OFDI on the countries along the BRI:

$$lnhdi_{i,t} = \beta_0 + \beta_1 lnOFDI_{i,t} + \beta_2 rup_{i,t} + \beta_3 lnpcap_{i,t} + \beta_4 lntrade_{i,t+}\beta_5 lnpgdp_{i,t} + \beta_6 ids_{i,t} + \beta_7 jlr_{i,t} + \delta_i + \mu_{i,t} \quad (1)$$

The $lnhdi_{i,t}$ denotes the logarithm of HDI of country i in period t; the $lnOFDI_{i,t}$ denotes the logarithm of China's OFDI in country i in period t; the β_0 is a constant term, β_1-β_7 is the regression coefficient between the core explanatory variables and control variables; δ_i denotes individual fixed effect; $\mu_{i,t}$ is a random disturbance term; t represents 2004-2020; i represents 59 countries along the BRI involved.

3.3 Descriptive Analysis

Descriptive statistical analysis of the relevant variables is as follows (Table 2):

Table 2. Descriptive Analysis of the Related Variables

Variable	N	Min	Max	Mean	SD	Skewness	Kurtosis
lnhdi	617	-0.759	-0.0640	-0.292	0.151	-1.011	3.565
lnOFDI	617	12.72	28.23	21.49	2.888	-0.252	3.162
rup	617	0	0.835	0.431	0.198	0.0510	2.282
lnpcap	617	-1.102	11.86	6.323	2.826	-0.255	2.726
lntrade	617	18.89	31.17	26.48	2.098	-0.376	3.211
lnpgdp	617	5.667	11.11	8.536	1.247	0.0300	2.075
ids	617	0.00900	0.333	0.161	0.0570	0.150	3.036
jlr	617	0.00100	0.445	0.0790	0.0710	2.714	12.58

4 Empirical Results and the Analysis

4.1 Correlation Analysis

This paper draws on the Pearson correlation matrix method to analyse the correlation coefficients between the variables. There is no multicollinearity between the main variables, and there is an obvious positive correlation between lnhdi and lnOFDI (Table 3), which is consistent with the expected hypothesis.

Table 3. Pearson Correlation Analysis

	lnhdi	lnOFDI	rup	lnpcap	lntrade	lnpgdp	ids	jlr
lnhdi	1							
lnOFDI	0.462**	1						
rup	-0.092**	-0.0490	1					
lnpcap	0.389**	0.308***	-0.093**	1				
lntrade	-0.0250	0.0150	-0.0100	-0.301***	1			

lnpgdp	0.312***	0.129***	-0.0550	0.130***	-0.0250	1		
ids	0.078*	-0.139***	-0.075*	0.0250	0.0160	0.149***	1	
jlr	-0.0190	0.0620	-0.0460	-0.0390	0.122***	-0.145***	-0.236***	1

4.2 Multiple Collinearity Test

The VIF value of each variable and the VIF value of the whole variable are less than 5 (Table 4), indicating that there is no multicollinearity among the variables

Table 4. Results of Multiple Collinearity Test

Variable	VIF	1/VIF
lnpcap	1.260	0.795
lnOFDI	1.170	0.856
lntrade	1.140	0.881
ids	1.110	0.898
jlr	1.100	0.911
lnpgdp	1.070	0.934
rup	1.020	0.978
Mean VIF	1.120	

4.3 Panel Model Regression Analysis

To verify the research hypothesis, combined with the previous linear regression algorithm model, this paper uses a panel model regression for the analysis.

Table 5. Benchmark Regression Analysis

Model DV	(FE) lnhdi
lnOFDI	0.0052***
	(0.0013)
rup	-0.4513***
	(0.0558)
lnpcap	0.0031
	(0.0026)
lntrade	0.0165***
	(0.0023)
lnpgdp	0.0236***
	(0.0047)
ids	-0.1313***
	(0.0460)
jlr	-0.0219
	(0.0347)

** p < 0.1， ** p < 0.05， *** p < 0.01*

According to the results (Table 5), lnOFDI has a significant positive impact on lnhdi, indicating that China's BRI OFDI has a positive impact on the economic and social development of host countries. Among the control variables, the proportion of rural population in the host country shows an obvious negative influence while the coefficient of the level of industrialization of the host country is negative. The level of economic development and trade of the host country has a significant positive impact on the HDI, while the capital abundance, the unemployment rate does not show a significant impact on the relationship.

4.4 Heterogeneity test

Countries and regions with different development degrees along the BRI also have differences in the degree of absorption and utilization of foreign capital. According to the classification criteria of the World Bank, this paper divides the sample countries into high- and low-income countries according to their income levels, and explores whether the influence relationship between China OFDI and host country HDI varies between countries along the routes with different income levels.

Table 6. Income Level Heterogeneity

Model	(FE1)	(FE 2)
DV	lnhdi	lnhdi
level of income	High-income countries	Low-income countries
lnOFDI	0.0123***	0.0042**
	(0.0018)	(0.0016)

According to the linear regression algorithm coefficient (Table 6), both high-income countries and low-income countries is greater than 0, but the regression coefficient of high-income countries is higher than that of low-income countries, indicating that the development effect of China's BRI OFDI in high-income countries is more significant than that of low-income countries.

5 Robustness Test

To ensure the robustness of the above model, a reverse causality test and high-level shrinkage test are conducted in turn, the conclusion obtained is consistent with the above conclusion.

In addition, this paper further analyzes the influence results at the local level and analyzes the influence trend of OFDI. According to the results, no matter in the whole sample, or in high-income and low-income countries, the regression coefficient is greater than 0 at all sub-points, which is consistent with the conclusion above.

6 Conclusions

From the above linear regression algorithm analysis, it can be concluded that China's BRI OFDI has a positive impact on the economic and social development of countries along the routes, and the development effect of China's BRI OFDI in high-income countries is more significant than that in low-income countries. Based on this, this paper argues that China should continue to

adhere to the concept of universal benefits, improve the construction of mechanisms, strengthen the communication between the people of countries along the BRI, and enhance the strength of enterprises. In this way, China could eventually make more contributions to the world.

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