

Research on the growth effect of “the Belt and Road” strategy based on international trade perspective

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Abstract

This paper demonstrates that China’s investment in “the Belt and Road” countries is beneficial to improve GDP of China and “the Belt and Road” countries by constructing the mathematical model. And on this basis, the empirical test was carried out in combination with relevant countries’ data from 2000 to 2016. The results show that the strategy of “the Belt and Road” can bring positive impact on China's GDP by promoting the growth of “the Belt and Road” countries investment and increasing the trade dependence between China and “the Belt and Road” countries. To a certain extent, this paper demonstrates the superiority of “the Belt and Road” strategy.

Keywords: *“the Belt and Road”*; *international trade*; *model test*

1 Introduction

The world economy is undergoing complex and profound changes, and the international trade pattern is facing serious development problems and the global free trade system is facing unprecedented challenges. After 30 years of rapid economic growth, China has faced an array of interwoven difficulties and challenges such as excess production capacity and aging of population¹. These problems are seriously affecting the sustainable development of the country's economy. The international and domestic environments faced by China in its development have been complicated and challenging. In 2015, the ministry of finance,

propaganda department and ministry of education jointly put forward the vision and initiative of jointly building “the Belt and Road”, and China takes the initiative to build a global framework for cooperation and provides creative thinking for the common development of the world economy in the form of international trade².

“the Silk Road Economic Belt and the 21st-Century Maritime Silk Road” involves 65 regions and countries. These are mainly developing countries and emerging countries in the stage of rapid economic development³. On the one hand, their demand for goods is increasing day by day, and their natural resource is abundant. On the other hand, they also facing the problem of backward technology, lack of capital, management experience and a series of developmental disorders^{4,5}. China, the world's second largest economy today, after decades of the accumulation of capital and the rapid development of science and technology, already has a mature production ability and scientific and technological development capability⁶. Zhen Lei use the economic freedom index and construct an economic growth model. The results show that taking the “the Belt and Road” strategy is an opportunity to deepen China economic reform, and economic freedom is an important driving force for economic growth of “the Belt and Road” countries⁷. Zhou Jialing, Zeng Xianghong take foreign direct investment as the analysis object, suggest that the key to optimize China's foreign direct investment today is to strengthen the support of "going global" in manufacturing and services^{8,9}. Besides, with the rapid development of China's energy-intensive industries and the shortage of domestic resources, the foreign high-energy industry will be the key investment in the future of China's outbound investment¹⁰. “the Belt and Road” strategy based on international trade is to promote the economic development of countries along “the Belt and Road”, promote the adjustment of China's own industrial structure, promote supply-side reform, and ultimately achieve win-win cooperation.

According to the existing literature on “the Belt and Road”, most research focus on the strategy and macro research at the government level, but less on economic and trade; Although most scholars are optimistic about “the Belt and Road”, there are few empirical studies involving data demonstration. By constructing mathematical models, this paper demonstrates that the GDP of China and "the Belt and Road" countries can be improved through strengthening economic investment and promoting technology investment.

2 Theoretical model and equilibrium analysis

2.1 Model hypothesis

Assuming that there are only two countries in the model, y_{output} is an investment exporter and y_{input} is an investment importer. Both countries are open economies, and the two countries trade with each other. Each region produces a product that is needed and can be imported from another area. In addition, assuming that the economic resources of the two regions are not fully utilized and there is unemployment, the GDP can be increased by increasing the demand for domestic output.

Assuming that investment senders and recipients of the two countries economy under the condition of same basic assumptions in the same mode. The differences between the two countries' economic characteristics are reflected in the setting of specific parameters of the economic model of the two countries. These parameters are influenced by factors such as the country's political system, economic system, stage of economic development or the rate of economic growth. The effect of the exchange rate in the model is not considered. At the same time, the effect of the exchange rate in the model is not considered.

2.2 Model construction

Suppose the income identities of the exporting countries are:

$$y_{output} = C_0 + I_0 + G_0 + (X_0 - M_0) = \beta_0 y_0 + I_0 - \varphi_0 r_0 + G_0 + GI_0 + X_0 - m_0 y_0 \quad (1)$$

$y_{output} (y_0)$ is the actual national output of the exporter of investment; β_0 is the marginal propensity to consume for investment exporting countries. I_0 is an investment in the independent investment function of the exporting countries. It is an investment caused by changes in the country's population, technology, resources and other exogenous variables, which have nothing to do with the interest rate of the country, and can be regarded as an exogenous variable. $-\varphi_0 r_0$ is the induced investment function of the country, φ_0 is the marginal investment tendency. G_0 is the government investment finance expenditure for investment exporting countries. GI_0 is the government's foreign investment and financial

expenditure, which is determined by government policy and can be regarded as an exogenous variable. $X - m_0y_0$ is the net export function, m_0 is the marginal export tendency.

In the same way, the income identity of the investment recipient is:

$$y_{input} = C_i + I_i + G_i + (X_i - M_i) = \beta_i y_i + I_i - \varphi_i r_i + G_i + X_i - m_i y_i \quad (2)$$

In the formula, y_{input} (y_i) is the actual national output of the investment country; β_i is the marginal propensity to consume in the country; I_i is the independent investment function of the country; $-\varphi_i r$ is the investment function of the country; φ_i is marginal propensity to invest. G_i is the government investment expenditure; m_i is marginal import trend. Assume that government spending on investment is 0. It all comes from the investment of the government of the exporting countries ($G_i = GI_0$).

According to the hypothesis, only investment and exporter countries are included in the model. Therefore, the export of investment importing countries is the import of investment exporting countries, and the export of investment exporting countries is the import of investment importing countries.

$$X_0 = m_i y_i \quad (3)$$

$$X_i = m_0 y_0 \quad (4)$$

Formula (3) and formula (4) are substituted into equation (1) and formula (2).

$$y_{output} = \beta_0 y_0 + I_0 - \varphi_0 r_0 + G_0 + GI_0 + m_i y_i - m_0 y_0 \quad (5)$$

$$y_{input} = \beta_i y_i + I_i - \varphi_i r_i + GI_0 + m_0 y_0 - m_i y_i \quad (6)$$

2.3 Model equilibrium

By equation (5) and equation (6), it can be seen that the GDP between investment and exporting countries is depended on each other.

$$y_{input}^* = \frac{k_0}{1 - k_i k_0 m_i m_0} [(I_i - \varphi_i r_i + GI_0) +$$

$$m_0 k_0 (I_0 - \phi_0 r_0 + G_0 + GI_0)] \quad (7)$$

$$y_{output}^* = \frac{k_i}{1 - k_i k_0 m_i m_0} [(I_0 - \phi_0 r_0 + G_0 + GI_0) + m_0 k_0 (I_i - \phi_i r_i + GI_0)] \quad (8)$$

$$k_x = \frac{1}{1 - \beta_x + m_x}; \quad x = i; 0 \quad (9)$$

k_0 and k_i are the expenditure multiplier in the open economy conditions of both the investment exporting countries and the importing countries, which have nothing to do with each other's output level and only depend on the domestic marginal import tendency ($m_x; x = i; 0$) and the marginal propensity to consume ($\beta_x; x = i; 0$).

$$k_0 = \frac{1}{1 - \beta_0 + m_0} > 0; \quad k_i = \frac{1}{1 - \beta_i + m_i} > 0; \quad (10)$$

$$k'_x = \frac{k_x}{1 - k_x k_y m_x m_y}; \quad x = i, y = 0; x = 0, y = i; \quad (11)$$

In the mutual trade between the exporting countries and the recipient countries, the expenditure multiplier between them has an impact on each other. The equation (11) is the interdependence coefficient. Under the conditions of bilateral trade, the expenditure coefficient between each other is larger, and the government fiscal policy is more effective and the bilateral income is increased.

$$k'_i = \frac{k_i}{1 - k_i k_0 m_i m_0} > k_i > 0; \quad k'_0 = \frac{k_0}{1 - k_i k_0 m_i m_0} > k_0 > 0 \quad (12)$$

To sum up, under the equilibrium conditions:

$$y_{input}^* = k'_0 [(I_i - \phi_i r_i + GI_0) + m_0 k_0 (I_0 - \phi_0 r_0 + G_0 + GI_0)] \quad (13)$$

$$y_{output}^* = k'_i [(I_0 - \phi_0 r_0 + G_0 + GI_0) + m_0 k_0 (I_i - \phi_i r_i + GI_0)] \quad (14)$$

In conclusion, the above mathematical model can prove that the GDP of capital exporting countries is positively correlated with the investment situation of both sides, the government investment expenditure of capital exporting countries and the investment expenditure of capital input countries (proposition 1). At the same time, the GDP of the capital exporting countries is affected by the dependence coefficient of the trading opponent of the capital exporting countries (proposition 2).

3 Model Test

3.1 Empirical model setting

The empirical model is established based on the equilibrium analysis of the mathematical model. The explained variables of the model is the GPD of capital exporting countries. The explanatory variables include the investment situation of the capital exporting countries, the investment situation of capital input countries, the trade dependence coefficient, and the government investment and fiscal expenditure of the capital exporting countries. The control variables include the technical progress and export situation of the capital exporting countries. The variable declaration is shown in Table 1.

Table1- Variable declaration

Variable Index	
K	Trade dependence coefficient
Y	GDP of capital exporting countries
Invest	Investment in capital exporting countries
Invest2	The investment situation of capital input country
Government	Government investment in capital exporting countries
Research	Technological advances in capital exporting countries
Output	The export situation of capital exporting countries

According to the equilibrium result of the mathematical model, the measurement model can be set for national i in time t.

$$Y_{it} = \beta_0 + \beta_1 \cdot K + \beta_2 \cdot Invest_{it} + \beta_3 \cdot Invest2_{it} + \beta_4 \cdot Government_{it} + \beta_5 \cdot Research_{it} + \beta_6 \cdot Output_{it} + \varepsilon_{it}$$

3.2 Data sources

Select “the Belt and Road” major countries, including India, Pakistan, Thailand, Singapore, kazakhstan, uzbekistan, Russia, Germany, Singapore and other countries related data of 2000-2016. The GDP of capital exporting countries, independent investment, government investment expenditure and r&d expenditure are from the "Statistical yearbook of china". The independent investment of capital input country, the investment expenditures and the exports of capital exporting countries by capital exporting countries are from the “World bank database”. The Hubness Measurement Index, which was constructed in Baldwin in its "Hub

and Spoke" theory, is usually used to measure the degree of economic interdependence between countries¹¹. The expression formula is:

$$HM_j = s_{ij}^x \times (1 - s_{ij}^m) = \frac{x_{ij}}{x_i} \times (1 - \frac{m_{ij}}{m_j})$$

In the formula, s_{ij}^x is the export share of country i to j, and s_{ij}^m is the import share of country j to country i. x_{ij} means the total exports of country i to country j; m_{ij} represents the imports of country i from country j; x_i means total exports of country i; m_j means total imports of country j; HM_j is mainly used to measure the dependence of country i on the market of country j, and its value range is (0,1). The closer the HM index is to 1, the greater the dependence of country i on the market of country j. By computing "the Belt and Road" countries' HM index of China, it measures the degree of trade dependence of capital input country on capital exporting countries. Furthermore, this paper will demonstrate that the GDP of capital exporting countries is affected by the dependence coefficient of the trading opponent of capital exporting countries.

3.3 Test results and analysis

Based on the above empirical model setting and data structure analysis, we use panel data to carry out empirical research. The analysis of panel data model can be based on empirical methods such as Generalized Method of Moments (GMM). However, due to the limited sample, the results obtained by GMM estimation dynamic panel data are biased. Through the test of individual effect and time effect, all the individual effects were found to be insignificant, and the random effects were not significant. Therefore, based on the results of the above test, we adopt the hybrid OLS measurement model to conduct empirical research.

At the same time, the regression method of the model is stepwise, and the selection of variables depends on the significance of the variable and the choice of variables depends mainly on the significance of the variable and the change of goodness of fit of the variable. If the added variable coefficient is significant, and the fitting of the regression model after adding the variable is not significantly reduced, the variable will be included in the model. Regression analysis was performed by using Stata12 software, and the regression results were shown in table 2.

Table 2- Empirical model results

	model (1)	model (2)	model (3)	model (4)
	GDP	GDP	GDP	GDP
K	263.8***		10.06***	0.397***
	(5.96)		(4.74)	(2.76)
Invest		0.655***	0.656***	0.0116***
		(1.57e+12)	(781.72)	(40.87)
Invest2		0.0328***	0.0327***	0.0127***
		(4.90e+12)	(565.05)	(8321.49)
Government		0.893***	0.887***	0.719***
		(5.97e+11)	(275.85)	(3941.84)
Research				23.63***
				(1710.85)
output				0.000000223***
				(9996.84)
_cons	332783.4***	40749.2***	40523.4***	37565.4***
	(45.16)	(6.00e+12)	(346.33)	(6680.85)
N	442	442	442	442

t statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

From the empirical model (1), it can be concluded that the GDP of capital exporting countries is significantly affected by the capital input country's dependence coefficient on the capital exporting countries, and the influence is significant at the 0.01% level. And trade dependence coefficient has positive influence to the GDP of capital exporting countries. At the same time, “the Belt and Road” strategy has also made countries more dependent on China's trade. The empirical model (2) and (3) can be concluded that the GDP of capital exporting countries is affected by the investment situation of capital exporting countries, the investment of capital input countries and the government investment expenditure of capital exporting countries. In addition, the empirical model (4) joins the technical progress and export situation of capital exporting countries as the control variables. Therefore, proposition 1 and proposition 2 are proved.

To sum up, China's GDP is positively correlated with China's trade dependence coefficient on capital exporting countries, government invests in finance, technological progress, export and the investment situation of both sides. Through “the Belt and Road” strategy, China has further promoted economic exchanges and deepened economic cooperation with the countries along “the Belt and Road”. Base on the transport network, China's industries can reduce the production cost and improve profit margins. The transfer of excess capacity in China can also boost domestic investment and exports. At the same time, China's cooperation with countries with high trade dependency ratio can have a positive impact on China's GDP. For the

Countries along “the Belt and Road”, the addition of China's advanced technology and advantageous industries not only can drive the independent investment of developing countries, but also increase the confidence of foreign investment and attract more foreign investment. The trend of foreign investment and trade interaction among countries will become more and more obvious, which will help improve the GDP of China and the countries along “the Belt and Road”, so as to form a "win-win" situation.

4 Conclusions

This paper studies the trade behavior between China and “the Belt and Road” countries. Through mathematical model under the condition of bilateral trade, the growth of domestic, foreign investment and the increase of trade dependence coefficient and the positive fiscal policy are beneficial to increase the GDP of both sides of the trade. In addition, this paper makes an empirical study through the data of 26 countries. The results show that the GDP of capital exporting countries is affected by the capital input country's dependence coefficient on capital exporting countries, the investment of capital input country, the government investment expenditure of capital exporting countries, and the foreign investment expenditure of capital exporting countries. Therefore, “the Belt and Road” strategy can have a positive impact on China's GDP due to the growth of investment in countries along “the Belt and Road” and the increase in trade dependence.

Along with China's rapid economic development of a large demand for oil, gas and mineral raw materials, the trend of rising labor costs and so on, China's development has entered the stage of capital export. Through “the Belt and Road” strategy, China's large excess capacity can be converted to increase the power of “the Belt and Road” infrastructure, and create a good environment for the development of economy, make up the disadvantages on resources, provide material guarantee for the long-term development in the future, stimulate the government investment and foreign investment. “the Belt and Road” countries are increasing their trade dependence on Chinese exports and the correlation of this multilateral trade has shown an extremely significant increase in recent years. Through pragmatic cooperation and efforts with countries along “the Belt and Road”, China's “the Belt and Road” strategy will have a more positive impact on the economic growth of capital investment of both sides.

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